

Amendments approved in 9th board of study held on 30-08-2021 at 11:00 a.m. have been incorporated in this document

AGENDA

FOR

7TH MEETING OF THE BOARD OF STUDIES

**DEPARTMENT OF COMPUTER SCIENCE & INFORMATION TECHNOLOGY,
MIRPUR UNIVERSITY OF SCIENCE AND TECHNOLOGY (MUST), MIRPUR
AZAD KASHMIR**

The 7th Meeting of the Board of Studies in the Department of Computer Science & Information Technology held on 06-06-2016 at 11:30 a.m. with the following items and subjects.

Item No.	Subject
1.	Approval of Scheme of Studies for 2-years MS (CS) program
2.	Approval / Recommendations of Panel of External Examiners for MS (CS) Thesis
3.	Approval of Scheme of Studies for 4-years BS (CS) program
4.	Approval of Scheme of Studies for 4-years BS (IT) program
5.	Any other item

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Item No. 1

Approval of Scheme of Studies for 2-years MS (CS) Program

1.1 Curriculum for MS (Computer Science)

The syllabi and courses of reading for MS computer science (CS) Semester-I and Semester-II of session (2013-15) and onward are hereby notified. A total of 31 credit hours of work is required for MS (CS).

MS (CS) Programme Structure:

Duration	4-6 Semesters (for full time students)
Courses	24 Credit Hrs
Reading Seminar	01 Credit Hrs
Thesis	06 Credit Hrs
Total	31 Credit Hrs

Category wise Credit Hours Distribution

Category or Area	Credit Hours
Core	06
Elective	15
Mandatory	03
Reading Seminar	01
Thesis	06
Total Credit Hours	31

1.1.1 Examination:

The examination rules will be adopted according to the University Semester System and thesis regulations will be adopted according to MUST graduate's thesis regulations. Thesis topic will be chosen with the consent of supervisors.

1.1.2 Eligibility:

- BS (CS/IT/SE) 4-years
OR
M.Sc. (Computer Science) or MCS / MIT 2-years
- At least 2nd Division or CGPA 2.5/4.0 required.
- No 3rd Division in academic record.
- University Test OR GAT General conducted by NTS with minimum 50% cumulative score, as per decision of the University.

1.1.3 Scheme of Studies for MS Computer Science

Courses will be offered subject to the suitability and availability of the faculty. However, the students will have to defend their thesis proposal / synopsis at the end of their third semester, as a full time student.

Code	Course Title	Cr. Hrs
Core Courses		
CS-5101	Advanced Analysis of Algorithms	3
CS-5102	Advanced Theory of Computation	3
Mandatory Courses		
CS-5103	Research Methods	3
Reading Seminar		
CS-6102	Reading CS Seminar	1
Thesis		
CS-6101	MS Thesis	6
Elective Courses		
Computer Networks and Security		
CS-5104	Advanced Network Programming	3
CS-5105	Advanced Computer Networks	3
CS-5106	Introduction to Cryptography and Security Mechanisms	3
CS-5107	Advanced Wireless Networks	3
CS-5201	Advanced Network Security	3
CS-5202	Network Performance Evaluation	3
CS-5203	Advanced Wireless and Mobile Computing Networks	3
CS-5204	Autonomous Computing	3
Artificial Intelligence		
CS-5108	Design of Intelligent Systems	3
CS-5109	Decision Support Systems	3
CS-5205	Machine Learning	3
CS-5206	Advanced Neural Networks	3
CS-5207	Natural Language Processing	3
CS-5208	Agents	3
CS-5209	Robotics	3
CS-5210	Pattern Recognition	3
CS-5211	Computational Intelligence	3
Software Engineering		
CS-5110	Advanced Software Engineering	3
CS-5111	Advanced Software Project Management	3
CS-5212	Object-Oriented Software Engineering	3
CS-5213	Software Quality Assurance and Testing	3
CS-5214	Software Requirements Engineering	3
CS-5215	Software Architectures	3
CS-5216	Software Patterns	3
Digital Signal and Image Processing / Computer Vision		
CS-5112	Advanced Digital Image Processing	3
CS-5113	Advanced Digital Signal Processing	3
CS-5114	Computer Vision	3
CS-5217	Digital Watermarking and Steganography	3
CS-5218	Multi-view Geometry	3
CS-5219	3D Computer Vision	3
CS-5220	Multispectral Image Processing	3
Other Elective Courses		
CS-5115	Advanced Computer Architecture	3
CS-5116	Advanced Operating System	3

MS (CS) Course Descriptions

Core Courses:

Advanced Analysis of Algorithms	
CS – 5101	Cr. Hrs. 3

Objective:

To introduce advanced mathematical techniques for analyzing the complexity and correctness of algorithms, with emphasis on probability theory, randomized algorithms, and approximation algorithms.

Course Description:

Advanced algorithm analysis including the introduction of formal techniques and the underlying mathematical theory. NP-completeness; Search Techniques; Randomized Algorithms. Heuristic and Approximation Algorithms; Topics include asymptotic analysis of upper and average complexity bounds using big-O, little-o, and theta notation. Fundamental algorithmic strategies (brute-force, greedy, divide-and-conquer, backtracking, branch-and-bound, pattern matching, and numerical approximations) are covered. Also included are standard graph and tree algorithms. Additional topics include standard complexity classes, time and space tradeoffs in algorithms, using recurrence relations to analyze recursive algorithms, noncomputable functions, the halting problem, and the implications of noncomputability. Algorithmic animation is used to reinforce theoretical results. Upon completion of the course, students should be able to explain the mathematical concepts used in describing the complexity of an algorithm, and select and apply algorithms appropriate to a particular situation.

Text Books/Reference Books:

- Approximation Algorithms, By Vijay V. Vazirani, Springer, 2004.
- Introduction to Algorithms, 2nd Edition, T. H. Cormen, C. E. Leiserson, and R. L. Rivest, MIT Press, McGraw-Hill, New York, NY, 2001.
- Algorithms and Theory of Computation Handbook, By Mikhail J. Atallah Contributor Mikhail J. Atallah, CRC Press, 1998.
- An Introduction to Analysis of Algorithms by Michael Soltys (McMaster University, Canada), (2009).

Advanced Theory of Computation	
CS – 5102	Cr. Hrs. 3

Objectives:

The objective of this course is to enable students to focus on the study of abstract models of computation. These abstract models allow the students to assess via formal reasoning what could be achieved through computing when they are using it to solve problems in science and engineering. The course exposes students to the computability theory, as well as to the complexity theory.

Course Description:

Automata theory, formal languages, Turing machines, computability theory and reducibility, computational complexity, determinism, non-determinism, time hierarchy, space hierarchy, NP completeness, selected advanced topics.

Text Books/Reference Books:

- Michael Sipser, Introduction to the Theory of Computation, First Edition, 1997, PWS Publishing Company.

- Christos Papadimitriou, Computational Complexity, 1994, Addison-Wesley.
- John Hopcroft and Jeffrey Ullman, Introduction to Automata Theory, Languages, and Computation, 1979, Addison-Wesley. (or the second edition).
- Tao Jiang, Ming Li, and Bala Ravikumar, Formal models and Computability, in Handbook of Computer Science, CRC Press, 1996.
- T.H. Cormen, et al., Introduction to Algorithms, MIT Press and McGraw-Hill Book Co., 1990.
- Peter Linz, An Introduction to Formal Languages and Automata, ISBN: 0-669-17342-8.

Mandatory Courses:

Research Methods	
CS – 5103	Cr. Hrs. 3

Course Description:

Research: introduction to the nature of research, and types of Research; Research questions, and the nature of evidence: deciding what type of question to ask, and how to handle the various types of answer; Mud pits and how to avoid them: things that go wrong; Isms: necessary assumptions, dubious assumptions, and being caught in crossfire; Searching the literature: why, where, what for and how; Research in society agendas, context and the like: things we take for granted, and things that can cause you trouble; Research design: Types of design: which to use and how to use them; Surveys and sampling; Field experiments: doing research in the world. **Controlled experiments:** changing things systematically and seeing what happens; Summary and technical terms; Generic advice; Arranging a study: subjects, equipment, procedures, things to remember, things to beware; Handling subjects; Recording; Data collection; Data collection methods: the methods, and choosing and using the appropriate method; Reports: getting respondents to talk about how things happen; Observation: watching what happens; Card sorts: getting respondents to categorise things; Laddering: unpacking the respondents' concepts systematically; Repertory grids: a systematic representation for respondents' knowledge interviews: asking people questions; Face-to-face interactions with respondents: the nuts and bolts of asking questions; Questionnaires: when to use, when not to use, which questions to ask, what format to use; Data analysis; Content analysis: what is said in a text, how it is said, and how often it's said; Discourse analysis: who says what, about what, to whom, in what format. **Knowledge representation:** formats, structures and concepts for making sense of knowledge; Statistics: describing things with numbers, and assessing the odds; Descriptive statistics: giving a systematic description of the numbers you've found; Measurement theory: types of measurement and their implications; Inferential statistics: what are the odds against your findings being due to random chance? Conclusion: the end game; **Writing up:** demonstrating your excellence efficiently, and practical points to remember; **References and referencing:** using and citing the right texts to demonstrate your excellence; what next; thinking forward about what you really want your life to be?

Text Books/Reference Books:

- *A Gentle Guide to Research*, Gordon Rugg & Marian Petre, Open University Press McGraw-Hill Education, 2007
- *Practical Research Methods*, CATHERINE DAWSON, How To Books Ltd, 3 Newtec Place, 2002.

Elective Courses for 1st Semester:

Advanced Computer Architecture	
CS – 5115	Cr. Hrs. 3

Objective:

To develop a thorough understanding of high-performance computer architecture, as a foundation for advanced work in computer architecture

Course Description:

This course is aimed at the hardware aspects of parallel computer architectures including the design and protocols evaluation for memory coherence, inter-connection networks and system scalability. Advanced topics in this course will cover multiprocessors on a chip, reconfigurable computing and power aware designs. Various coarse-grained and fine-grained architectures with reference to SIMD and MIMD designs should also be covered.

Text Books/Reference Books:

- *Advanced Computer Architecture: A Design Space Approach*, Dezso Sima, Terence Fountain, Peter Kacsuk, Addison-Wesley Publishers, 1997.
- *Scalable Parallel Computing Technology, Architecture, Programming*, Kai Hwang, Zhiwei Xu, McGraw-Hill Publishers, 1998.

Advanced Operating Systems	
CS – 5116	Cr. Hrs. 3

Objective:

To apprise the students with characteristics of modern operating systems and architectural models. To provide discussions of Internal design issues of a Modern operating systems like Linux, Microsoft Windows, MacOS, and others.

Course Description:

Characterization of Modern Operating Systems; file systems, memory management techniques, Process scheduling and resource management, System Models Architectural models, Inter-process Communication, Issues of Security in Distributed Systems (Partial coverage), Distributed File System, Concurrency Control in Distributed Systems, Problems of coordination and agreement in Distributed Systems, Replication, advantages and requirements, Fault-tolerant services, Mobile and Ubiquitous Computing.

Text Books/Reference Books:

- Distributed Systems Concepts and Design 4th edition by George Coulouris, Jean Dollimore and Tim Kindberg
- Distributed Operating Systems: Concepts and Design by Pradeep k. Sinha
- Advanced Concepts in Operating Systems by Singhal and Shivratri
- Modern Operating Systems, Andrew S. Tanenbaum, 2nd Edition, Prentice Hall, 2001
- Linux Programming Richard Stones and Neil Mathew, Wrox Publications.
- Operating Systems – Internals and Design Principles, Stallings, W., , Prentice Hall, 6th Edition
- Operating Systems Concepts, A. Silberschatz and P. B. Galvin, 6th Edition, John Wiley and Sons.
- Operating Systems – Design and Implementation, Andrew S. Tanenbaum and A. Woodhull.
- Distributed Operating Systems, Andrew S. Tanenbaum, Pearson Education 2006.

Advanced Network Programming

CS – 5104

Cr. Hrs. 3

Course Description:

The Network Programming course is aimed at developing Network programming concepts and skills in general. This course covers TCP protocol suite, socket programming, UDP and TCP sockets; routing & raw sockets ; RPC ; shared memory, network programming in the context of network protocol development and implementation (e.g., TCP, ICMP, routing, broadcasting, multicasting, ARP, etc.), and distributed services and 'system-level' applications (e.g., client-server and peer-to-peer applications, distributed file systems, name services, etc.), I/O Multiplexing including Non-blocking I/O, Advanced Socket Options, Name and Address Conversions, IPv4 and IPv6 Interoperability.

Text Books/Reference Books:

- *UNIX Network Programming Volume I* by Richard Steven, Prentice Hall; 2nd Edition (September 4, 1998). ISBN-10: 0130810819.
- *Windows System Programming* by Johnson M. Hart, Addison-Wesley Professional; 4 Edition (February 26, 2010). ISBN-10: 0321657748.
- *The Linux Programming Interface: A Linux and UNIX System Programming Handbook* by Michael Kerrisk, No Starch Press; 1st Edition (October 28, 2010). ISBN-10: 1593272200.
- *Linux Kernel Development* by Robert Love, Addison-Wesley Professional; 3rd Edition (July 2, 2010). ISBN-10: 0672329468.
- *System Software: An Introduction to Systems Programming (3rd Edition)* by Leland L. Beck, Addison Wesley (1996). ASIN: B0084YEEWO.
- *Beginning Internet Communication Programming through X Windows on Linux Using GTK+*, M. Siraz Baig published by Shakeel Sons.

Advanced Computer Networks

CS – 5105

Cr. Hrs. 3

Course Description:

Network architecture, Networking principles, Network services and Layered architecture, Future Networks. Advanced Technologies. Performance of Networks. Advanced Routing: Routing architecture , Routing between peers (BGP) , IP switching and Multi-Protocol Label Switching MPLS), MPLS Architecture and related protocols, Traffic Engineering (TE) and TE with MPLS, NAT and Virtual Private Networks (L2, L3, and Hybrid), CIDR – Introduction, CIDR addressing, CIDR address blocks and Bit masks. Mobile IP- characteristics, Mobile IP operation, Security related issues. Mobility in networks. Voice and Video over IP (RTP, RSVP, QoS) IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc., neighbor discovery, auto-configuration, routing. Changes to other protocols. Application Programming Interface for IPv6. Ad Hoc Networking: An Introduction, A DoD Perspective on Mobile Ad Hoc Networks, DSDV: Routing over a Multihop Wireless Network of Mobile Computers, Cluster-Based Networks, DSR: The Dynamic Source Routing Protocol for Multihop Wireless Ad Hoc Networks.

Text Books/Reference Books:

- *Computer Networks: A Systems Approach* by Larry L. Peterson, Bruce S, Morgan Kaufmann; 5th Edition (March 25, 2011). ISBN-10: 0123850592.
- *Internetworking with TCP/IP Vol –I* by Douglas E. Comer, Addison-Wesley; 5th Edition (July 10, 2005). ISBN-10: 0131876716
- *High Performance Communication Networks* by Jean Walrand and Pravin

Varniya, Morgan Kaufmann; 2nd Edition (October 25, 1999). ISBN-10: 1558605746

- *Metro Ethernet* by Sam Halabi Publisher: Cisco Press ISBN: 158705096X
- *Computer Networks* by A. S. Tanenbaum, Prentice Hall; 5th Edition (October 7, 2010). ISBN-10: 0132126958

Introduction to Cryptography and Security Mechanisms

CS – 5106

Cr. Hrs. 3

Course Description:

Core security services provided by cryptography, Basic model of a cipher system (classical cipher, block ciphers) and use of cryptography, Block ciphers like AES and DES, Block cipher modes of operation, Historical algorithms, Security in theory and practice. **Cryptographic Toolkit:** Symmetric and public key encryption, Data integrity, Entity authentication, Message authentication codes, Digital signatures, Cryptographic protocols. **Practical aspects:** Key management, Cryptographic applications.

Text Books/Reference Books:

- K. M. Martin, *Everyday Cryptography*, Oxford University Press (2012).
- N. Ferguson, B. Schneier and T. Kohno, *Cryptography Engineering*, Wiley (2010).
- Katz and Lindell: *Introduction to Modern Cryptography*. Chapman & Hall/ CRC Press, 2007.

Advanced Wireless Networks

CS – 5107

Cr. Hrs. 3

Course Description:

This course covers fundamental techniques in design and operation of first, second, and third generation wireless networks: cellular systems, medium access techniques, radio propagation models, error control techniques, handoff, power control, common air protocols (AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, etc), radio resource and network management. As an example for the third generation air interfaces, WCDMA is discussed in detail since it is expected to have a large impact on future wireless networks. This course is intended for graduate students who have some background on computer networks. Latest Research Papers in wireless communication domain are main part of this course.

Text Books/Reference Books:

- *Wireless Communications and Networks*, W. Stallings, Prentice Hall, (2002).
- *Wireless Communications: Principles & Practice*, Second Edition, T.S. Rappaport, Prentice Hall, (2002).
- *Mobile Communications*, J. Schiller, Addison Wesley, (2000).
- *IS-95 CDMA and CDMA 2000*, V.K. Garg, Prentice Hall PTR, (2000).
- *The UMTS Network and Radio Access Technology - Air Interface Techniques for Future Mobile Systems*, J.P. Castro, Wiley, (2001).
- *WCDMA for UMTS Radio Access for Third Generation Mobile Communications*, H. Holma and A. Toskala, John Wiley & Sons, (2001).

Design of Intelligent Systems

CS – 5108

Cr. Hrs. 3

Course Description:

This course outlines fundamentals of soft computing based design approaches using such tools as approximate reasoning, fuzzy inferencing, neural networks, evolutionary algorithms, and neuro-fuzzy systems. It includes Approximate Reasoning, Fuzzy Inferencing and Intelligent Systems, Fundamentals of Connectionist Modelling: Artificial neural Networks, Classification, Nonlinear Regression and Support Vector Machines, Evolutionary Techniques, Hybrid Systems Design, Neuro-Fuzzy Systems, Gentic-Neuro Systems. Fundamentals and advances on these procedures are outlined along with their potential applications to various real world applications in virtually most fields of engineering including pattern recognition, big data analysis, classification and clustering, power generation, intelligent transportation, systems and control, intelligent mechatronics, optimization, communication, robotics and manufacturing, to name a few.

Text Books/Reference Books:

- M F. Karray and C. de Silva, *Soft Computing and Intelligent Systems Design*, Addison Wesley Publishing, Pearson Education, August 2004.
- M. Negnevitsky, *Artificial Intelligence, A Guide to Intelligent Systems*, Pearson Publishing, 2006.
- C. T. Lin and C.S. Lee, *Neural Fuzzy Systems*, Prentice Hall Publishing, 1995.
- J. Jang, C. Sun, and E. Mizutani, *NeuroFuzzy and Soft Computing*, Prentice Hall Publishing, 1997.

Decisions Support Systems

CS – 5109

Cr. Hrs. 3

Course Description:

Decision making; uncertainty, preferences, and actions; motivation for decision support; decision support systems, Decision making, systems, modeling, and decision support, Human and organizational decision making, Rationality, rational behavior; good decisions vs. good outcomes; foundations of decision-analytic approach to decision support, Structuring decisions; decision modeling tools: influence diagrams; Bayesian networks; causality and decision analysis; examples of structuring decisions; clarity test. An overview of decision support systems. The architecture of decision support systems. Data management: warehousing, access, and visualization. Learning problem structure from data. Modeling and analysis. Artificial intelligence and knowledge-based systems. The goal, applications, and pitfalls of modeling; iterative character of modeling decision problems. User interface and decision visualization applications. Building decision support systems. Internet and group decision support systems. Organizational and societal decision making. Analytic hierarchy processes, Expert Choice. Client-server architectures. Expert Systems, Implementing and integrating decision support systems. Organizational and societal impact of decision support systems.

Text Books/Reference Books:

- Efraim Turban and Jay E. Aronson. *Decision Support Systems and Intelligent Systems*, 5th edition, Prentice Hall, 1998, ISBN 0-13-740937-0

Advanced Software Engineering

CS – 5110

Cr. Hrs. 3

Course Description:

Consideration and use of engineering principles to design and implement cost-effective, reliable software; Current software requirements methodologies and design practices, documentation standards, software project management, verification and validation techniques, software security considerations and computer human interfaces; Agent based software engineering; Clean-room process model; Management and evolution; costing and estimation; legacy systems.

Text Books/Reference Books:

- Applying UML and Patterns by Larman, Craig, 2nd Edition.
- Software Engineering by Pressman, Roger S., 5th Edition.

Advanced Software Project Management

CS – 5111

Cr. Hrs. 3

Course Description:

Software Crisis and Software Engineering, Classic Mistakes, Overview of Project Management, PMI Process Groups, Software project Phases, Project charter, Statement of Work (SOW), Planning Phase: Development lifecycle models, matching lifecycles to projects, Project plans, Work Breakdown Structures (WBS), Estimation of effort and cost (Expert Judgment, FP and Use Case point methods), Scheduling: Project network diagram fundamentals, CPM, PERT, Gantt charts, Critical chain scheduling, Using MS-Project, Assigning Resources, Resource leveling, Team models, Managing conflict and motivating, Project Monitoring and Control: Status reporting, Project metrics, EVM, Communications Techniques, Risk management and Change control Project Recovery, Documentation, Cutover/Migration, Post Project Reviews, Closing.

Text Books/Reference Books:

- *M Software Project Management*, Bob Hughes, Mike Cotterell, McGraw-Hill Higher Education, 5th Edition, 2009 (or Latest Edition).
- *The Software Project Manager's Handbook: Principles that work at work*, Dwayne Phillips, IEEE Computer Society Press and Wiley Interscience, 2nd Edition, 2004 (or Latest Edition).

Advanced Digital Image Processing

CS – 5112

Cr. Hrs. 3

Course Description:

Introduction: Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels, Image Enhancement: Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain, Colour Image Processing, image Segmentation: Discontinuity detection, Edge linking and boundary detection, Tresh holding, Region oriented segmentation, Use of motion for segmentation, Image Registration: Introduction to image registration, Techniques of image registration, Representation and Description: Boundary description, Regional description, Morphological Image Processing: Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to gray level images, Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform.

Text Books/Reference Books:

- M *Digital Image Processing*, R. C. Gonzalez & R. E. Woods, 3rd edition, Prentice Hall, 2008, ISBN 9780131687288.
- *Digital Image Processing (3rd Edition)* by Rafael C. Gonzalez, Prentice Hall; 3rd edition (2007).

Advanced Digital Signal Processing

CS – 5113

Cr. Hrs. 3

Course Description:

One and N -dimensional signals and systems, Sampling theorem, Discrete-time Fourier transform, discrete Fourier transform, fast Fourier transform, z-transforms: stability and minimum phase signals/systems, *Linear filtering of signal*: Time domain: Difference equations and convolution, Impulse invariance, bilinear transform, FIR filter design, 2D filter design, *Statistical signal processing*: Stochastic signals: correlation functions and power density spectra, Optimal filtering: Wiener filters, Adaptive filters: LMS and array processing.

Text Books/Reference Books:

- *Discrete-Time Signal Processing*, 2nd edition Alan V. Oppenheim and Ronald W. Schaffer, Prentice-Hall.

Computer Vision

CS – 5114

Cr. Hrs. 3

Course Description:

Concepts behind computer-based recognition and extraction of features from raster images, applications of vision systems and their limitations. Overview of early, intermediate and high level vision, Segmentation: region splitting and merging; quadtree structures for segmentation; mean and variance pyramids; computing the first and second derivatives of images using the isotropic, Sobel and Laplacian operators; grouping edge points into straight lines by means of the Hough transform; limitations of the Hough transform; parameterisation of conic sections. Perceptual grouping: failure of the Hough transform; perceptual criteria; improved Hough transform with perceptual features; grouping line segments into curves. Overview of mammalian vision: experimental results of Hubel and Weisel; analogy to edge point detection and Hough transform; Relaxation labeling of images: detection of image features; Grouping of contours and straight lines into higher order features such as vertices and facets; Depth measurement in images.

Text Books/Reference Books:

- *Computer Vision: A Modern Approach*, by David Forsyth, Jean Ponce, Prentice Hall, 2003.
- *Computer Vision*, by Linda G. Shapiro, George C. Stockman, Prentice Hall, 2001.
- *Handbook of Mathematical Models in Computer Vision*, by Nikos Paragios, Yunmei Chen, Olivier Faugeras, Birkhäuser, 2006.

Elective Courses for 2nd Semester:

Advanced Network Security	
CS – 5201	Cr. Hrs. 3

Course Description:

Network Security Overview. Data Encryption Algorithms. Public-Key Cryptography and Key Management. Data Authentication. Network Security Protocols in Practice. Wireless Network Security. Network Perimeter Security. Anti Malicious Software. Intrusion Detection, Network-Based Detections and Host-Based Detections, Signature Detections, Statistical Analysis, Behavioral Data Forensics, Honeypots. Latest Development in Network Security.

Text Books/Reference Books:

- *Computer Network Security: Theory and Practice* by Jie Wang, Springer; (March 16, 2009). ISBN-10: 3540796975
- *Network Security: The Complete Reference* by Mark Rhodes-Ousley, Roberta Bragg, and Keith Strassberg, McGraw-Hill Osborne Media; 1st Edition (November 17, 2003). ISBN-10: 0072226978
- *Network Security and Management* by Brijendra Singh, PHI Learning Private Limited; 3rd Edition (April 13, 2012). ASIN: B007U49118
- *Network Security Bible* by Eric Cole, Wiley; 2nd Edition (September 8, 2009). ISBN-10: 0470502495
- *Network Warrior* by Gary A. Donahue, O'Reilly Media; 2nd Edition (June 2, 2011). ISBN-10: 1449387861

Network Performance Evaluation	
CS – 5202	Cr. Hrs. 3

Course Description:

This is an advanced course in networks and protocols. Analytical, simulation and experimental methods should be used to evaluate and design networks and protocols. Investigate network management tools and techniques. The science of Network Performance Evaluation (NPE), Common NPE errors, NPE Techniques and Metrics, Introduction to statistics, The art of modelling and performance evaluation, Workload Modeling, Design of Experiments, Internet Measurement and Empirical Case Studies, Introduction to Stochastic Processes, Common Stochastic Processes, Discrete-Time Markov Chains, Continuous-Time Markov Chains.

Text Books/Reference Books:

- T. G. Robertazzi, *Computer Networks and Systems: Queuing Theory and Performance Evaluation*, Springer-Verlag, 2nd edition, 1994.
- R. Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", Wiley-Interscience, 1991.
- Averill M. Law, "Simulation Modeling and Analysis", Fourth Edition, McGraw-Hill, 2007.
- George Box, Stuart Hunter, William Hunter, "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley-Interscience, 2005
- Mark Crovella and Balachander Krishnamurthy, "Internet Measurement: Infrastructure, Traffic and Applications", Wiley, 2006.
- Roy Yates and David Goodman, "Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers", Wiley, 2004.

- Leonard Kleinrock, "Queueing Systems. Volume 1: Theory", Wiley, 1975;
- S. Keshav, "Mathematical Foundations of Computer Networking", Addison-Wesley Professional, 2012;
- Arnold Allen, "Probability, Statistics and Queueing Theory with Computer Science Applications", Wiley, 1990.
- Leonard Kleinrock, "Queueing Systems. Volume 1: Theory", Wiley, 1975.
- Gunter Bolch et al., "Queueing Networks and Markov Chains: Modeling and Performance Evaluation with Computer Science Applications", Wiley-Interscience, 2006.
- K. Trivedi, "Probability and Statistics with Reliability, Queueing, and Computer Science Applications", Wiley-interscience, 2nd Edition, 2001.
- Robert Sargent, "Verification and Validation of Simulation Models", Winter Simulation Conference, 2011.

Advanced Wireless and Mobile Computing Networks

CS – 5203

Cr. Hrs. 3

Course Description:

Introduction and Background, Naming and Service Discovery, Dealing with Location, Mobile Data Access, Mobile Networking, Ad-Hoc Networks, Distributed File Systems, Energy Management, Sensor Networks, Location and Context Awareness, Security, End to End Application Consideration, miscellaneous topics.

Text Books/Reference Books:

- Latest Research papers at individual topics.
- F. Adelstein, S. K. Gupta, G. Richard III, L. Schwiebert. *Fundamentals of Mobile and Pervasive Computing*, McGraw-Hill Professional.
- Judith Symonds and Mehdi Khosrow-Pour. 2009. *Ubiquitous and Pervasive Computing: Concepts, Methodologies, Tools, and Applications*. Information Science Reference, Hershey, PA..

Autonomous Computing

CS – 5204

Cr. Hrs. 3

Course Description:

Autonomous Computing: An Introduction, Type of Autonomous Agents, Simple Reflex based autonomous systems and their limitations, Goal based autonomous systems , Utility agent based autonomous systems, Cognitive Agents Paradigm, Cognitive Agents Architecture, Cognition, Autonomous Agent Planning, Planning algorithms, Autonomous agents Decision making, Decision making algorithms, Markove processes , Markove decision processes , Markove partially observable decisions process, Autonomous agents learning, Learning algorithms, Implementing autonomous systems practices and theory.

Text Books/Reference Books:

- *Cognitive Agent-based Computing-I: A Unified Framework for Modeling Complex Adaptive Systems using Agent-based & Complex Network-based Methods* by Muaz A Niazi and Amir Hussain, Springer Science & Business Media, 2012, ISBN: 9400738528, 9789400738522

Machine Learning

CS – 5205

Cr. Hrs. 3

Course Description:

Basic concepts of Machine Learning; Supervised learning; Supervised learning setup. Logistic regression; Perceptron; Generative learning algorithms; Gaussian discriminant analysis; Support vector machines; Model selection and feature selection; Evaluating and debugging learning algorithms; Learning theory; Bias/variance tradeoff; Union and Chernoff/Hoeffding bounds; Unsupervised learning; K-means Clustering; EM algorithm.

Factor analysis; PCA (Principal components analysis); ICA (Independent components analysis); Reinforcement learning and control; Bellman equations; Value iteration and policy iteration; Linear quadratic regulation; Qlearning; Value function approximation.

Text Books/Reference Books:

- *Pattern Recognition and Machine Learning*, Bishop, C., 2006
- *Machine Learning*, Mitchell, T., McGraw-Hill, (1997)
- *The Elements of Statistical Learning*, Hastie, T., Tibshirani, R., and Friedman, J., *Neural Networks for Pattern Recognition*, 2009 Bishop, C., 1995

Advanced Neural Networks

CS – 5206

Cr. Hrs. 3

Course Description:

Basic notions and models of artificial neural nets; single layer neural classifiers; multilayer one-way neural nets; single layer feedback networks; neural models of associative memory; self organizing neural nets; translation between neural networks and knowledge bases; applications of neural networks. (On Demand).

Text Books/Reference Books:

- Introduction to Neural Networks Using Matlab 6.0, S. N. Sivanandam, S. N. Deepa, Tata McGraw-Hill Education 2006.
- Advanced Models of Neural Networks. Gerasimos Rigatos, Springer-Verlag Berlin Heidelberg. ISBN: 978-3-662-43763-6, 2015.

Natural Language Processing

CS – 5207

Cr. Hrs. 3

Course Description:

Introduction and Overview, Ambiguity and uncertainty in language, Regular Expressions. Chomsky hierarchy, regular languages, and their limitations. Finite-state automata. Practical regular expressions for finding and counting language phenomena. A little morphology. In class demonstrations of exploring a large corpus with regex tools, String Edit Distance and Alignment, Key algorithmic tool: dynamic programming, first a simple example, then its use in optimal alignment of sequences. String edit operations, edit distance, and examples of use in spelling correction, and machine translation, Context Free Grammars, Constituency, CFG definition, use and limitations. Chomsky Normal Form. Top-down parsing; bottom-up parsing, and the problems with each. The desirability of combining evidence from both directions, Information Theory, What is information? Measuring it in bits. The "noisy channel model." The "Shannon game"--motivated by language! Entropy, cross-entropy, information gain. Its application to some language phenomena, Language modeling and Naive Bayes, Probabilistic language modeling and its

applications. Markov models. N-grams. Estimating the probability of a word, and smoothing. Generative models of language. Their application to building an automatically-trained email spam filter, and automatically determining the language, Part of Speech Tagging and Hidden Markov Models, The concept of parts-of-speech, examples, usage. The Penn Treebank and Brown Corpus. Probabilistic (weighted) finite state automata. Hidden Markov models (HMMs), definition and use, Probabilistic Context Free Grammars, Weighted context free grammars, Maximum Entropy Classifiers, The maximum entropy principle, and its relation to maximum likelihood. The need in NLP to integrate many pieces of weak evidence. Maximum entropy classifiers and their application to document classification, sentence segmentation.

Text Books/Reference Books:

- M Daniel Jurafsky and James H. Martin. 2008. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Second Edition.* Prentice Hall.
- *Foundations of Statistical Natural Language Processing*, Manning and Schütze, MIT Press. Cambridge, MA: May 1999.

Agents	
CS – 5208	Cr. Hrs. 3

Course Description:

A Overview of Intelligent Agents (Introduction, Applications, Types of Intelligent Agents), Theories and Frameworks of Decision Making, Agent Technologies, Knowledge, Inference and Communication, Agent Planning, Agent System Design, Mobile Agents, Trust, Security and Legal Issues, Advance Topics like Agents in Sensor networks, Smart Buildings, eCommerce, HCI and Social Simulation etc.

Text Books/Reference Books:

- Introduction to Multiagent Systems By Michael Wooldridge, Second edition ISBN: 978-0-470-51946-2
- Agent Technology: E-commerce by Maria Fasku ISBN 978-0-470-03030-1
- Artificial Intelligent: A Modern Approach by Stuart Russell and Peter Norving, Third edition, ISBN-10: 0136042597, ISBN-13: 978-0136042594

Robotics	
CS – 5209	Cr. Hrs. 3

Course Description:

A brief history of robotics, types of robots; Potential applications of intelligent systems and robotics; Sensors and Actuators; Sonar, laser scanner, optical encoders; DC motors. Control; Feedback control; Localization and mapping; Dead-reckoning; Triangulation. Kalman filter; Uncertainty grid; Behavior based programming; Robot behaviors. Potential field approach; Behavior based architecture; Recent advances; Multi-robotic systems; Robot evolution.

Text Books/Reference Books:

- *Robot Motion Planning*, Jean-Claude Latombe Kluwer, Academic Publishers, Boston, 1991.
- *Artificial Intelligence and Mobile Robots*, D. Kortenkamp, R. Bonasso, and R. Murphy, ed., AAAI Press, 1998.
- *Handbook of Robotics*, Siciliano, Bruno; Khatib, Oussama (Eds.), Springer

Springer 2008

- *An Introduction to Intelligent and Autonomous Control*, P. Antsaklis and K. Passino, Kluwer, 1993.

Pattern Recognition

CS – 5210

Cr. Hrs. 3

Course Description:

Bayes Decision Theory: Discriminant Functions and Services, the Normal Distribution, Bayesian Classification, Estimating Probability Density Functions, Nearest Neighbor Rules, Bayesian Networks, Linear Classifiers: the Perceptron Algorithm, Least-Squares Methods, Nonlinear Classifiers: Multilayer Perceptron's, Back Propagation Algorithm, Decision Trees, Combinations of Classifiers, Boosting, Feature Selection: Data Preprocessing, ROC Curves, Class Separability Measures, Feature Subset Selection, Bayesian Information Criterion, Dimensionality Reduction: Basis Vectors, Singular Value Decomposition, Independent Component Analysis, Kernel PCA, Wavelets, Additional Features And Template Matching: Texture, Shape and Size Characterization, Fractals, Features For Audio, Template Matching Using Dynamic Time Warping and Edit Distance, Context Dependent Classification: Clustering: Sequential Algorithms, Hierarchical Algorithms, Functional Optimization-Based Clustering, Graph Clustering, Learning Clustering, Clustering High Dimensional Data, Subspace Clustering, Cluster Validity Measures.

Text Books/Reference Books:

- MTheodoridis, S. and K. Koutroumbas, *Pattern recognition*. 4th ed. 2009, San Diego, CA: Academic Press.

Computational Intelligence

CS – 5211

Cr. Hrs. 3

Course Description:

Introduction to Computational intelligence, Applicability and history, Fundamentals of Genetic Algorithms, Encoding, Fitness Function, Tournament Selection, Truncation Selection, Elitist Selection, Crossover, Mutation, Control Parameters Estimation, Parallel Genetic Algorithms, Handling Constraints, Fundamentals and background of Particle Swarm Optimization Techniques, Discrete PSO, Hybrid PSO (HPSO), Adaptive PSO (APSO), Fundamentals of Ant Colony Search Algorithms, Behavior of Real Ants, The Max-Min Ant System, Use of Greedy Search and Constructive Heuristic Information, Fundamentals of Tabu Search, Neighbourhood Structure, Characterization of the Neighbourhood, Recency-Based Tabu Search, The Use of Long-Term Memory in Tabu Search, Fundamentals of Simulated Annealing, Cooling Schedule, Determination of Cooling Rate, Stopping Criterion, Fuzzy Systems, Creation of the Fuzzy Control, Evolutionary Algorithms, Differential Evolution, Key Operators for Differential Evolution.

Text Books/Reference Books:

- *Computational Intelligence: An Introduction, Second Edition*, 2007, Andries P. Engelbrecht, Print ISBN: 9780470035610, Online ISBN: 9780470512517.
- *Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems*, Kwang Y. Lee (Editor), Mohamed A. El-Sharkawi (Editor), IEEE Press Series on Power Engineering, Publication Date: February 8, 2008.

Object-Oriented Software Engineering

CS – 5212

Cr. Hrs. 3

Course Description:

Introduction to Software Engineering, Modeling with UML, Project Organization and Communication, Requirements Elicitation, Analyses, System Design: Decomposing the System, System Design: Addressing Design Goals, Object Design: Reusing Pattern Solutions, Object Design: Specifying Interfaces, Mapping Models to Code, Testing, Rationale Management, Configuration Management, Project Management, Software Life Cycle, Methodologies: Putting It All Together.

Text Books/Reference Books:

- *M Object-Oriented Software Engineering: Using UML, Patterns, and Java*, Bernd Bruegge, Allen H. Dutoit, Prentice Hall, 2010 (or Latest Edition)
- *Object-Oriented Software Construction*, Bertrand Meyer, 2nd Edition, Prentice Hall in 1997 (or Latest Edition)
- *Formal Methods in Computing*, M. Ferenczi, and Andras Pataricza , Akademiai Kiado, 2005 (or Latest Edition)
- *Code Complete: A practical handbook of software construction*, Microsoft Press, 2004. (or Latest Edition)
- *Software Engineering*, Ian Sommerville, 8th edition, Addison & Wesley. 2006 (or Latest Edition)

Software Quality Assurance and Testing

CS – 5213

Cr. Hrs. 3

Course Description:

What Is Software Quality: Quality Assurance, Quality Engineering Software Testing: Testing: Concepts, Issues, and Techniques, Test Activities, Management, and Automation, Coverage and Usage Testing Based on Checklists and Partitions, Input Domain Partitioning and Boundary Testing, Coverage and Usage Testing Based on Finite-State Machines and Markov Chains, Control Flow, Data Dependency, and Interaction Testing, Testing Techniques: Adaptation, Specialization, and Integration.

Quality Assurance Beyond Testing: Defect Prevention and Process Improvement, Software Inspection, Formal Verification, Fault Tolerance and Failure Containment, Comparing Quality Assurance Techniques and Activities.

Quantifiable Quality Improvement: Feedback Loop and Activities for Quantifiable Quality Improvement, Quality Models and Measurements, Defect Classification and Analysis.

Risk Identification for Quantifiable Quality Improvement, Software Reliability Engineering.

Text Books/Reference Books:

- *Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement*, Jeff Tian, Wiley-IEEE Computer Society Press, 1st Edition, 2005(or Latest Edition).
- *Mastering Software Quality Assurance: Best Practices, Tools and Techniques for Software Developers*, Murali Chemuturi, J. Ross Publishing, 2010 (or Latest Edition).

Software Requirements Engineering

CS – 5214

Cr. Hrs. 3

Course Description:

Role of requirements engineering in system development, Fundamental concepts and activities of requirements engineering, Information elicitation techniques, Fundamentals of goal-oriented requirements engineering, Modeling behavioral goals, Modeling quality goals, Goal modeling heuristics, Deriving operational requirements from goals, Requirements Specification, Requirements verification and validation, Management of inconsistency and conflict, requirements engineering risks, requirement change control board and process, the role of quality goals in the requirements selection process, Techniques for requirements evaluation, selection and prioritization; Requirements management; Requirements traceability and impact analysis.

Text Books/Reference Books:

- *M Software Requirements*, Karl E. Wiegers, Microsoft Press, 2003(or Latest Edition).
- *Software Requirements Specificaion*, David Tuffley, CreateSpace Independent Publishing Platform, 2010 (or Latest Edition).
- *System Requirements Engineering*, Loucopoulos and Karakostas, McGraw-Hill, 1995(or Latest Edition).
- *Requirements Engineering: Processes and Techniques*, Gerald Kotonya and Sommerville, John-Wiley Sons, 1998 (or Latest Edition).

Software Architecture

CS – 5215

Cr. Hrs. 3

Course Description:

Introduction: Software Architecture, Software Architecture Important, Contexts of Software Architecture, **Quality Attributes:** Understanding Quality Attributes, Availability, Interoperability, Modifiability, Performance, Security, Testability, Usability, Other Quality Attributes, Architectural Tactics and Patterns, Quality Attribute and Modeling and Analysis, **Architecture in the Life Cycle:** Architecture in Agile Projects, Architecture and Requirements, Designing an Architecture, Documenting Software Architectures, Architecture, Implementation, and Testing, Architecture Reconstruction and Conformance, Architecture Evaluation, Management and Governance, **Architecture and Business:** Economic Analysis of Architectures, Architecture Competence, Architecture and Software Product Lines, **The Brave New World:** Architecture in the Cloud, Architectures for the Edge, Epilogue.

Text Books/Reference Books:

- *Software Architecture in Practice*, Third Edition by Rick Kazman, Paul Clements, Len Bass - Addison-Wesley Professional, September 2012

Software Patterns

CS – 5216

Cr. Hrs. 3

Course Description:

What Is a Design Pattern; Describing Design Patterns; The Catalog of Design Patterns; Organizing the Catalog; How Design Patterns Solve Design Problems; How to Select a Design Pattern; How to Use a Design Pattern? Design Problems; Document Structure; Formatting; Embellishing the User Interface; Supporting

Multiple Look-and-Feel Standards; Supporting Multiple Window Systems; User Operations; Spelling Checking and Hyphenation. Creational Patterns; Abstract Factory; Builder; Factory Method; Prototype; Singleton; Structural Patterns; Adapter; Bridge; Composite; Decorator; Façade; Flyweight; Proxy. Behavioural Patterns; Chain of Responsibility; Command; Interpreter; Iterator; Mediator; Memento; Observer; State; Strategy; Template Method, Visitor.

Text Books/Reference Books:

- Software Design Patterns Elements of Reusable Object-Oriented Software. Erich Gamma, John Vlissides, Ralph Johnson, and Richard Helm. Produced by Kevin Zhang and published by Addison-Wesley - 1 ed. (Oct. 31, 1994).

Digital Watermarking and Steganography

CS – 5217

Cr. Hrs. 3

Course Description:

Introduces students to the Study of enabling technologies for digital watermarking and steganography including the history of information hiding, basic principles and techniques such as still images, video, and 3-D video objects, and their applicability to owner authentication, content authentication, information embedding and communication with side information. Evaluation and benchmarking of watermarking and steganography mechanisms. Study of malicious attacks inclusive of bit rate limitation, counterfeiting marks and removal attacks. Overview of attempts to formalize watermarking. Steganography vs. watermarking. Applications of steganography. software for steganography, and steganalysis techniques.

Text Books/Reference Books:

- Techniques and Applications of Digital Watermarking and Content Protection by Michael Arnold, Martin Schmucker, and Stephen D. Wolthusen. Artech House, Inc., Norwood, MA, USA. 2003.
- Digital Watermarking and Steganography, Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker. 2nd Ed. Morgan Kaufmann.

Multi-view Geometry

CS – 5218

Cr. Hrs. 3

Course Description:

Introduction: Camera projection, Reconstruction from more than one view, 3-view, 4-view and n-view geometry, Auto-calibration. **Background:** Projective Geometry, Transformation and Estimation, Projective geometry and transformations of 2D and 3D, Estimation of 2D projective transformation. **PART 1: Camera Geometry and Single View Geometry:** Camera models, Computation of the camera matrix, Action of a projective camera on planes, Lines, Conics and quadrics. **PART 2: Two-View Geometry:** Epipolar geometry and the fundamental matrix, 3D reconstruction of cameras and structure, Different algorithms for computing the fundamental matrix. **PART 3 - N-View Geometry:** N-view computational methods, Auto-calibration.

Text Books/Reference Books:

- Multiple View Geometry in Computer Vision by Richard Hartley and Andrew Zisserman, Second Edition, CAMBRIDGE University Press.

3D Computer Vision

CS – 5219

Cr. Hrs. 3

Course Description:

Auto Camera Models, Geometry of Multiple Views, Shape reconstruction methods from visual cues: Stereo, shading, shadows, contours, low level image processing methodologies(feature detection and description), Mid level vision techniques (segmentation and clustering), High level vision problems, Object detection, Image classification, Scene understanding and target tracking.

Text Books/Reference Books:

- Ma, Yi, et al. *An invitation to 3-d vision: from images to geometric models*. Vol. 26. Springer Science & Business Media, 2012

Multispectral Image Processing

CS – 5220

Cr. Hrs. 3

Course Description:

Intro to imaging spectrometry: Spectral Sensing Concepts, Quantitative remote Sensing Techniques, Literal and non-Literal Information, Multi Sensor Concept, Hyper Spectral and Multihyper systems, Scientific Principles, **Hyper spectral concepts and multi-system tradeoffs:** Spectral/Spatial resolution, Sampling, Range, Temporal Resolution, Signal to Noise Ratio (SNR), Calibration Techniques, Spectral Smile and Keystone effects, Dispersion Techniques, Infrared HIS Systems, Current HIS Active and Passive systems, **Hyper spectral Imaging Data Processing:** N-dimensional Analysis and Visualization, Classification Techniques, ,Pattern Recognition Methods, Principal Component Analysis (PCA), Spectral Matching, Pixel Purity Index (PPI), Minimum Noise Fraction (MNF), Mixture Tuned Matched Filtering (MTMF), Spectral Libraries

Text Books/Reference Books:

- *Multispectral Image Processing and Pattern Recognition* Edited by: Jun Shen (Bordeaux-3 University, France), P S P Wang (Northeastern University, USA), Tianxu Zhang (Huazhong University of Science & Technology, China). ISBN: 978-981-02-4593-1

**Approval / Recommendations of Panel of External
Examiners for MS (CS) Thesis Evaluation**

Panel of External Examiners

1.	<p>Dr. Akmal Saeed Khattak Assistant Professor, Department of Computer Science, Quaid-i-Azam University, Islamabad, Pakistan. Email: akhattak@qau.edu.pk Phone:0320-8574165</p>
2.	<p>Dr. Muhammad Adeel Assistant Professor, Department of Computer Science, International Islamic University, Islamabad, Pakistan. Email: Phone:0321-5009423</p>
3.	<p>Dr. Iftikhar Azim Niaz Assistant Professor, Department of Computer Science , COMSATS Institute of Information Technology, Islamabad Campus, Pakistan. Email: ianiaz@comsats.edu.pk Phone:0333-5491753</p>
4.	<p>Dr. Syed Afaq Husain Associate Professor, Department of Computer Science, King Faisal University, Kingdom of Saudi Arabia. Email: sahusain@kfu.edu.sa</p>
5.	<p>Dr. Rizwan Bin Faiz Assistant Professor, Faculty of Computing, Riphah International University, Islamabad, Pakistan. Email: rizwan.faiz@riphah.edu.pk</p>

6.	<p>Dr. Adnan Idrees Assistant Professor (HoD), Department of Computer Science, The University of Poonch Rawalakot, Pakistan. Email: adnanidris@upr.edu.pk Phone: 0344-5197572</p>
7.	<p>Dr. Fazl-e-Hadi Associate Professor, Department of Computer Science, Preston University, Peshawar Campus, Pakistan. Email: Phone:0333-9119129</p>
8.	<p>Dr. Tamleek Ali Tanveer Assistant Professor, Department of Computer Science, Institute of Management Sciences (IMS), Peshawar, Pakistan. Email: tamleek@imsciences.edu.pk</p>
9.	<p>Dr. Sajid Anwar Assistant Professor, Department of Software Engineering, Institute of Management Sciences (IMS), Peshawar, Pakistan. Email: sajid.anwar@imsciences.edu.pk</p>
10.	<p>Dr. Imran Sarwar Bajwa Assistant Professor, Department of Computer Science & IT, The Islamia University of Bahawalpur, Pakistan. Email: imran.sarwar@iub.edu.pk</p>
11.	<p>Dr. Naeem Khalid Janjua Post-Doctoral Fellow, School of Business, University of New South Wales, Australia.</p>

	Email: n.janjua@adfa.edu.au
12.	Dr. Malik Shahzad Kaleem Awan Research Fellow, School of Computing, Electronics and Mathematics, Plymouth University, Drake Circus, Plymouth, Devon PL4 8AA United Kingdom. E-Mail: shahzad.awan@gmail.com
13.	Dr. Wazir Zada Khan Lecturer, Faculty of Computer and Information System Jazan University, Kingdom of Saudi Arabia . Cell: +96-6509689421(KSA) E-Mail: wazirzadakhana@jazanu.edu.sa
14.	Dr. Imran Usman Assistant Professor, Department of CAST, Comsats Institute of Information Technology, Islamabad Campus, Pakistan. Phone: +92-518318471 ext 202 E-Mail: imran_usman@comsats.edu.pk
15.	Dr. Saeed Arif Shah Assistant Professor, Department of Computer Science and Information Technology, University of Azad Jammu and Kashmir, AJ&K, Pakistan. Phone: +92-5822960510 E-Mail: saeed.arif@gmail.com
16.	Dr. Abdul Majid Assistant Professor, Department of Computer Science and Information Technology, University of Azad Jammu and Kashmir, AJ&K, Pakistan. Phone: +92-3318194801 E-Mail: majid@ajku.edu.pk
17	Dr. Javed Iqbal Asst. professor, Dept of Computer Science (HEC approved Supervisor) University of Engineering & Technology (UET Taxila) Phone: +92-300-5038231

	E-Mail: javed.iqbal@uettaxila.edu.pk
18	Dr. Tahir Lecturer University of Wahh Cantt. Email:tahir591@hotmail.com Phone:0344-5417161
19	Dr. Sardraz University of Wahh Cantt Email: Sardraz@hotmail.com Phone: 0345-2040074
20	Dr. Qamar Abbas Urdu Fedral University Email:qamar.bhk@gmail.com Phone:0333-6845352
21	Dr. Salabat Khan Asst. Professor, COMSATS Attock Email:salabat.khan@ciit-attock.edu.pk Phone:0334-5202110
22	Dr. Ahmed Khan Asst. Professor, COMSATS Abbotabad Email:ahmadkhan@ciit.net.pk Phone:0334-9326934
23	Dr. Irum Inayat Department of Computer science, National University of Computer and Emerging Sciences (FAST-NU), Islamabad Pakistan. Cell: E-Mail:

Item No. 3

Scheme of Studies for Bachelor of Science in Computer Science (BSCS)

Programme's Aims and Objectives:

The aim of the BS(CS) program is to produce entrepreneurs of great character, competence, vision and drive equip with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values to take on appropriate professional roles in Computer Science domain or proceed to further or higher education or training. One of the key objectives of the program is to equip students with skills and knowledge that enable them to take on appropriate professional positions in CS and grow into leading roles.

Programme Structure of BS Computer Science:

Duration:	8-12 Semesters
Courses:	130 Credits
Oral Comprehensive Examination:	S/U Basis
Internship:	S/U Basis
Project:	06 Credits
Total Credits:	136 Credits

Category wise Credit Hours Distribution

No.	Category	Credit Hours
1	Computing Courses	
	Computing Core	40
	Computing Supporting	12
2	Computer Science Courses	
	Core	21
	Elective	24
	Supporting	9
3	General Education Courses	18
4	University Elective Courses	12
	Total Credit Hours	136

Computing Core Courses

	Credit Hrs
Programming Fundamental	4(3+1)
Object Oriented Programming	4(3+1)
Data Structures and Algorithms	3(2+1)
Discrete Structures	3
Digital and Logic Design	3
Operating Systems	4(3+1)
Database System	4(3+1)
Software Engineering	3
Data Communication and Networks	3
Human Computer Interaction	3
Final Year Project	6
	Total:40

Computer Science Courses

	Credit Hrs.
Micro Processor and Assembly Language	3(2+1)
Theory of Automata	3
Design and analysis of Algorithms	3
Artificial Intelligence	3
Computer Architecture and Organization	3
Compiler Construction	3
Information Security	3
	Total:21

Computing Supporting

	Credit Hrs.
Calculus and Analytical Geometry	3
Probability and Statistics	3
Linear Algebra	3
Basic Electronics	3
	Total:12

University Elective Courses

	Credit Hrs.
Financial Accounting	3
Human Resource Management	3
Psychology	3
Arabic	3
	Total:12

Computing General Education

	Credit Hrs.
English Composition and Comprehension	3
Technical and Business Writing	3
Communication Skills	3
Islamic Studies	2
Pakistan Studies	2
Professional Practices	2
Introduction to Information and Communication Technologies	(2+1)
	Total:18

Computer Science Supporting Courses

	Credit Hrs.
Numerical Computing	3
Multivariate Calculus	3
Differential Equations	3
	Total:9

Computer Science Elective

	Credit Hrs.
Computer Graphics	(2+1)
Digital Image Processing	3
Mobile Application and Development	3
Fundamental of Data Mining	3
Fuzzy logics	3
Web Design and Development	3
Software Project Management	3
System Programming	3
	Total: 24

COURSES FOR BS(CS)

Semester-1

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-1101	-	Intro. To information and Communication Technology	2	1	3
BCS-1102	-	Programming Fundamental	3	1	4
MAT-1103	-	Calculus and Analytical Geometry	3	0	3
ELE-1104	-	Basic Electronics	3	0	3
ENG-1105	-	English Composition & Comprehension	3	0	3
HUM-1106	-	Pakistan Studies	2	0	2
		Total:			18

Semester-2

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-1201	BCS-1102	Object Oriented Programming	3	1	4
BCS-1202		Digital Logic Design	3	0	3
BCS-1203		Discrete Structures	3	0	3
MAT-1204		Linear Algebra	3	0	3
ENG-1205		Technical and Business Writing	3	0	3
HUM-1206		Islamic Studies	2	0	2
		Total:			18

Semester-3

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-2301		Data Structure and Algorithms	3	1	4
BCS-2302		Computer Architecture and Organization	3	0	3
MGS-2303		Human Resource Management	3	0	3
MAT-2304		Statistics and Probability	3	0	3
ENG-2305		Communication Skills	3	0	3
HUM-2306		Arabic	3	0	3
		Total:			19

Semester-4

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-2401		Database Systems	3	1	4
BCS-2402		Operating Systems	3	0	3
MSG-2403		Micro Processor and Assembly Language	2	1	3
BCS-2404		Computer Graphics	2	1	3
MAT-2405		Multivariate Calculus	3	0	3
		Total:			16

Semester-5

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-3501		Web Design and Development	2	1	3
BCS-3502		Data Comm. & Computer Networks	3	0	3
BCS-3503		Design and Analysis of Algorithms	3	0	3
BCS-3504		Theory of Automata	3	0	3
MAT-3505		Differential Equations	3	0	3
BCS-3506		Financial Accounting	3	0	3
		Total:			18

Semester-6

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-3601		Human Computer Interaction	3	0	3
BCS-3602		Software Engineering	3	0	3
BCS-3603		Mobile Computing	3	0	3
BCS-3604		Artificial Intelligence	3	0	3
BCS-3605		Data Mining	3	0	3
HUM-3606		Psychology	3	0	3
		Total:			18

Semester 7

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-4701		Fuzzy Logic	3	0	3
BCS-4702		Compiler Construction	3	0	3
BCS-4703		Numerical Computing	3	0	3
BCS-4704		Digital Image Processing	3	0	3
BCS-4705		System Programming	2	1	3
BCS-4706		Final Year Project (1)	-	-	S/U
		Total:			15

Semester-8

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BCS-4801		Information Security	3	0	3
BCS-4802		Software Project Management	3	0	3
BCS-4803		Professional Practices	3	0	3
BCS-4804		Final Year Project (2)	0	0	6
BCS-4805		Oral Comprehensive Examination	-	-	S/U
BCS-4806		Internship/ Practical Training	-	-	S/U
		Total:			15

Semester 1

Course Code: BCS-1101	Course Name: Intro. To Information and Communication Technology
Course Structure: Lectures:2/ Labs: 3	Credit Hours: 3
Prerequisite: None	
Course Outline: Basic Definitions & Concepts, Hardware: Computer Systems & Components. Storage Devices, Number Systems, Software: Operating Systems, Programming and Application Software, Introduction to Programming, Databases and Information Systems, Networks, Data Communication, The Internet, Browsers and Search Engines, The Internet: Email, Collaborative Computing and Social Networking, The Internet: E-Commerce, IT Security and other issues, Project Week, Review Week	
Text Book Introduction to Computers 6th International Edition, Peter, N. McGraw-Hill Reference Material: <ol style="list-style-type: none"> Using Information Technology: A Practical Introduction to Computer & Communications, 6th Edition. Williams, S. McGraw-Hills. Computers, Communications & information: A user's introduction, Sarah, E. Hutchinson. Stacey, C. Sway Fundamentals of Information Technology, Alexis L Mathewsleon LeonPress. 	

Course Code: BCS-1102	Course Name: Programming Fundamental
Course Structure: Lectures:3/ Labs: 3	Credit Hours: 4
Prerequisite: None	
Course Outline: This course covers overview of Computer Programming, Principles of Structured and Modular Programming, Overview of Structured Programming Languages, Algorithms and Problem Solving, Program Development: Analyzing Problem, Designing Algorithm/Solution, Testing Designed Solution, Translating Algorithms into Programs, Fundamental Programming Constructs, Data Types; Basics of Input and Output, Selection and Decision (If, If-Else, Nested If-Else, Switch Statement and Condition Operator), Repetition (While and For Loop, Do-While Loops), Break Statement, Continue Statement, Control Structures, Functions, Arrays, Pointers, Records, Files (Input-Output), Testing & Debugging.	
Text Book: Reference Material: <ol style="list-style-type: none"> C How to Program, Paul Deitel and Harvey Deitel, Prentice Hall; 7th edition (March 4, 2012) Programming in C, Stephen G. Kochan, Addison-Wesley Professional 4th edition (September 25, 2013). ISBN-10: 0321776410 Java How to Program, Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (March, 2011) C++ How to Programme, Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (February, 2013).. 	

Course Code: MAT-1103	Course Name: Calculus and Analytical Geometry Numerical Computing
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline The concepts of efficiency, reliability and accuracy of a method; Minimising computational errors; Theory of Differences, Difference Operators, Difference Tables, Forward Differences, Backward Differences and Central Differences. Mathematical Preliminaries, Solution of Equations in one variable, Interpolation and Polynomial Approximation, Numerical Differentiation and Numerical Integration, Initial Value Problems for Ordinary Differential Equations, Direct Methods for Solving Linear Systems, Iterative Techniques in Matrix Algebra, Solution of non-linear equations.	
Text Book: .Numerical Methods in Scientific Computing by Germund, D. Åke, B. Reference Material:	
<ol style="list-style-type: none"> 1. Numerical Methods for Scientific Computing by J. H. Heinbockel. 2. Numerical Analysis by I. A. Khubaza. 3. Numerical Analysis and Programming by Shan S Kuo. 4. Numerical Analysis by Berden, F. 5. Numerical Analysis by Gerald. 	

Course Code: MAT-1104	Course Name: Basic Electronics
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Fundamentals of Semiconductor physics: Band theory, semiconductors(intrinsic and extrinsic), PN junction, PN junctions as a rectifier, clipper and clamper circuits, Zener diode and voltage regulator, LED and LCD etc., Transistors: Bipolar Junction transistors, BJT biasing circuits, Q-point, BJT as a switch, BJT amplifiers, classes of amplifiers, power amplifiers, Metaloxide transistors, nMOS, pMOS and CMOS inverters circuits. Introduction to A/D and D/A conversion circuits.	
Text Book: Digital Fundamentals: A Systems Approach, by Thomas L. Floyd . ISBN-10: 0132933950, Person, Preston Hall.	

Course Code: ENG-1105	Course Name: English Composition and Comprehension
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Principles of writing good English, understanding the composition process: writing clearly; word, sentence and paragraph. Comprehension and expression; Use of grammar and punctuation; Process of writing, observing, audience analysis, collecting, composing, drafting and revising, persuasive writing, reading skills, listening	

skills and comprehension, skills for taking notes in class, skills for exams.
Text Book & Reference Material:
1. John E. Warriner. Warriner's English Grammar and Composition.

Course Code: HUM-1106	Course Name: Pakistan Studies
Course Structure: Lectures:2	Credit Hours: 3
Prerequisite: None	
Course Outline: Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj- Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geo-political dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.	
Text Book & Reference Material:	
1. The Emergence of Pakistan, Chaudary M., 1967	
2. The making of Pakistan, Aziz. 1976	

2nd Semester

Course Code: BCS-1201	Course Name: Object-Oriented Programming
Course Structure: Lectures:3 / Labs: 3	Credit Hours: 4
Prerequisite: 112 (Programming Fundamental)	
Course Outline: Evolution of Object Oriented Programming (OOP), Object Oriented concepts and principles, problem solving in Object Oriented paradigm, OOP design process, classes, functions/methods, objects and encapsulation; constructors and destructors, operator and function/method overloading, association, aggregation, composition, generalization, inheritance and its types, derived classes, function/method overriding, abstract and concrete classes, virtual functions, polymorphism, exception handling.	
Text Book & Reference Material:	
1. Object Oriented Programming in C++ by Robert Lafore	
2. An Introduction to Object-Oriented Programming with Java, C. Thomas Wu (2010). 5th Edition. McGraw-Hill ISBN: 9780073523309	
3. Java: How to Programme, 5/e, Deitel and Deitel, Prentice Hall, 0131016210/ 0131202367 International Edition	
4. Ivor Horton's Beginning Java, 7/e, Ivor Horton	
5. C++: How to Programme, Deitel and Deitel, 5/e, Pearson.	

Course Code: MAT-1204	Course Name: Linear Algebra
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	

Course Outline: Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear Independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthogonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition.

Text Book & Reference Material:

1. Elementary Linear Algebra with Applications 9th edition Bernard, K. David, H. 2007. Prentice Hall PTR.
2. Strang's Linear Algebra and Its Applications, 4th edition. Gilbert, S.
3. Strang, B. Coonley. Andy, B. Andrew, B. 2005. Brooks/Cole.
4. Elementary Linear Algebra: Applications Howard. A. Chris. 2005. Version, 9th edition.

Course Code:ENG -1205	Course Name: Technical and Business Writing
Course Structure: Lectures:3	Credit Hours: 3

Prerequisite: None

Course Outline:

Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information; Technical exposition; topical arrangement, exemplification, definition, classification and division, causal analysis, effective exposition, technical narration, description and argumentation, persuasive strategy, Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining inventions, electronic communication, generation solutions. Polishing style: paragraphs, listing sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, technical research reports, manuals and documentation, thesis. Electronic documents, near versus hierarchical structure documents.

Text Book & Reference Material:

1. Technical and Business Writing for Working Professionals, Ray E. Hardesty, Xlibris Corporation Dec-2010, ISBN = 1456819402
2. Successful Technical Writing/Instructor's Guide, Bill Wesley Brown, Goodheart-Willcox Publisher, 01-Mar-193-Technology and Engineering.

Course Code:BCS-1203	Course Name: Discrete Structures
Course Structure: Lectures:3	Credit Hours: 3

Prerequisite: None

Course Outline: Mathematical reasoning: introduction to logic, propositional and predicate calculus; negation disjunction and conjunction; implication and equivalence; truth tables; predicates; quantifiers; natural deduction; rules of Inference; methods of proofs; use in program proving; resolution principle; Set theory: Paradoxes in set theory; inductive definition of sets and proof by induction; Relations, representation of relations by graphs; properties of relations, equivalence relations and partitions; Partial orderings; Linear and well ordered sets; Functions: mappings, injection and surjection, composition of functions; inverse functions; special functions; Peano postulates; Recursive function theory; Elementary combinatorics; counting techniques; recurrence relation; generating functions. Graph Theory: elements of graph theory, Planar Graphs, Graph Colouring, Euler graph, Hamiltonian path, trees and their applications.

Text Book & Reference Material:

1. Discrete Mathematical Structure with Application to Computer Science, J. P. Temblay and B Manohar, McGraw-

Hill, 2nd Edition.

2. Discrete Mathematics, 7th edition, Richard Johnsonbaugh, 2008, Prentice Hall Publishers.
3. Discrete Mathematics and Its Applications, 6th edition, Kenneth H. Rosen, 2006, McGraw-Hill Book Co.
4. Discrete Mathematical Structures, 4th edition, Kolman, Busby & Ross, 2000, Prentice-Hall Publishers.
5. Discrete and Combinatorial Mathematics: An Applied Introduction, Ralph P. Grimaldi, Addison-Wesley Pub. Co., 1985.
6. Logic and Discrete Mathematics: A Computer Science Perspective by Winifred Grassman, Jean-Paul Tremblay, Winifred Grassman, Prentice Hall, 1995

Course Code: ISM-1206	Course Name: Islamic Studies
Course Structure: Lectures:2	Credit Hours: 2
Prerequisite: None	
Course Outline: Fundamentals of Islam. (Aqaid, Ibadat, Islamic Dawah etc.); Ethical values of Islam; Serah of the Holy Prophet (PBUH); Islamic Civilization and its effects on humanity. Study of other prominent world religions and ethical systems in comparison with Islamic viewpoint. Multicultural societies.	
Text Book: Islamyat Allama Iqbal Open University, Pakistan	

Course Code: BCS-1202	Course Name: Digital Logic Design
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Number Systems, Logic Gates, Boolean Algebra, Combination logic circuits and designs, Simplification Methods K-Maps, Quinne, Mc-Cluskey,, Flip Flops and Latches, Asynchronous and Synchronous circuits, Counters, Shift Registers, Shift Registers Counters, Triggered devices & its types. Binary Arithmetic and Arithmetic Circuits, Memory Elements, State Machines. Introduction Programmable Logic Devices (CPLD, FPGA); Lab Assignments using tools such as Verilog HDL/VHDL, MultiSim, etc.	
Text Book& Reference Material: 1. Digital Fundamentals by Floyd, 11/e. 2. Fundamental of Digital Logic with Verilog Design, Stephen Brown, 2/e.	

3rd Semester

Course Code: BSCS-2301	Course Name: Data Structures and Algorithms
Course Structure: Lectures:2/ Labs: 3	Credit Hours: 3
Prerequisite: Object Oriented Programming	
Course Outline: Introduction to Data Structures and Algorithms; Complexity Analysis; Arrays; Sorting Algorithms: Insertion Sort, Selection Sort, Bubble Sort, Shell Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, Bucket Sort; Linked Lists: Singly Linked Lists, Doubly Linked Lists, Circular List; Stacks, Queues, and Priority Queue; Recursion: Function call and Recursion Implementation, Tail Recursion, Non-tail Recursion, Indirect Recursion, Nested Recursion, Backtracking. Trees: Binary Trees, Binary Heap, Binary Search. Tree Traversal, Insertion, Deletion, and Balancing a Tree; Heap; B-Tree; Spanning Tree, Splay Trees; Graphs: Representation, Traversal, Shortest Path, and Cycle Detection; Isomorphic Graphs; Graph Traversal Algorithms; Hashing; Memory Management and Garbage Collection.	

Text Book & Reference Material:

1. Data Structures and Algorithm Analysis, Mark Allen Weiss, Florida International University, Addison-Wesley (latest Edition)
2. Algorithms , Robert Sedgewick, Princeton University Publisher: Addison- Wesley Professional (latest Edition)
3. Data Structures: Abstraction and Design Using Java, Koffman and Wolfgang, Wiley; 2nd Edition (or latest Edition), 2011

Course Code: HUM-2306	Course Name: Arabic
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Institution/Universities follow their approved syllabus	
Text Book &Reference Material:	

Course Code: BCS-2302	Course Name: Computer Architecture and Organization
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: The design of computer systems and components. Processor design, instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchies; and interrupts and I/O structures. Pipelining of processor Issues and Hurdles, exception handling, Parallelism, Multiprocessor Systems.	
Text Book & Reference Material: 1. Computer Architecture: A Quantitative Approach by Hennessy & Patterson, Morgan & Kauffman Series (2006) 4th Edition 2. Computer Organization & Design: The Hardware/Software Interface By Patterson & Hennessy, Morgan & Kauffman Series (2008) 4th Edition.	

Course Code: MAT-2304	Course Name: Statistics and Probability
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Introduction to Statistics and Data Analysis, Statistical Inference, Samples, Populations, and the Role of Probability. Sampling Procedures. Discrete and Continuous Data. Statistical Modeling. Types of Statistical Studies. Probability: Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Bayes' Rule. Random Variables and Probability Distributions. Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem. Discrete Probability Distributions. Continuous Probability Distributions. Fundamental Sampling Distributions and Data Descriptions: Random Sampling, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem. Sampling Distribution of S^2 , t-Distribution, F-Quantile and Probability Plots. Single Sample & One- and Two-Sample Estimation Problems. Single Sample & One- and Two-Sample Tests of Hypotheses. The Use of P-Values for Decision Making in Testing Hypotheses (Single Sample & One- and Two-Sample Tests), Linear Regression and Correlation. Least Squares and the Fitted Model, Multiple Linear Regression and Certain, Nonlinear Regression Models, Linear	

Regression Model Using Matrices, Properties of the Least Squares Estimators.

Text Book & Reference Material:

1. Probability and Statistics for Engineers and Scientists by Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying E. Ye, Pearson; 9th Edition (January 6, 2011). ISBN-10: 0321629116
2. Probability and Statistics for Engineers and Scientists by Anthony J. Hayter, Duxbury Press; 3rd Edition (February 3, 2006), ISBN-10: 0495107573
3. Schaum's Outline of Probability and Statistics, by John Schiller, R. Alu Srinivasan and Murray Spiegel, McGraw-Hill; 3rd Edition (2008). ISBN-10: 0071544259
4. Probability: A Very Short Introduction by John Haigh, Oxford University Press (2012). ISBN-10: 0199588481

Course Code: MGS-2303	Course Name: Human Resource Management.
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Managing Human Resources. Understanding the External and Organizational Environments. Ensuring Fair Treatment and Legal Compliance. HR Planning for Alignment and Change. Using Job Analysis and Competency Modeling. Recruiting and Retaining Qualified Employees. Selecting Employees to Fit the Job and the Organization. Training and Developing a Competitive Workforce. Conducting Performance Management. Developing an Approach to Total Compensation. Using Performance-Based Pay to Achieve Strategic Objectives. Providing Benefits and Services for Employees' Well-Being, Risk Management. Employee Relations. Risk Management. Health, Safety, and Employee Well-Being. Understanding Unionization and Collective Bargaining.	
Text Book Reference Material:	
<ol style="list-style-type: none"> 1. Managing Human Resources by Susan E. Jackson, Randall S. Schuler and Steve Werner, South-Western College Pub; 11th Edition (June 16, 2011).ISBN-10: 1111580227 2. Management of Human Resources by Gary Dessler, Carolin Rekar Munro and Nina D. Cole, Pearson Education Canada; 3rd Edition (February 28, 2010). ISBN-10: 0321687140 3. Human Resource Management by Robert L. Mathis and John H. Jackson, South-Western Cengage Learning; 13th Edition (August 19, 2010). ISBN- 10: 053845315X 4. Human Resource Management Applications: Cases, Exercises, Incidents, and Skill Builders by Stella M. Nkomo, Myron D. Fottler and R. Bruce McAfee, South-Western Cengage Learning; 7th Edition (September 29, 2010). ISBN-10: 0538468076 	

Course Code: ENG-2305	Course Name: Communication Skills
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Communication & Effective Communication, Definition & Meaning, Concepts & components, Message, Structure & Components of Message, Sender Receiver & Feedback, Communication Types, Intra person communication, Inter person communication, Communication Barriers, Perception, Types of perceptions, The Seven Cs of Effective Communication, Verbal Communication, Types of verbal communication, Non-verbal Communication, Types of Non-verbal communication, Listening Skills, Difficulties in listening, How can listening be improved?, Speaking Skills, Presentation Skills, Techniques for enhancing speaking & presentation Skills, Reading Skills, Kind of reading, Aims of reading, Writing Skills, Job resume, Kinds of job resume, Job Application, Kinds of job application, Interviews, Types of interview, Formal Interview, Informal Interview, Structured Interview, Unstructured Interview, Business Letters, Different types of business letters, Techniques of writing an effective business letter, Memos and Messages, Good News Messages, Bad News Messages, Persuasive Messages, Reports Business reports, Types of reports, Parts of reports, Importance of Agenda, Importance of Minutes, Revision/ Review, Presentation	

Text Book &Reference Material:

1. Practical Business English, Colleen Vawdrey, 1993, ISBN = 0256192740
2. Effective Communication Skills: The Foundations for Change, John Nielsen, 2008, ISBN = 1453506748

4th semester

Course Code: MAT-2405	Course Name: Multivariate Calculus
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Functions of Several Variables and Partial Differentiation. Multiple Integrals, Line and Surface Integrals. Green's and Stoke's Theorem. Fourier Series: periodic functions, Functions of any period P-2L, Even & odd functions, Half Range expansions, Fourier Transform; Laplace Transform, Z-Transform.	
Text Book &Reference Material:	
<ol style="list-style-type: none"> 1. Multivariable Calculus, 6th edition James, Stewart 2007 Cengage Learning publishers. 2. Calculus and Analytical Geometry, 6th edition. Swokowski, Olinick and Pence. 1994. Thomson Learning EMEA, Ltd. 3. Multivariable Calculus, 5th edition Howard, A. Albert, H. 1995, John Wiley. 	

Course Code: BCS-2402	Course Name: Operating System
Course Structure: Lectures:3 :Labs 3	Credit Hours: 4
Prerequisite: None	
Course Outline: History and Goals, Evolution of multi-user systems. Introduction to the techniques used to implement operating systems and related kinds of systems software. Among the topics covered will be process management (creation, synchronization, and communication); Multi-Threading, processor scheduling; deadlock prevention, avoidance, and recovery; main-memory management; virtual memory management (swapping, paging, segmentation and page-replacement algorithms); control of disks and other input/output devices; file-system structure and implementation; and protection and security. Lab assignments involving different single and multithreaded OS algorithms.	
Text Book &Reference Material:	
<ol style="list-style-type: none"> 1. Operating System Concepts, 9th Edition, Silberschatz A., Peterson, J. L., & Galvin P.C. 2012. 2. Modern Operating Systems, 3rd Edition, Tanenbaum A. S., 2008. 	

Course Code: BCS-2401	Course Name: Database System
Course Structure: Lectures:3 :LAB 3	Credit Hours: 4
Prerequisite: None	
Course Outline: Basic database concepts, Database Architecture, DB Design Life Cycle, Schema Architecture, Conceptual, Logical and physical database Modeling and design, Entity Relationship diagram (ERD), Enhanced ERD, Relational data model, mapping ERD to relational model, Functional dependencies and Normalization, Relational Algebra, Structured Query language (SQL), Transaction processing, concurrency control and recovery techniques, Query optimization concepts.	
Text Book &Reference Material:	
<ol style="list-style-type: none"> 1. Database Systems A Practical Approach to Design, Implementation, and Management, 4th Edition, Thomas Connolly, Carolyn Begg, Addison Wesley, 2005. 	

2. Modern Database Management by Fred McFadden, Jeffrey Hooper, Maryth Prescott, Prentice Hall; 11 Edition (July 26, 2012). ISBN-10: 0132662256
3. Fundamentals of Database Systems by R. Elmasri and S. Navathe. 6th Edition, Addison-Wesley (2010). ISBN-10: 0136086209.
4. Database Design and Relational Theory: Normal Forms and All That Jazz by C. J. Date, O'Reilly Media; 1st Edition (April 24, 2012). ISBN-10: 1449328016.

Course Code: BCS-2403	Course Name: Micro Processor and Assembly language
Course Structure: Lectures:2, Lab1	Credit Hours: 3
Prerequisite: None	
Course Outline: Microprocessor Bus Structure: Addressing, Data and Control, Introduction to Registers and Flags. Addressing Modes, Instruction sets including Data Movement, Arithmetic and Logic, Programmed Control, Stack and its operation. Peripheral Control Interrupts. Introduction to the Assembler and Debugger, Manipulate and translate machine and assembly code, Describe actions inside the processing chip.	
Text Book & Reference Material:	
<ol style="list-style-type: none"> 1. The Intel Microprocessor 8th ed, Barry B Brey. 2. Assembly Language for Intel-based Computers, 6th Ed Irvine, http://vig.prenhall.com/catalog/academic/product/0,1144,0132383101,00.html 3. The 8086/8088 Microprocessor 4th Edition by Avtar Singh. 	

Course Code: BCS-2404	Course Name: Computer Graphics
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline: Graphics hardware. Fundamental algorithms. Applications of graphics. Interactive graphics programming — graph plotting, windows and clipping, and segmentation. Programming raster display systems, Differential Line Algorithm, panning and zooming. Raster algorithms and software — Scan-Converting lines, characters and circles. Scaling, Rotation, Translation, Region filling and clipping. Two and three dimensional imaging geometry (Perspective projection and Orthogonal projection) and transformations. Curve and surface design, rendering, shading, colour and animation.	
Text Book & Reference Material:	
<ol style="list-style-type: none"> 1. Fundamentals of Computer Graphics: 2nd Edition by Peter Shirley A. K Peters, 2005 2. Computer Graphics, Principles and Practice, J. D. Foley, A. van Dam, S. K. Feiner and J. F. Hughes, Addison-Wesley ISBN: 0-201-12110-7. 3. Computer Graphics, F. S. Hill, Maxwell MacMillan ISBN: 0-02-354860-6. 4. Interactive Computer Graphics: Functional, Procedural and Device-level methods; Peter Burger and Duncan. F. Gillies; Addison-Wesley, (2003) 	

5th semester

Course Code: BCS-3506	Course Name: Financial Accounting
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Introduction to Accounting and its concepts. Recording Business Transactions: Journal, Ledger, Trial Balance. Preparation of Financial Statements: Balance Sheet, Income Statement, Completion of Accounting Cycle: Adjustments, Closing, Work Sheet Accounting for purchase and sales of merchandise. Receivable and payable, Inventories, Payroll Systems. Plant and Equipment: Acquisition, Depreciation, Disposal. Corporations: Organization and stock-holders equity, Operations, Earning per share and dividends.	
Text Book &Reference Material: <ol style="list-style-type: none"> 1. Robert F.Meigs and Walter B.Meigs: Accounting: The Basis for Business Decisions, McGraw Hill, Inc 2. Eric G. Flamholtz, Diana Troik Flamholtz, Michael A.Diamond: Principle of Accounting, Macmillan Publishing Co. New York 3. Frankwood, Business Accounting-I and Business Accounting-II 4. Simon and Karren Brock: Intermediate Accounting 	

Course Code: BCS-3502	Course Name: Data Comm. And Computer Networks
Course Structure: Lectures: 2 Lab:3	Credit Hours: 3
Prerequisite: None	
Course Outline Data Communication concepts, Analogue and digital Transmission, Noise, Media, Encoding, Asynchronous and Synchronous transmission. Network system architectures (OSI, TCP/IP), Error Control, Flow Control, Data Link Protocols, Bridging. Local Area Networks and MAC Layer protocols, Multiplexing, Switched and IP Networks, Inter-networking, Routing. Transport layer protocols TCP, UDP and SCTP. Application Layer Protocols. Wireless LANs.	
Text Book &Reference Material: <ol style="list-style-type: none"> 1. Data Communications and Networking, by Behrouz A. Forouzan, 5th edition, 2013 2. Computer Networks by A. S. Tanenbaum, D. J. Wetherall, 5th Edition Prentice Hall 2010 3. Data and Computer Communications By William Stallings 9th Edition 2011 	

Course Code: BCS-3503	Course Name: Design and Analysis of Algorithms
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Introduction; Asymptotic notations; Recursion and recurrence relations; Divide-and-conquer approach; Sorting; Search trees; Heaps; Hashing; Greedy approach; Dynamic programming; Graph algorithms; Shortest paths; Network flow; Disjoint Sets; Polynomial and matrix calculations; String matching; NP complete problems; Approximation algorithms.	

<p>Text Book & Reference Material:</p> <ol style="list-style-type: none"> 1. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson, and R. L. Rivest, MIT Press, McGraw-Hill, 3rd Edition, New York, NY, 2010. 2. Algorithms in C++; Robert Sedgewick
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Course Code: BCS-3504	Course Name: Theory of Automata
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
<p>Course Outline:</p> <p>Finite State Models: Language definitions preliminaries, Regular expressions/Regular languages, Finite automata (FAs), Transition graphs (TGs), NFAs, Kleene's theorem, Transducers (automata with output), Pumping lemma and non regular language Grammars and PDA: Context free grammars, Derivations, derivation trees and ambiguity, Simplifying CFLs , Normal form grammars and parsing, Decidability, Context sensitive languages, grammars and linear bounded automata (LBA), Chomsky's hierarchy of grammars Turing Machines Theory: Turing machines, Post machine, Variations on TM, TM encoding, Universal Turing Machine, Defining Computers by TMs.</p>	
<p>Text Book & Reference Material:</p> <ol style="list-style-type: none"> 1. Introduction to computer theory, Daniel I. A. Cohen, 2nd Edition 2. Automata, Computability and Complexity: Theory and Applications, by Elaine Rich, 2011 3. An Introduction to Formal Languages and Automata, By Peter Linz, 4th edition, Jones & Bartlett Publishers, 2006 4. Theory of Automata, Formal Languages and Computation, By S. P Eugene, Kavier, 2005, New Age Publishers, ISBN (10): 81-224-2334-5, ISBN (13): 978-81-224-2334-1. 	

Course Code: BCS-3501	Course Name: Web Design and Development
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
<p>Course Outline:</p> <p>HTML, DHTML, CSS, clients side scripting, server side scripting, dynamic website development. Introduction to current technology e.g. MySQL, php, Php frameworks Codeignitor, Cake PHP, Zend. ASP, ASP.NET, JSP, JAVA Introduction to related methods and tools e.g., website hosting, database connectivity, Macromedia. Overview of XML. HTML VALIDATION, XML QUERY. Xml parsers. DOM Parser.</p>	
<p>Text Book & Reference Material:</p> <ol style="list-style-type: none"> 1. Web enabled Commercial application development using HTML, DHTML, and JAVASCRIPT by Ivon Bayross. BPS Publications. 2. Beginning ASP by Richard Anderson, Brain Francis. Wrox series Publications. 	

Course Code: BCS-3505	Course Name: Differential Equations
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Ordinary Differential Equations of the First Order: Geometrical Considerations, Isoclines, Separable Equations, Equations Reducible to Separable Form, Exact Differential Equations, Integrating Factors, Linear First-Order Differential Equations, variation of Parameters. Ordinary Linear Differential Equations; Homogeneous Linear Equations of the Second Order, Homogeneous Second-Order Equations with Constant Coefficients, General Solution, Real Roots, Complex Roots, Double Root of the Characteristic Equation, Differential Operators, Cauchy Equation, Homogeneous Linear Equations of Arbitrary Order, Homogeneous Linear Equations of Arbitrary Order with Constant Coefficients, Non-homogeneous Linear Equations. Modeling of Electrical Circuits. Systems of Differential Equations. Series Solutions of Differential Equations. Partial Differential Equations: Method of Separation of variables, wave, Heat & Laplace equations and their solutions by Fourier series method.	
Text Book &Reference Material: 1. Advanced Engineering Mathematics Michael, G.1996, Prentice Hall Publishers. 2. Advanced Engineering Mathematics, 7 edition, Erwin, K. 1993, John Wiley & Sons Inc. 3. A First Course in Differential Equation Zill. Prindle. Weber. Schmidt.1996. Brooks/Cole Publishing. 4. Differential Equations with Boundary-Value Problems, Dennis. G. Zill, Michael, R. Cullen. 1996, Brooks/Cole Publishing, 5. Elementary Differential Equations with Applications C. H. Edwards. David, E. 1993. Penney, Prentice Hall.	

6th semester

Course Code: BCS-3603	Course Name: Mobile Computing
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Mobile Development Concepts, Activities, Resource Management and Media, Services and Content Providers, Data Storage, Security, Managing Evolution, Tablets Graphics Speech Sensors Networking, Processes and Threads, Deployment	
Text Book &Reference Material: 1. Android Wireless Application Development, third edition, Lauren Darcey, Shane Conder, Addison Wesley, 2012, ISBN 0321813839 2. Mobile Design and Development: Practical concepts and techniques for creating mobile sites and web apps, by Brian Fling Publisher: O'Reilly Media, 2009.	
Course Code: BCS-3601	Course Name: Human Computer Interaction
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline The Human, Computer and Interaction, Usability paradigm and principles, Introduction to design basics, HCI in software process, Design rules, prototyping, evaluation techniques, task analysis, Universal design and User support and Computer Supported Cooperative Work; Introduction to specialized topics such as Groupware, pervasive and ubiquitous applications.	

Text Book & Reference Material:

1. "Human-Computer Interaction", Alan Dix, Computing Department, Lancaster University Janet E. Finlay, Leeds Metropolitan University, Gregory D. Abowd, Georgia Institute of Technology, Russell Beale, University of Birmingham ISBN-10: 0130461091 ISBN-13: 9780130461094 Publisher: Prentice Hall 3rd Ed or Latest Edition
2. "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Ben Shneiderman, University of Maryland Catherine Plaisant, University of Maryland ISBN-10: 0321197860 ISBN-13: 9780321197863 Publisher: Addison-Wesley 4th Ed or Latest Edition.

Course Code: BCS-3602	Course Name: Software Engineering
Course Structure: Lectures:3	Credit Hours: 3

Prerequisite: None**Course Outline**

Overview of SE, Practice & Myths; the Software Processes, Generic Process Models: Framework Activity, Task Set, Process Patterns, Process Improvement, CMM Prescriptive, Process Models: Waterfall Model, Incremental Process Model, Evolutionary Process Model; Specialized Process Models: Component Based Development, the Formal Methods Models, Agile Development; Business Information Systems: Components, Types, and Evaluating methods. SDLC: Phases, System Planning, Preliminary Investigation, SWOT Analysis. The Importance of Strategic

Planning; Evaluation of Systems Requests, Requirements Engineering. Difference between Structured Analysis and Object Oriented Analysis, Difference between FDD Diagrams & UML Diagrams; Data & Process Modelling; Diagrams: Data Flow, Context, Conventions, Detailed Level DFD's; Levelling and Balancing. Logical Versus Physical Models. The Design Process; Architecture Design Elements, Interface Design Elements, Component-Level Design Elements, Deployments Design Elements; System Architecture, Architectural Styles. User Interface Design. WebApps Interface Design; Software Quality Assurance. Validation Testing, System Testing; Internal and External View of Testing. Project Management. Risk Management; Maintenance and Reengineering.

Text Book & Reference Material:

1. Software Engineering 8E by Ian Sommerville, Addison Wesley; 8th Edition (2006). ISBN-10: 0321313798
2. Systems Analysis and Design by Gary B. Shelly, Thomas J. Cashman and Harry J. Rosenblatt, Course Technology; 7th Edition (2007). ISBN-10: 1423912225
3. Software Engineering: A Practitioner's Approach by Roger S. Pressman, McGraw-Hill Science/Engineering/Math; 7th Edition (2009). ISBN-10: 0073375977.

Course Code: BCS-3604	Course Name: Artificial Intelligence
Course Structure: Lectures:2 Labs:3	Credit Hours: 3

Prerequisite: None**Course Outline**

Artificial Intelligence: Introduction, AI Paradigms and Hypothesis, Intelligent Agents. Difference between Cybernetic Intelligence and Artificial Intelligence, Objectives and Scope of Weak AI and Strong AI, Problem-solving: Solving Problems by Searching, Informed Search and Exploration, Constraint Satisfaction Problems, Adversarial Search. Knowledge and reasoning: Logical Agents, First-Order Logic, Inference in First-Order Logic, Knowledge Representation. Planning and Acting in the Real World. Uncertain knowledge and reasoning: Uncertainty, Probabilistic Reasoning, Probabilistic Reasoning over Time, Making Simple Decisions, Making Complex Decisions. Learning: Learning from Observations, Knowledge in Learning; Learning Methods, Reinforcement Learning. Communicating, perceiving, and acting: Communication, Probabilistic Language Processing, Perception and Robotics.

Introduction to LISP/PROLOG and Expert Systems (ES) and Applications; Artificial General Intelligence, Issues in Safe AI, Introduction to Cognitive and Conscious Systems.

Text Book &Reference Material:

1. Artificial Intelligence: Structures and Strategies for Complex Problem Solving: International Edition by George F. Luger, 6th edition: Pearson Education, 2008.
2. Artificial Intelligence: A Modern Approach, by Stuart Jonathan Russell, Peter Norvig, John F. Canny, 3rd Edition, Prentice Hall.

Course Code: BCS-3605	Course Name: Fundamental of Data Mining
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
<p>Course Outline Concepts of Data mining, data pre-processing and pre-mining,(noisy and missing data, data normalization and discretization), outlier detection, Data mining learning methods, Data mining classes (association rule mining, clustering, classification), fundamental of other algorithms related to data mining(fuzzy logic, genetic algorithm and neural network), decision trees, rules, patterns and trends.</p>	
<p>Text Book &Reference Material:</p> <ol style="list-style-type: none"> 1. Data Mining: Concepts and Techniques, 3rd Edition Jiawei Han, Micheline Kamber, Jian Pei; , 2011 2. Data Mining: Concepts, Models, Methods, and Algorithms, 2nd Edition, Mehmed Kantatardzic, 2011. 3. Data Mining, Introductory and Advanced Topics, 2006, Margaret H. Dunham and S. Sridhar, Pearson Education. 4. Principles of Data Mining, 2007, Max Bramer, Springer-Verlag. 	

Course Code: HUM-3606	Course Name: Psychology
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
<p>Course Outline Basics concepts of Psychology and Research Methods. Brain and Behavior. Human Development. Sensation and Perception. States of Consciousness. Conditioning and Learning. Memory. Cognition, Language, Creativity, and Intelligence. Motivation and Emotion. Sex, Gender, and Sexuality. Personality. Health, Stress, and Coping. Social Behavior.</p>	
<p>Text Book &Reference Material:</p> <ol style="list-style-type: none"> 1. Psychology: Modules for Active Learning by Dennis Coon and John O. Mitterer, Wadsworth Publishing; 12th Edition (January 1, 2011). ISBN-10: 1111342849 2. Introduction to Psychology by James W. Kalat, Wadsworth Publishing; 9th Edition (January 1, 2010). ISBN-10: 0495810762 3. Introduction to Psychology by Rod Plotnik and Haig Kouyoumdjian, Wadsworth Publishing; 9th Edition (February 25, 2010). ISBN-10: 0495903442 4. Psychology by David G. Myers, Worth Publishers; 9th Edition (January 10, 2009). ISBN-10: 1429215976 	

7th semester

Course Code: BCS-4701	Course Name: Fuzzy Logic System
Course Structure: Lectures:2 Lab:3	Credit Hours: 3
Prerequisite: None	
Course Outline Mathematical introduction of fuzzy sets and fuzzy logic, A study of the fundamentals of fuzzy sets, operations on these sets, and their geometrical interpretations. Methodologies to design fuzzy models and feedback controllers for dynamical systems, fundamental concepts of dynamical systems, multi-input multi-output dynamical systems, stability, feedback- control design, and MATLAB® Control System Toolbox. Fuzzy systems and properties Fuzzifier and Defuzzifier design, Design of fuzzy systems Fuzzy controllers, Hardware and Software based design of fuzzy logic control system.	
Text Book &Reference Material: 1. A Course in Fuzzy Systems and Control, Li-Xin Wang (Prentice-Hall) Hand out and research papers related with the subject.	

Course Code: BCS-4702	Course Name: Compiler Construction
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Introduction to interpreter and compiler. Compiler techniques and methodology; Organization of compilers; Lexical and syntax analysis; Parsing techniques. Types of parsers, top-down parsing, bottom-up parsing, Type checking, Semantic analyser, Object code generation and optimization, detection and recovery from errors.	
Text Book &Reference Material: 1. Compilers: Principles, Techniques, and Tools By Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Contributor Jeffrey D. Ullman, Addison-Wesley Pub. Co., 2nd edition, 2006 Original from the University of Michigan 2. Modern Compiler Design, by Dick Grune, Henri E. Bal, Criel J. H. Jacobs, Koen G. Langendoen, John Wiley, 2000. 3. Modern Compiler Implementation in C, by Andrew W. Appel, Maia Ginsburg, Contributor Maia Ginsburg, Cambridge University Press, 2004. 4. Modern Compiler Design by Dick Grune, Henri E. Bal, Criel J. H. Jacobs, Koen G. Langendoen, 2003, John Wiley & Sons.	

Course Code: BCS-4703	Course Name: Numerical Computing
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline The concepts of efficiency, reliability and accuracy of a method; Minimising computational errors; Theory of Differences, Difference Operators, Difference Tables, Forward Differences, Backward Differences and Central Differences. Mathematical Preliminaries, Solution of Equations in one variable, Interpolation and Polynomial Approximation, Numerical Differentiation and Numerical Integration, Initial Value Problems for Ordinary Differential Equations, Direct Methods for Solving Linear	

Systems, Iterative Techniques in Matrix Algebra, Solution of non-linear equations.
Text Book & Reference Material: <ol style="list-style-type: none"> 1. Numerical Methods in Scientific Computing by Germund, D. Åke, B. 2. Numerical Methods for Scientific Computing by J. H. Heinbockel. 3. Numerical Analysis by I. A. Khubaza. 4. Numerical Analysis and Programming by Shan S Kuo. 5. Numerical Analysis by Berden, F. 6. Numerical Analysis by Gerald.

Course Code: BCS-4704	Course Name: Digital Image Processing
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Introduction: Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels, Image Enhancement: Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain, Colour Image Processing, image Segmentation: Discontinuity detection, Edge linking and boundary detection, Tresh holding, Region oriented segmentation, Use of motion for segmentation, Image Registration: Introduction to image registration, Techniques of image registration, Representation and Description: Boundary description, Regional description, Morphological Image Processing: Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to gray level images, Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform	
Text Book & Reference Material: <ol style="list-style-type: none"> 1. Digital Image Processing, R. C. Gonzalez & R. E. Woods, 3rd edition, Prentice Hall, 2008, ISBN 9780131687288. 2. Digital Image Processing (3rd Edition) by Rafael C. Gonzalez, Prentice Hall; 3rd edition (2007) 	

8th Semester

Course Code: BCS-4803	Course Name: Professional Practices
Course Structure: Lectures:3	Credit Hours: 2
Prerequisite: None	
Course Outline Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization.	
Text Book & Reference Material: <ol style="list-style-type: none"> 1. Professional Issues in Software Engineering M.F. Bott et al. 	

Course Code: BCS-4801	Course Name: Information Security
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Basic notions of confidentiality, integrity, availability; authentication models; protection models; security kernels; Encryption, Hashing and Digital Signatures; audit; intrusion detection and response; database security, hostbased and network-based security issues operational security issues; physical security issues; personnel security; policy formation and enforcement; access controls; information flow; legal and social issues; identification and authentication in local and distributed systems; classification and trust modeling; risk assessment	
Text Book &Reference Material: 1. Computer Security: Art and Science, Matthew Bishop 2. Cryptography and Network Security by William Stallings 6th Edition, 2012 3. Principles of Information Security 3rd Edition by Michael E. Whitman and	

Course Code: BCS-4802	Course Name: Software Project Management
Course Structure: Lectures:3	Credit Hours: 3
Prerequisite: None	
Course Outline Software Crisis and Software Engineering, Classic Mistakes, Overview of Project Management, PMI Process Groups, Software project Phases, Project charter, Statement of Work (SOW), Planning Phase: Development lifecycle models, matching lifecycles to projects, Project plans, Work Breakdown Structures (WBS), Estimation of effort and cost (Expert Judgment, FP and Use Case point methods), Scheduling: Project network diagram fundamentals, CPM, PERT, Gantt charts, Critical chain scheduling, Using MS-Project, Assigning Resources, Resource leveling, Team models, Managing conflict and motivating, Project Monitoring and Control: Status reporting, Project metrics, EVM, Communications Techniques, Risk management and Change control Project Recovery, Documentation, Cutover/Migration, Post Project Reviews, Closing.	
Text Book &Reference Material: 1. Software Project Management, Bob Hughes, Mike Cotterell, McGraw-Hill Higher Education, 5th Edition, 2009 (or Latest Edition). 2. The Software Project Manager's Handbook: Principles that work at work, Dwayne Phillips, IEEE Computer Society Press and Wiley Interscience, 2nd Edition, 2004 (or Latest Edition).	

**CURRICULUM FOR BS IN
INFORMATION TECHNOLOGY
(BSIT),
Department of Computer Science &
Information Technology (CS&IT),
Mirpur University of Science &
Technology (MUST),
Mirpur (AJ&K)**

Approval of Scheme of Studies for 4-years BS (IT) Program

Scheme of studies for Bachelor of Science in Information Technology (BSIT)

Programme's Aims and Objectives:

The aim of the BS (IT) program is to produce entrepreneurs of great character, competence, vision and drive equip with up-to-date knowledge, marketable skills, valuable competencies, unique expertise, globally compatible dispositions and culturally and professionally acceptable values to take on appropriate professional roles in information technology domain or proceed to further or higher education or training. One of the key objectives of the program is to equip students with skills and knowledge that enable them to take on appropriate professional positions in IT and grow into leading roles.

Programme Structure of BS Information Technology:

Duration:	8-12 Semesters
Courses:	130 Credits
Oral Comprehensive Examination:	S/U Basis
Internship:	S/U Basis
Project:	06 Credits
Total Credits:	136 Credits

Category wise Credit Hours Distribution

No.	Category	Credit Hours
1	Computing Courses	
	Core	40
	Supporting Areas	12
2	Information Technology Courses	
	Core	21
	Elective	21
	Supporting	15
3	General Education Courses	18
4	University Elective Courses	09
	Total Credit Hours	136

COURSES FOR BS(IT)

Semester-1

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-1101	-	Fundamentals of ICT (IC*)	2	1	3(2+1)
BIT-1102	-	Programming Fundamentals(CC*)	3	1	4(3+1)
MAT-1103	-	Calculus and Analytical Geometry *(CS)	3	0	3
MGS -1104	-	Financial Accounting * UE	3	0	3
ENG-1105	-	English Comprehension*(GE)	3	0	3
HUM -1106	-	Pakistan Studies *(GE)	2	0	2
		Total:			18

Semester-2

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-1201	BIT-1102	Object Oriented Programming	3	1	4(3+1)
BIT-1202	-	Intro to Computer Architecture *(CS)	3	0	3
BIT-1203	-	Discrete Structures *(CC)	3	0	3
MGS-1204	-	Human Resource Management *(UE)	3	0	3
ENG-1205	-	Technical and Business Writing *(GE)	3	0	3
HUM-1206	-	Islamic Studies *(GE)	2	0	2
		Total:			18

Semester-3

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-2301	-	Data Structures and Algorithm *(CC)	3	1	4(3+1)
BIT-2302	-	Computer Communication and Networks(*CC)	3	0	3
BIT-2303	-	Operating System Concepts *(CC)	3	0	3
MAT-2304	-	Statistics and Probability *(CS)	3	0	3
ENG-2305	-	Communication Skills *(GE)	3	0	3
HUM-2306	-	Arabic *(GE)	3	0	3
		Total:			18

Semester-4

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-2401	-	Database Systems *(CC)	3	1	4(3+1)
BIT-2402	-	Software Engineering-I *(CC)	3	0	3
BIT-2403	-	Internet Architecture & Protocols *(IS)	3	0	3
BIT-2404	-	Information System *(IS)	3	0	3
MGS-2405	-	Organizational Behavior *(UE)	3	0	3
MAT-2406	-	Linear Algebra *(CS)	3	0	3
		Total:			19

Semester-5

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-3501	-	Web Design and Development *(IC)	2	1	3(2+1)
BIT-3502	-	DB Administration & Management *(IS)	3	0	3
BIT-3503	-	Multimedia Technologies *(IC)	3	0	3
BIT-3504	-	Telecommunication Systems *(IE)	3	0	3
BIT-3505	BIT-2402	Software Engineering II *(CC)	3	0	3
BIT-3506	-	Technology Management *(IC)	3	0	3
		Total:			18

Semester-6

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-3601	-	Human Computer Interaction *(CC)	3	0	3
BIT-3602	-	Object Oriented Analysis & Design *(IS)	3	0	3
BIT-3603	BIT-2401	Distributed Database Systems *(IE)	3	0	3
BIT-3604	-	E-Commerce *(IE)	3	0	3
BIT-3605	-	Systems and Network Administration *(IC)	3	0	3
BIT-3606	-	Distributed Computing *(IE)	3	0	3
		Total:			18

Semester-7

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-4701	-	Mobile Computing *(IE)	3	0	3
BIT-4702	-	Network Security *(IC)	3	0	3
BIT-4703	-	Data Mining *(IE)	3	0	3
BIT-4704	-	Artificial Intelligence *(IE)	3	0	3
BIT-4705	-	IT Project Management *(IS)	3	0	3
BIT-4706	-	Capstone Project Part -1 *(CC)	-	-	S/U
		Total:			15

Semester-8

Code	Pre-Req	Title	Lec. Hrs	Lab. Hrs	Credit Hours
BIT-4801	-	System Integration & Architecture *(IC)	3	0	3
BIT-4802	-	Professional Practices *(GE)	3	0	3
BIT-4803	-	Capstone Project Part 2 *(CC)	-	-	6
BIT-4804	-	Semantic Web	3	0	3
BIT-4805	-	Oral Comprehensive Examination	-	-	S/U
BIT-4806	-	Internship/ Practical Training	-	-	S/U
		Total:			15

*CC = Computing Core,

*IS = IT Supporting,

*CS = Computing Supporting,

*GE = General Education,

*IC = IT Core,

*UE = University Elective

*IE = IT Elective,

Course Contents Semester 1

Course Code: BSIT -1101

Course Name: Fundamentals of ICT

Credit Hours: 03

Course Structure: Lectures 2, Lab 1

Prerequisite: None

Course Outline:

Brief history of computers and their applications. Major components of a computer. Computer and Society. The social impact of computer age. Computers in offices, industry and education. Office automation tools; Word processing, Graphic packages, Databases and Spreadsheets. Current trends, research and future prospects. Legal and moral aspects of Computer Science. Using Internet.

Text Book:

1. *Introduction to Computers* by PK Sinha, *Introduction to Computers* by Peter Norton, 6th Edition, McGraw-Hill SiE, ISBN 0-07-059374-4.

Reference Material:

2. *Computers: Information Technology in Perspective*, 9/e by Larry Long and Nancy Long, Prentice Hall, 2002/ISBN: 0130929891.
3. *An Invitation to Computer Science*, Schneider and Gersting, Brooks/Cole Thomson Learning, 2000.
4. *Information System Today* by Leonard Jessup, Joseph Valacich.
5. *Computers Today* by Suresh K. Basandra.
6. *Computer Science: An overview of Computer Science*, Sherer.

Course Code: BSIT -1102

Course Name: Programming Fundamentals

Credit Hours: 04

Course Structure: Lectures 3, Lab 1

Prerequisite: None

Course Outline:

This course covers overview of Computer Programming, Principles of Structured and Modular Programming, Overview of Structured Programming Languages, Algorithms and Problem Solving, Program Development: Analysing Problem, Designing Algorithm/Solution, Testing Designed Solution, and Translating Algorithms into Programs, Fundamental Programming Constructs, and Data Types. Basics of Input and Output, Selection and Decision (If, If-Else, Nested If-Else, Switch Statement and Condition Operator), Repetition (While and For Loop, Do-While Loops), Break Statement, Continue Statement, Control Structures, Functions, Arrays, Pointers, Records, Files (Input-Output), Testing & Debugging.

Reference Materials:

1. *C How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 7 edition (March 4, 2012). ISBN-10: 013299044X
2. *Programming in C* by Stephen G. Kochan, Addison-Wesley Professional; 4 edition (September 25,

2013). ISBN-10: 0321776410

3. *Java How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (March, 2011)

4. *C++ How to Program* by Paul Deitel and Harvey Deitel, Prentice Hall; 9th edition (February, 2013)

Course Code: MAT-1103

Course Name: Calculus and Analytical Geometry

Credit Hours: 03

Course Structure: Lectures 3,

Prerequisite: None

Course Outline:

Real Numbers and the Real Line, Coordinates, Lines, and Increments, Functions, Shifting Graphs, Trigonometric Functions. Limits and Continuity: Rates of Change and Limits, Rules for Finding Limits, Target Values and Formal Definitions of Limits, Extensions of the Limit Concept, Continuity, Tangent Lines. Derivatives: The Derivative of a Function, Differentiation Rules, Rates of Change, Derivatives of Trigonometric Functions, The Chain Rule, Implicit Differentiation and Rational Exponents. Applications of Derivatives. Integration: Indefinite Integrals, Integration by Substitution, Definite Integrals, Substitution in Definite Integrals. Numerical Integration. Applications of Integrals. Transcendental Functions: Inverse Functions and Their Derivatives, Natural Logarithms, The Exponential Function, ax and $\log ax$, Growth and Decay, L'Hôpital's Rule, Relative Rates of Growth, Inverse Trigonometric Functions, Derivatives of Inverse Trigonometric Functions; Hyperbolic Functions. Conic Sections, Parametrized Curves, and Polar Coordinates. Graphing in Polar Coordinates. Polar Equations for Conic Sections. Integration in Polar Coordinates. Vectors and Analytic Geometry in Space; Vectors in the Plane Dot Products; Vector-Valued Function Cartesian (Rectangular) Coordinates and Vectors in Space. Dot Products; Cross Products. Lines and Planes in Space; Cylinders and Quadric Surfaces; Cylindrical and Spherical Coordinates.

Reference Materials:

1. *Calculus and Analytic Geometry* by George B. Thomas and Ross L. Finney, Addison Wesley; 10th Edition (1995) ISBN-10: 0201531747

2. *Calculus and Analytical Geometry* by Swokowski, Olinick and Pence, 6th Edition, 1994, Brooks/Cole Publishers.

3. *Calculus* by Howard Anton, Irl C. Bivens, Stephen Davis, Wiley; 10th Edition (2012), ISBN-10: 0470647728

4. *Calculus with Analytic Geometry: Student Solution Manual* by Howard Anton, Wiley; 5th Edition (1995). ISBN-10: 0471105899

Course Code: MGS-1104

Course Name: Financial Accounting

Credit Hours: 03

Course Structure: Lectures 3,

Prerequisite: None

Course Outline:

Introduction to Accounting and its concepts. Recording Business Transactions: Journal, Ledger, and Trial Balance. Preparation of Financial Statements: Balance Sheet, Income Statement, and Completion of Accounting Cycle: Adjustments, Closing, Work Sheet Accounting for purchase and sales of merchandise. Receivable and payable, Inventories, Payroll Systems. Plant and Equipment: Acquisition, Depreciation, Disposal. Corporations: Organization and stock-holders equity, Operations, Earning per share and dividends.

Text Book:

Accounting: The Basis for Business Decisions, Robert F.Meigs and Walter B.Meigs: McGraw Hill, Inc.

Reference Material:

1. *Principle of Accounting*, Eric G. Flamholtz, Diana Troik Flamholtz, Michael A.Diamond:

Macmillan Publishing Co. New York
2. *Intermediate Accounting*, Frankwood, Business Accounting-I and Business Accounting-II
Simon and Karren Brock:

Course Code: ENG-1105

Credit Hours: 03

Prerequisite: None

Course Name: English Comprehension

Course Structure: Lectures 2,

Course Outline:

Basic Grammar, Parts of Speech and use of articles, Sentences structure, active and passive voice, practice in unified sentences, Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Comprehension: Answer to questions on a given text, Discussion: General topics and everyday conversation, Listening: To be improved by showing documentaries/ films carefully selected by subject teacher, Paragraph writing, Presentation skills.

Text Book:

1. *Functional English: Practical English Grammar* by A.J. Thomson and A.V. Martinet, 3rd Edition, Oxford University Press 1997

Course Code: HUM-1106

Credit Hours: 02

Prerequisite: None

Course Name: Pakistan Studies

Course Structure: Lectures 2,

Course Outline:

Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj- Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geo-political dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

Reference Material:

1. *The Emergence of Pakistan*, Chaudary M., 1967
2. *The making of Pakistan*, Aziz. 1976

Semester 2

Course Code: BIT-1201

Credit Hours: 04

Prerequisite: 1102

Course Name: Object Oriented Programming

Course Structure: Lectures 3, Lab 1

Course Outline:

Evolution of Object Oriented Programming (OOP), Object Oriented concepts and principles, problem solving in Object Oriented paradigm, OOP design process, classes, functions/methods, objects and encapsulation; constructors and destructors, operator and function/method overloading, association, aggregation, composition, generalization, inheritance and its types, derived classes, function/method overriding, abstract and concrete classes, virtual functions, polymorphism, exception handling.

Reference Materials:

1. *Java: How to Programme*, Harvey M. Deitel and Paul J. Deitel, Prentice Hall; 8 edition (March 27, 2009). ISBN-10: 0136053068 127
2. *C++: How to Programme*, Prentice Hall; 8 edition (March 25, 2011). ISBN-10: 0132662361
3. *Object Oriented Programming in C++* by Robert Lafore, Sams Publishing; 4 edition (December 29, 2001). ISBN-10: 0672323087
4. *Java Programming: From the Ground Up* by Ralph Bravaco and Shai Simonson, McGraw-Hill Higher Education New York, 2010, ISBN 978-0-07-352335-4
5. *Beginning Java* by Ivor Horton, John Wiley & Sons, Inc, 7th Edition, 2011, ISBN: 978-0-470-40414-0

Course Code: BIT-1202

Credit Hours: 03

Prerequisite: None

Course Name: Intro to Computer Architecture

Course Structure: Lectures 3

Course Outline:

The design of computer systems and components. Processor design, instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchies; and interrupts and I/O structures. Pipelining of processor Issues and Hurdles, exception handling, Parallelism, Multiprocessor Systems.

Reference Materials:

1. *Computer Architecture: A Quantitative Approach* by Hennessy & Patterson, Morgan & Kauffman Series (2006) 4th Edition.
2. *Computer Organization & Design: The Hardware/Software Interface* By Patterson & Hennessy, Morgan & Kauffman Series (2008) 4th Edition.

Course Code: BIT-1203
Credit Hours: 03
Prerequisite: None

Course Name: Discrete Structures
Course Structure: Lectures 3

Course Outline:

Mathematical reasoning: introduction to logic, propositional and predicate calculus; negation disjunction and conjunction; implication and equivalence; truth tables; predicates; quantifiers; natural deduction; rules of Inference; methods of proofs; use in program proving; resolution principle; Set theory: Paradoxes in set theory; inductive definition of sets and proof by induction; Relations, representation of relations by graphs; properties of relations, equivalence relations and partitions; Partial orderings; Linear and well-ordered sets; Functions: mappings, injection and surjection, composition of functions; inverse functions; special functions; Peano postulates; Recursive 20 function theory; Elementary combinatorics; counting techniques; recurrence relation; generating functions. Graph Theory: elements of graph theory, Planar Graphs, Graph Colouring, Euler graph, Hamiltonian path, trees and their applications.

Reference Materials:

1. *Discrete Mathematical Structure with Application to Computer Science*, J. P. Temblay and B Manohar, McGraw-Hill, 2nd Edition.
2. *Discrete Mathematics*, 7th edition, Richard Johnson Baugh, 2008, Prentice Hall Publishers.
3. *Discrete Mathematics and Its Applications*, 6th edition, Kenneth H. Rosen, 2006, McGraw-Hill Book Co.
4. *Discrete Mathematical Structures, 4th edition*, Kolman, Busby & Ross, 2000, Prentice-Hall Publishers.
5. *Discrete and Combinatorial Mathematics: An Applied Introduction*, Ralph P. Grimaldi, Addison-Wesley Pub. Co., 1985.
6. *Logic and Discrete Mathematics: A Computer Science Perspective* by Winifred Grassman, Jean-Paul Tremblay, Winifred Grassman, Prentice Hall, 1995

Course Code: MGS-1204
Credit Hours: 03
Prerequisite: None

Course Name: Human Resource Management
Course Structure: Lectures 3

Course Outline:

An overview of Human Resource Management and Human Resource Manager. The Environment of Human Resource Management, external and Internal Environment. Equal Employment Opportunity and Affirmative Action. Job Analysis: A Basic Human Resource Tool. Human Resource Planning, Recruitment, and Selection. Organization Change and Human Resource Development, Corporate Culture and Organization Development. Career Planning Development. Performance Appraisal

Text Book:

1. *Garry Dessler, Human Resource Management*

Reference Material:

1. *Personnel The Management of people at work*, Dale S. Beach.
2. *Human Resource Management*, Holdin.
3. *Werther & Keith Davis Human Resource & Personnel*, William B., McGraw Hill

Course Code: ENG-1205

Course Name: Technical and Business Writing

Credit Hours: 03

Course Structure: Lectures 3

Prerequisite: None

Course Outline:

Overview of technical reporting, use of library and information gathering, administering questionnaires, reviewing the gathered information; Technical exposition; topical arrangement, exemplification, definition, classification and division, casual analysis, effective exposition, technical narration, description and argumentation, persuasive strategy, Organizing information and generation solution: brainstorming, organizing material, construction of the formal outline, outlining conventions, electronic communication, generation solutions. Polishing style: paragraphs, listening sentence structure, clarity, length and order, pomposity, empty words, pompous vocabulary, document design: document structure, preamble, summaries, abstracts, table of contents, footnotes, glossaries, cross-referencing, plagiarism, citation and bibliography, glossaries, index, appendices, typesetting systems, creating the professional report; elements, mechanical elements and graphical elements. Reports: Proposals, progress reports, Leaflets, brochures, handbooks, magazines articles, research papers, feasibility reports, project reports, Technical research reports, manuals and documentation, thesis. Electronic documents, Linear versus hierarchical structure documents.

Reference Material:

1. *Technical and Business Writing for Working Professionals*, Ray E. Hardesty, Xlibris Corporation, 15-Dec-2010, ISBN = 1456819402
2. *Successful Technical Writing/Instructor's Guide*, Bill Wesley Brown, Goodheart-Willcox Publisher, 01-Mar-193-Technology and Engineering.

Course Code: HUM-1206

Course Name: Islamic Studies

Credit Hours: 02

Course Structure: Lectures 2

Prerequisite: None

Course Outline:

Fundamentals of Islam. (Aqaid, Ibadat, Islamic Dawah etc.); Ethical values of Islam; Serah of the Holy Prophet (PBUH); Islamic Civilization and its effects on humanity. Study of other prominent world religions and ethical systems in comparison with Islamic viewpoint. Multicultural societies.

Text Book:

1. *Islamyat Allama Iqbal Open University, Pakistan*

Semester 3

Course Code: BIT-2301

Course Name: Data Structure and Algorithms

Credit Hours: 04

Course Structure: Lectures 3, Lab1

Prerequisite: None

Course Outline:

Introduction to Data Structures and Algorithms. Complexity Analysis. Arrays. Sorting Algorithms: Insertion Sort, Selection Sort, Bubble Sort, Shell Sort, Heap Sort, Quick Sort, Merge Sort, Radix Sort, and Bucket Sort. Linked Lists: Singly Linked Lists, Doubly Linked Lists, Circular List. Stacks, Queues, and Priority Queue. Recursion: Function call and Recursion Implementation, Tail Recursion, Non -tail Recursion, Indirect Recursion, Nested Recursion, Backtracking. Trees: Binary Trees, Binary Heap, Binary Search. Tree Traversal, Insertion, Deletion, and Balancing a Tree. Heap. B-Tree, B+ Tree, Spanning Tree, Splay Trees. Graphs: Representation, Traversal, Shortest Path, and Cycle Detection; Isomorphic Graphs. Graph Traversal Algorithms. Hashing. Memory Management and Garbage Collection

Reference Materials:

1. *Data Structures & Problem Solving Using Java* by Mark Allen Weiss, Addison-Wesley, 4th Edition (October 7, 2009). ISBN-10: 0321541405 (or Latest Edition).
2. *Algorithms*, Robert Sedgewick, Princeton University Publisher: Addison-Wesley Professional (latest Edition)
3. *Data Structures: Abstraction and Design Using Java* by Koffman and Wolfgang, Wiley; 2nd Edition (January 26, 2010). ISBN-10: 0470128704 128
4. *Data Structures and Algorithms in C++* by Adam Drozdek, Course Technology; 4th Edition (August 27, 2012). ISBN-10: 1133608426
5. *Data Structures Using C++* by D. S. Malik, Course Technology; 2nd Edition (July 31, 2009). ISBN-10: 0324782012
6. *Data Structures and Other Objects Using C++* by Michael Main and Walter Savitch, Prentice Hall; 4th Edition (March 6, 2010). ISBN-10:0132129485

Course Code: BIT-2302

Course Name: Computer Communication and Networks

Credit Hours: 03

Course Structure: Lectures 3

Prerequisite: None

Course Outline:

Data Communication concepts, Analogue and digital Transmission, Noise, Media, Encoding, Asynchronous and Synchronous transmission. Network system architectures (OSI, TCP/IP), Error Control, Flow Control, Data Link Protocols, Bridging. Local Area Networks and MAC Layer protocols, Multiplexing, Switched and IP Networks, Inter-networking, Routing. Transport layer protocols TCP, UDP and SCTP. Application Layer Protocols. Wireless LANs. Lab exercises using tools such as Wireshark, OpNet, Packet tracer etc.

Text Book:

1. *Data Communications and Networking*, by Behrouz A. Forouzan, McGraw-Hill Science; 5th edition (February 17, 2012). ISBN-10: 0073376221
2. *Data and Computer Communications* by William Stallings, Prentice Hall; 9th Edition (August 13, 2010). ISBN-10: 0131392050
3. *Computer Networks* by Andrew S. Tanenbaum and David J. Wetherall, Prentice Hall; 5th Edition (October 7, 2010). ISBN-10: 0132126958
4. *Computer Networks and Internets* by Douglas E. Comer, Prentice Hall; 5th Edition (April 28, 2008). ISBN-10: 0136066984

Course Code: BIT-2303

Credit Hours: 03

Prerequisite: None

Course Name: Operating System Concepts

Course Structure: Lectures 3

Course Outline:

History and evolution of operating systems. Types of operating systems. Case histories of significant operating systems. Processes, inter-process communication, process co-ordination and synchronization. Process scheduling. Memory management. File systems. Security and protection. Case operating systems.

Text Book:

1. *Operating Systems* by William Stallings(4th Edition)
2. *Concepts of Operating Systems* by Silberschatz

Reference Material:

1. *Modern Operating Systems* by Andrew S. Tanenbaum

Course Code: MGS-2304

Credit Hours: 03

Prerequisite: None

Course Name: Statistics and Probability

Course Structure: Lectures 3

Course Outline:

Introduction to Statistics, Descriptive Statistics, Statistics in decision making, Graphical representation of Data Stem-and Lead plot, Box-Cox plots, Histograms and Ogive, measures of central tendencies, dispersion for grouped and ungrouped Data, Moments of frequency distribution; examples with real life, use of Elementary statistical packages for explanatory Data analysis. Counting techniques, definition of probability with classical and relative frequency and subjective approaches, sample space, events, laws of probability. Conditional probability and Bayes theorem with application to Random variable (Discrete and continuous) Binomial, Poisson, Geometric, Negative Binomial Distributions; Exponential Gamma and Normal distributions.

Text Book:

1. *Basic statistics for Business and Economics*, Earl K. Bowen & Martin Starr.

Reference Material:

1. *Introduction to Statistics*, Walpole, 1982 Prentice Hall, ISBN: 0024241504. Prof. Sher Muhammad Chaudhry: Introduction to Statistical Theory, part-1

Course Code: ENG-2305
Credit Hours: 03
Prerequisite: None

Course Name: Communication Skills
Course Structure: Lectures 3

Course Outline:

Principles of writing good English, understanding the composition process: writing clearly; words, sentence and paragraphs; Comprehension and expression; Use of grammar and punctuation. Process of writing, observing, audience collecting, composing, drafting and revising, persuasive writing, reading skills, listening skills and comprehension, skills for taking notes in class, skills for exams; Business communications; planning messages, writing concise but with impact. Letter formats, mechanics of business, letter writing, letters, memo and applications, summaries, proposals, writing resumes, styles and formats, oral communications, verbal and non-verbal Communication, conducting meetings, small group communication, taking minutes. Pre presentation skills; presentation strategies, defining the objective, scope and audience of the presentation, material gathering material organization strategies, time management, opening and concluding, use of audio-visual aids, delivery and presentation.

Reference Material:

1. *Practical Business English*, Collen Vawdrey, 1993, ISBN = 0256192740
2. *Effective Communication Skills: The Foundations for Change*, John Nielsen, 2008, ISBN = 1453506748

Course Code: HUM-2306
Credit Hours: 03
Prerequisite: None

Course Name: Arabic
Course Structure: Lectures 3

Course Outline:

Course Outline will be provided by concerned teacher.

Semester 4

Course Code: BIT-2401

Credit Hours: 04

Prerequisite: None

Course Name: Database Systems

Course Structure: Lectures 3, Lab1

Course Outline:

Basic Database Concepts, Database Architecture, DB Design Life Cycle, Schema Architecture, Conceptual, Logical and Physical Database Modelling and Design, , Entity Relationship Diagram (ERD), Enhanced ERD, Relational Data Model, Mapping ERD to Relational Model, Functional Dependencies and Normalization, Relational Algebra, Structured Query Language (SQL), Transaction Processing, Concurrency Control And Recovery Techniques, Query Optimization Concepts.

Reference Materials:

1. *Database Systems A Practical Approach to Design, Implementation, and Management*, Thomas Connolly and Carolyn Begg, Prentice Hall; 7th edition (March 10, 2011)
2. *Modern Database Management* by Fred McFadden, Jeffrey Hooper, Mary Prescott, Prentice Hall; 11th Edition (July 26, 2012). ISBN-10: 0132662256
3. *Fundamentals of Database Systems* by R. Elmasri and S. Navathe. 6th Edition, Addison-Wesley (2010). ISBN-10: 0136086209.
4. *Database Design and Relational Theory: Normal Forms and All That Jazz* by C. J. Date, O'Reilly Media; 1st Edition (April 24, 2012). ISBN-10: 1449328016.
5. *Modern Database Management* by Fred McFadden, Jeffrey Hooper, Mary Prescott, Prentice Hall; 11th Edition (July 26, 2012). ISBN-10: 0132662256

Course Code: BIT-2402

Credit Hours: 03

Prerequisite: None

Course Name: Software Engineering I

Course Structure: Lectures 3, Lab1

Course Outline:

Software development life-cycles and models, System specification, Project control and development of team structures, Software Analysis and Design, Structured Analysis, Functional and object-oriented design, Programming, testing and debugging, validation, maintenance and modifications, Software development tools. Software quality. Process models. Report writing, Introduction to Case Tools.

Text Book:

1. *Introduction to Software Engineering* by Pressmann
2. *Software Engineering* by Sommerville

Reference Material:

1. *Applying UML and Patterns* by Craig Larman

Course Code: BIT-2403
Credit Hours: 03
Prerequisite: None

Course Name: Internet Architecture & Protocols
Course Structure: Lectures 3,

Course Outline:

Terms and Concepts. Functioning of the Internet. Review of the TCP/IP Model. Network Layer Addresses (IP Addresses). DHCP. DNS Servers & Configuration. Error Recovery Operations. Internet Local Area Networks (LANs). IEEE Standards. (CSMA/CD), (CSMA/CA) LANs. CSMA/CD Protocol Stacks. Review of Ethernet. CSMA/CD Frames. Subnetwork Access Protocol (SNAP). CSMA/CD. Ethernet Layers. CSMA/CD Standards. The Token Ring Network. The Ring Configuration. FDDI. FDDI Configuration. The FDDI Layers. FDDI Backbones. Switched LANs. Fast Ethernet. Fast Ethernet and the Layered Model. Auto-Negotiation. Gigabit Ethernet. Internet Wide Area Networks (WANs). Message Switching and Packet Switching. Frame Relay. Cell Relay. Comparing WAN Technologies. X.25, Frame Relay, and ATM Virtual Circuits. Mapping IP Addresses to "Labels": Label or Tag Switching. IP and ICMP. Time-to-Live. Destination Unreachable. Redirect. Router Discovery. Pings. IPv6. TCP and UDP. Round Trip Time (RTT). Nagle's Algorithm. The Slow Start. Congestion Window and Threshold Size. The User Datagram Protocol (UDP). The Point-to-Point Protocol (PPP) and The Layer 2 Tunneling Protocol (L2TP). Routing Protocols. Autonomous Systems. Multiple Routing Protocols. Operation of Internet Operates with the Routing Protocols. Levels of Access. Peering through the Routing Protocols.

Text Book:

1. *Internet Architecture: An Introduction to IP Protocols* by Uyles D. Black, Prentice Hall PTR; 1st Edition (2000). ISBN-10: 0130199060
2. *Internet Routing Architectures* by Sam Halabi, Cisco Press; 2nd Edition (2000). ISBN-10: 157870233X
3. *TCP/IP Protocol Suite* by Behrouz A. Forouzan, McGraw-Hill Science/Engineering/Math; 4th Edition (2009). ISBN-10: 0073376043
4. *Next-Generation Internet: Architectures and Protocols* by Andrei Gurtov, Cambridge University Press (2011). ISBN-10: 0521113687

Course Code: BIT-2403
Credit Hours: 03
Prerequisite: None

Course Name: Information System
Course Structure: Lectures 3,

Course Outline:

Information Systems Concepts, Types, Advantages, and Global Challenges. System Development Life Cycle. System Investigation, Systems Analysis, Systems Design, Environmental Design Considerations, System Implementations, Ethical and Social Issues, Systems Operations and Maintenance. Themes in information systems development. System Development Techniques. Information Systems Development Tools and toolsets. Information Systems Development Methodologies.

Reference Materials:

1. *Fundamentals of Information Systems* by Ralph Stair and George Reynolds, Course Technology; 6th Edition (January 1, 2011). ISBN-10: 0840062184
2. *Information Systems Development: Methodologies, Techniques & Tools* by David Avison and Guy Fitzgerald, McGraw-Hill; 4th Edition (May 1, 2006). ISBN-10: 0077114175
3. *Introduction to Information Systems: Supporting and Transforming Business* by R. Kelly Rainer and Casey G. Cegielski, Wiley; 3rd Edition (June 16, 2010). ISBN-10: 0470473525
4. *Information Systems* by Richard T. Watson, Create Space Independent Publishing Platform (March 20, 2012). ISBN-10: 1475074921

Course Code: MGS-2405

Credit Hours: 03

Prerequisite: None

Course Name: Organizational Behaviour

Course Structure: Lectures 3,

Course Outline:

Introduction to OB. People-Centered Organizations and Ethical Conduct. Organizational Culture. Socialization. Mentoring. Key Individual Differences. Values. Attitudes. Job Satisfaction and Counterproductive Work Behaviors. Social Perceptions and Attributions. Foundations of Motivation. Improving Job Performance with Goals, Feedback, Rewards, and Positive Reinforcement. Group Dynamics. Developing and Leading Effective Teams. Individual and Group Decision Making. Managing Conflict and Negotiating. Communicating in the Digital Age. Leadership, Influence, Empowerment, and Politics. Organizational Design, Effectiveness, and Innovation.

Reference Materials:

1. *Organizational Behavior* by Robert Kreitner and Angelo Kinicki, McGraw- Hill/Irwin; 10th Edition (January 17, 2012). ISBN-10: 0078029368
2. *Organizational Behavior* by Stephen P. Robbins and Timothy A. Judge, Prentice Hall; 15th Edition (January 16, 2012). ISBN-10: 0132834871
3. *Meeting the Ethical Challenges of Leadership: Casting Light or Shadow* by Craig E. Johnson, SAGE Publications, Inc; 4th Edition (February 28, 2011). ISBN-10: 1412982227

Course Code: MAT-2406

Credit Hours: 03

Prerequisite: None

Course Name: Linear Algebra

Course Structure: Lectures 3,

Course Outline:

Vectors, Vector Spaces, Matrices & Determinants, Cofactor and Inverse, Rank, Linear independence, Solution of system of Linear systems, Positive Definite matrix, Linear Transformations, Operations on matrices, Inner products, orthogonality and least squares, Eigenvalue & Eigenvectors. Applications to Systems of Equations and to Geometry, Singular Value Decomposition.

Reference Materials:

1. *Elementary Linear Algebra with Applications* 9th edition Bernard, K. David, H. 2007. Prentice Hall PTR.
2. *Strang's Linear Algebra and Its Applications, 4th edition.* Gilbert, S. Strang, B. Coonley. Andy, B. Andrew, B. 2005. Brooks/Cole.
3. *Elementary Linear Algebra: Applications* Howard. A. Chris. 2005. Version, 9th edition.

Semester 5

Course Code: BIT-3501

Credit Hours: 03

Prerequisite: None

Course Name: Web Design & Development

Course Structure: Lectures 2, Lab1

Course Outline:

HTML, DHTML, CSS, clients side scripting, server side scripting, dynamic website development. Introduction to current technology e.g. MySQL, php, ASP, ASP.net. Introduction to related methods and tools.

Reference Materials:

1. *Web enabled Commercial application development using HTML, DHTML, JAVASCRIPT* by Ivon Bayross. BPS Publications.
2. *Beginning ASP* by Richard Anderson, Brain Francis. Wrox series Publications.

Course Code: BIT-3502

Credit Hours: 03

Prerequisite: None

Course Name: DB Administration & management

Course Structure: Lectures 3

Course Outline:

Installation of DBMS; SQL* Plus; DBA Tools. DBMS Physical Structure & Architectural Components: Server, Instance, SGA, Shared Pool, Library Cache, Data Dictionary Cache, Large Pool, Processes. Start-up and Shutdown Database. Managing Instances. Managing Files. Creating Database and Data dictionary. Managing Tablespaces. Operations with Tablespaces. Data File Management, Segments, Block. Managing Undo Data, Undo Data Statistics: Managing Tables and Users. Indexes Management, Maintaining Data Integrity, Constraints. Managing Privileges. Server Side Configuration. Client Side Configuration. Usage and Configuration of Oracle Shared Server. Backup and Recovery. Sizing Shared 154 Pool, Sizing Buffer Cache, I/O Issues. Tuning Rollback Segments. Tuning Shared Servers, Types of Locks, Block Efficiency, Storage hierarchy, and Avoiding Dynamic allocation, Statistics, PCTFREE and PCTUSED, Monitoring Index Usage.

Reference Materials:

1. *Database Administration: The Complete Guide to DBA Practices and Procedures* by Craig S. Mullins, Addison-Wesley Professional; 2nd Edition (October 21, 2012). ISBN-10: 0321822943
2. *Database Systems: A Practical Approach to Design, Implementation and Management* by Thomas M. Connolly and Carolyn E. Begg, Addison-Wesley; 5th Edition (2009). ISBN-10: 0321523067

Course Code: BIT-3503

Credit Hours: 03

Prerequisite: None

Course Name: Multimedia Technologies

Course Structure: Lectures 3

Course Outline:

What is Multimedia? Text, Multimedia Authoring and Tools, Multimedia Authoring, Multimedia Production, Multimedia Presentation, Automatic Authoring; Editing and Authoring Tools- (Adobe Premiere, Macromedia Director, Macromedia Flash, Dreamweaver), VRML, Handling Images, 158 Sound, Making Animation and Video, Making Multimedia, Multimedia Skills, Planning and Costing, Designing and Producing, Content and Talent, The Internet and Multimedia, Designing for the World Wide Web, Delivering Multimedia Product. Instructors need to devise a content delivery and Lab work plan using a multimedia Authoring tool in line with the contents of the Textbook.

Reference Materials:

1. *Multimedia Making It Work 8th Edition* by Tay Vaughan, McGraw-Hill Osborne Media; 8th Edition (October 29, 2010). ISBN-10: 0071748466
2. *Fundamentals of Multimedia* by Z. M. Li and M. S. Drew, Prentice Hall (2004), ISBN: 0-13-127256-X
3. *Digital Multimedia* by N. Chapman and J. Chapman. 2nd Edition, Wiley 2004, ISBN: 0-470-85890-7
4. *The Technology of Video and Audio Streaming* by David Austerberry, Focal Press; 2nd Edition (2004). ISBN-10: 0240805801
5. *Multimedia Security: WaTermarking, Steganography, and Forensics* by Frank Y. Shih, CRC Press; 1st Edition (2012), ISBN-10: 1439873313

Course Code: BIT-3504

Credit Hours: 03

Prerequisite: None

Course Name: Telecommunication Systems

Course Structure: Lectures 3

Course Outline:

Communication Channel and the Communication Network Technologies. Digital Telephony. Switching and Signalling Systems. Switching Fabric Interfaces and ICs, Optics and the Future. Cellular Systems. Fixed Wireless Access Technologies. Digital Subscriber Loop. Transmission Techniques. Telecommunication Systems Testing. Embedded Systems Design for Telecommunications: AMR Speech Codecs and the GSM Environment, Digital Signal Processor Architecture, AD6526 Multiprocessor Architecture, AMR Speech Codec, Algorithmic Complexity of the AMR Speech Codec, Implementation considerations of AMR Speech Codec and porting the Code. Emerging Technologies in Telecommunication Systems.

Reference Materials:

1. *Essentials of Modern Telecommunications Systems* by Nihal Kularatna and Dileeka Dias, Artech House (May 2004). ISBN-10: 1580534910
2. *The Irwin Handbook of Telecommunications* by James Harry Green, McGraw-Hill; 5th Edition (October 26, 2005). ISBN-10: 0071452222
3. *Telecommunications Essentials: The Complete Global Source for Communications Fundamentals, Data Networking and the Internet, and Next-Generation Networks* by Lillian Goleniewski, Addison-Wesley Professional; 1st Edition (January 5, 2002). ISBN-10: 0201760320.

Course Code: BIT-3505
Credit Hours: 03
Prerequisite: BIT-2402

Course Name: Software Engineering-II
Course Structure: Lectures 3

Course Outline:

Software verification and validation: Techniques are introduced to evaluate software correctness, efficiency, performance and reliability, integration of these techniques into a verification and validation plan. Technical reviews, software testing, program verification, prototyping, and requirement tracing. Attitude of industry toward reliability and performance.

Text Book:

1. *Software Engineering: A Practitioner's Approach*, Roger Pressman, McGraw-Hill, 2001.

Reference Material:

1. *Applying UML and Patterns* by Craig Larman
2. *Introduction to Software Engineering* by Pressmann
3. *Software Engineering* by Sommerville

Course Code: BIT-3506
Credit Hours: 03
Prerequisite: None

Course Name: Technology Management
Course Structure: Lectures 3

Course Outline:

Introduction to Technology Management, TM activities and tools, The TM framework, TM activities behind technological capabilities. TM Activities: Identification, Selection, Acquisition, Exploitation, Protection, Learning. TM Tools. TM Tools-Patent Analysis. TM Tools-Portfolio Management. TM Tools- Road mapping. TM Tools-Value Analysis/Value Innovation. TM-Functions: Planning and Forecasting, Decision Making, Organizing, Leading Technical People

Reference Materials:

1. *Technology Management: Activities and Tools* by Dilek Cetindamar, Rob Phaal, and David Probert, Palgrave Macmillan (April 27, 2010). ISBN-10: 0230233341 (TB1)
2. *Managing Engineering and Technology* by Lucy C. Morse And Daniel L. Babcock, Prentice Hall; 5th Edition (August 20, 2009). ISBN-10: 0136098096 (TB2)
3. *Management of Technology: Managing Effectively in Technology- Intensive Organizations* by Hans J. Thamhain, Wiley; 2nd Edition (May 25, 2005). ISBN-10: 0471415510
4. *Managing Information Technology* by Carol V. Brown, Daniel W. DeHayes, Jeffrey A. Hoffer, Wainright E. Martin, and William C. Perkins, Prentice Hall; 7th Edition (March 18, 2011). ISBN-10: 0132146320
5. *Technology Management: Activities and Tools* by Dilek Cetindamar, Rob Phaal, and David Probert, Palgrave Macmillan (April 27, 2010). ISBN-10: 0230233341

Semester 6

Course Code: BIT-3601

Course Name: Human Computer Interaction

Credit Hours: 03

Course Structure: Lectures 3

Prerequisite: None

Course Outlines:

The Human, Computer and Interaction, Usability paradigm and principles, Introduction to design basics, HCI in software process, Design rules, prototyping, evaluation techniques, task analysis, Universal design and User support and Computer Supported Cooperative Work; Introduction to Specialized topics such as Groupware, pervasive and ubiquitous applications.

Reference Materials:

1. "Human-Computer Interaction", Alan Dix, *Computing Department, Lancaster University* Janet E. Finlay, *Leeds Metropolitan University*, Gregory D. Abowd, *Georgia Institute of Technology*, Russell Beale, *University of Birmingham* ISBN-10: 0130461091 ISBN-13: 9780130461094 Publisher: Prentice Hall 3rd Ed or Latest Edition
2. "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Ben Shneiderman, *University of Maryland* Catherine Plaisant, *University of Maryland* ISBN-10: 0321197860 ISBN-13: 9780321197863 Publisher: Addison-Wesley 4th Ed or Latest Edition.

Course Code: BIT-3602

Course Name: Object Oriented Analysis & Design

Credit Hours: 03

Course Structure: Lectures 3

Prerequisite: None

Course Outline:

Principles of Object Technology. OOP Review. Principles of Modelling, OOA&D Overview. OO Development Process. Requirements Engineering, Analysis, and Specification: Requirements Engineering, Use Cases, Prototyping, Class Models. Interaction Diagrams. Verification and Validation, Architectural and Detailed Design. Class Diagrams. Interaction Diagrams, State Machines and Diagrams. Implementation, Package Diagrams. Activity Diagrams. OO Patterns, Verification and Validation. Note: Students may also be introduced to Object Diagram, Component Diagram, Package Diagram, Deployment Diagram, and Network Diagram.

Text Book:

1. *Applying UML and patterns: An introduction to Object-Oriented Analysis and Design and Iterative Development* by Craig Larman, Prentice Hall; 3rd Edition (October 30, 2004). ISBN-10: 0131489062
2. *Using UML: Software Engineering with Objects and Components* by Perdita Stevens, Addison-Wesley; Edition (February 13, 2006). ISBN- 10: 03212696753. *Fundamental of Object-Oriented Design in UML* by Meiler Page-Jones, Addison Wesley, 2000. ISBN: 020169946X.
3. *The Unified Modeling Language User Guide* by G. Booch, J. Rumbaugh and I. Jakobson, Addison-Wesley Professional; 2nd Edition (2005). ISBN-10: 0321267974.
4. *The Unified Modeling Language Reference Manual* by James Rumbaugh, Ivar Jacobson and Grady Booch Addison-Wesley Professional; 2nd Edition (2004). ISBN-10: 032171895X.

Course Code: BIT-3603
Credit Hours: 03
Prerequisite: BIT-2401

Course Name: Distributed Database Systems
Course Structure: Lectures 3

Course Outline:

Distributed Data Processing, Distributed Database Systems, Design Issues, Distributed DBMS Architecture. Distributed Database Design. Database Integration. Data and Access Control. Query Processing. Query Decomposition and Data Localization. Optimization of Distributed Queries. Multidatabase Query Processing. Transaction Management. Distributed Concurrency Control. Distributed DBMS Reliability. Data Replication.

Reference Materials:

1. *Principles of Distributed Database Systems* by M. Tamer Özsu and Patrick Valduriez, Springer, 3rd Edition, (March 2, 2011). ISBN-10: 1441988335 166
2. *Distributed Database Management Systems: A Practical Approach* by Saeed K. Rahimi, and Frank S. Haug, Wiley-IEEE Computer Society Pr; 1st Edition (May 23, 2011). ASIN: B005CDYQSC
3. *Distributed Systems: Principles and Paradigms* by Andrew S. Tanenbaum and Maarten van Steen, Prentice Hall; US Edition (January 15, 2002). ISBN-10: 0130888931
4. *Distributed Systems: Concepts and Design* by Jean Dollimore, Tim Kindberg and George Coulouris, Addison Wesley; 4th Edition (May 20, 2005). ISBN-10: 0321263545
5. *Distributed Database Systems* by Chhanda Ray, Pearson (October 3, 2012). ASIN: B009NEMZ0W

Course Code: BIT-3604
Credit Hours: 03
Prerequisite: None

Course Name: E-Commerce
Course Structure: Lectures 3

Course Outline:

An overview of e-Commerce & Models the technological infrastructure and critical issues like security, reliability, and scalability. Secure transactions, product catalogues, data warehousing, data mining and auctioning. Business Models, leverage of business. Revenue Models, online advertising (CPC) (CPM) online advertising revenue generation and models.

Reference Materials:

1. *Danial Armor: E-Business Revolution*
2. *Karra Kota: E-Business*
3. *Dave Chaffey: E-Business and E-Commerce Management Strategy, Implementation and Practice (fourth or 5th Edition)* ISBN: 978-0-273-71960-1

Course Code: BIT-3605

Credit Hours: 03

Prerequisite: None

Course Name: Systems and Networks Administration

Course Structure: Lectures 3

Course Outline:

Introduction To System Administration. SA Components. Server Environment (Microsoft and Linux). Reliable Products, Server Hardware Costing, Maintenance Contracts and Spare Parts, Maintaining Data Integrity, Client Server OS Configuration, Providing Remote Console Access. Comparative Analysis of OS: Important Attributes, Key Features, Pros and Cons. Linux Installation and Verification, Configuring Local Services and Managing Basic System Issues. Administer Users and Groups. Software Management. Managing Network Services and Network Monitoring Tools. Boot Management and Process Management. IP Tables and Filtering. Securing Network Traffic. Advanced File Systems and Logs. Bash Shell Scripting. Configuring Servers (FTP, NFS, Samba, DHCP, DNS and Apache).

Reference Material :

1. *The Practice of System and Network Administration*, Second Edition by Thomas Limoncelli, Christina Hogan and Strata Chalup, Addison-Wesley Professional; 2nd Edition (2007). ISBN-10: 0321492668
2. *Red Hat Enterprise Linux 6 Bible: Administering Enterprise Linux Systems* by William vonHagen, 2011
3. *Studyguide for Practice of System and Network Administration* by Thomas A. Limoncelli, Cram 101; 2nd Edition (2011). ISBN-10: 1428851755
4. *Networking Systems Design and Development* by Lee Chao, CRC Press; 1st Edition (December 21, 2009). ISBN-10: 142009159X (TB2)
5. *Windows Administration* Latest Edition, Microsoft Press
6. *Linux Administration* Guide Latest Edition

Course Code: BIT-3606

Credit Hours: 03

Prerequisite: None

Course Name: Distributed Computing

Course Structure: Lectures 3

Course Outline:

Introduction to Parallel and Distributed Systems, Software Architectures: Threads and Shared memory, Processes and Message passing, Distributed Shared Memory (DSM), Distributed Shared Data (DSD). System Models, Networking and Internetworking, Communication Models and Abstractions (Message passing, stream-oriented communications, remote procedure calls, remote method invocation), Naming in Distributed Systems, Concurrency and Synchronization, Process Synchronization, Distributed Transaction and Concurrency Control, Distributed Data Replication, Security and Access Control, Overview of Web Services, Cloud Computing.

Reference Materials:

1. *Distributed Systems: Principles and Paradigms*, Andrew S. Tanenbaum and Maarten van Steen. Prentice-Hall, 2002.
2. *Distributed Systems: Concepts and Design* by 4th edition, George Coulouris, Jean Dollimore and Tim Kindberg. Addison-Wesley, 2005 37
3. *Web Services: Principles and Technology*. Michael P. Papazoglou. Pearson Prentice Hall, 2007.

Semester 7

Course Code: BIT-4701

Credit Hours: 03

Prerequisite: None

Course Name: Mobile Computing

Course Structure: Lectures 3

Course Outline:

Types of Mobile Applications How are Users of Mobile Devices (Smartphones) Different from Users of Other Devices? Technologies Involved in Application Development. Differences from Desktop and Server Side Software Development, Software Design Concerns, Stakeholders in mobile applications: manufacturers, network operators, consumers, application developers, content providers, Android Platform Architecture and Application Fundamentals, Android application development tools. User Interface components, Data Storage and Content Providers, Services, Broadcast Receivers, Application Resources and other android structures, Using Android platform APIs, Web applications, Application Testing Framework, Introduction to games for mobile platforms, Introduction to 100 mobile gaming engines. Overview of game development using a game engine, Apple iOS, Java ME, Windows Phone, Comparison and limitations of Popular Cross platform development tools.

Reference Materials:

1. *Pro Android 4*, Satya Komatineni and Dave MacLean, Professional Apress, (Latest Edition)
2. *The Busy Coder's Guide to Android Development*, Mark Murphy, CommonsWare, LLC. (Latest Edition)
3. *Professional Android 4 Application Development*, Reto Meier, Wrox. (Latest Edition)
4. *Beginning Android Games*, Mario Zechner et al, Apress, (Latest Edition)
5. *Designing the Mobile User Experience*, Barbara Ballard, Wiley. (Latest Edition).

Course Code: BIT-4702

Credit Hours: 03

Prerequisite: None

Course Name: Network Security

Course Structure: Lectures 3

Course Outline:

Security Concepts, Such as Confidentiality, Integrity, Authenticity, Availability etc. Symmetric and Asymmetric Cryptography and Their Uses; Key Distribution and Digital Signatures; Discretionary and Mandatory Access Control Policies for Confidentiality and Integrity. Communication Protocols for Authentication, Confidentiality and Message Integrity. Network Security; System Security, Intrusion Detection and Malicious Code. Security Models and Security Evaluation. Administration of Security. Legal Aspects of Computer Security.

Reference Materials:

1. *Security in Computing* by Charles P. Pfleeger and Shari Lawrence Pfleeger, Prentice Hall; 4th Edition (2006). ISBN-10: 0132390779
2. *Network Security Fundamentals* by Gert DeLaet and Gert Schauwers, Cisco Press; 1st Edition (September 18, 2004). ISBN-10: 1587051672
3. *Network Security Bible* by Eric Cole, Wiley; 2nd Edition (September 8, 2009). ISBN-10: 0470502495
4. *Network Security Essentials: Applications and Standards* by William Stallings, Prentice Hall; 4th Edition (March 22, 2010). ISBN-10: 0136108059

Course Code: BIT-4703

Credit Hours: 03

Prerequisite: None

Course Name: Data Mining

Course Structure: Lectures 3

Course Outline:

Data-Mining Concepts, Preparing the Data, Data Reduction, Learning From Data, Statistical Methods, Decision Trees and Decision Rules, Artificial Neural Networks, Ensemble Learning, Cluster Analysis, Association Rules, Web Mining and Text Mining, Genetic Algorithms, Fuzzy Sets and Fuzzy Logic, Visualization Methods, Data Mining Tools: Weka, CBA and Yale, etc.

Reference Materials:

1. *Data Mining: Concepts, Models, Methods, and Algorithms* by Mehmed Kantardzic, Wiley-IEEE Press; 2nd Edition (August 16, 2011). ISBN-10:0470890452
2. *Data Mining: Concepts and Techniques, Third Edition (The Morgan Kaufmann Series in Data Management Systems)* by Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufmann; 3rd Edition (2011). ISBN-10: 0123814790
3. *Principles of Data Mining (Adaptive Computation and Machine Learning)* by David J. Hand, Heikki Mannila and Padhraic Smyth, A Bradford Book (August 1, 2001). ISBN-10: 026208290X

Course Code: BIT-4704

Credit Hours: 03

Prerequisite: None

Course Name: Artificial Intelligence

Course Structure: Lectures 3

Course Outline:

Introduction to AI, Turing Test, Strong AI vs Weak AI, Heuristics, Applications and Methods, History of AI. Uninformed Search: Search in IS, Generate-and- Test Paradigm, Blind Search Algorithm. Informed Search: Heuristics, The Best-First Search, The Beam Search, The A* Search, The Bidirectional Search. Search Using Game: Game Trees and Minimum, Game Theory.

Logic in AI: Logic and Representation, Propositional Logic, Predicate Logic, Other Logics. Knowledge Representation: Search Tree, Production System, Objects, Frames, Scripts & the Conceptual Dependency System, Semantic Networks, Recent Approaches, Agents. Prolog Programming. Production Systems: Strong Methods vs. Weak Methods, Production System and Inference Methods, Stochastic Processes and Markov Chain. [Uncertainty in AI: Fuzzy Sets, Fuzzy Logic, Fuzzy Inference, Probability Theory and Uncertainty. [Expert Systems: Characteristics of ES, Knowledge Engineering, Knowledge Acquisition, Classical ES, Case-Based Reasoning. Neural Networks: Introduction, The Perceptron Learning Rule, Back propagation, Discrete Hopfield Networks, Application Areas. Evolutionary Computation: Simulated Annealing, Genetic Algorithms, Genetic, Genetic Programming. Natural Language Processing: History of NLP, Syntax and Formal Grammars, Syntax and Formal Grammar, Statistical Parsing, Hidden Markov Model, Wordnet, Question Answering System. Automated Planning: Planning Terminology, Planning as Search, Hierarchical Planning, Case-Based Planning, Planning Approaches to Learning System. Advanced Computer Games: Rote Learning and Generalization, Signature Table and Book Learning, Programing Methods, Search in Machines.

Reference Materials:

1. *Artificial Intelligence in the 21st Century* by Stephen Lucci by Danny Kopec, Mercury Learning and Information (May 18, 2012). ISBN-10:1936420236
2. *Artificial Intelligence: A Modern Approach*, 2nd Edition, by Russell and Norvig, Prentice Hall
3. *Artificial Intelligence: A Systems Approach* by M. Tim Jones, Jones and Bartlett Publishers, Inc; 1st Edition (December 26, 2008). ISBN-10:0763773379.

Course Code: BIT-4705
Credit Hours: 03
Prerequisite: None

Course Name: IT Project Management
Course Structure: Lectures 3

Course Outline:

Introduction to Project Management. The Project Management and Information Technology Context. The Project Management Process Groups. Project Integration Management. Project Scope Management. Project Time Management. Project Cost Management. Project Quality Management. Project Human Resource Management. Project Communications Management. Project Risk Management. Project Procurement Management. Project Management Tools.

Text Book:

1. *Information Technology Project Management* by Kathy Schwalbe, Course Technology; 6th Edition (July 22, 2010). ISBN-10: 1111221758
2. *A Guide to the Project Management Body of Knowledge*, 3rd Edition (PMBOK Guides), ISBN-13: 978-1930699458
3. *IT Project Management: On Track from Start to Finish* by Joseph Phillips, McGraw-Hill Osborne Media; 3rd Edition (February 25, 2010). ISBN-10: 0071700439
4. *Information Technology Project Management* by Jack T. Marche, Wiley; 3rd Edition (January 6, 2009). ISBN-10: 0470371935
5. *Effective Project Management: Traditional, Agile, Extreme* by Robert K. Wysocki, Wiley; 6th Edition (2011). ISBN-10: 111801619X

Semester 8

Course Code: BIT-4801

Course Name: System Integration & Architecture

Credit Hours: 03

Course Structure: Lectures 3

Prerequisite: None

Course Outline:

Enterprise Architecture (EA) and Enterprise Engineering (EE). Balanced Scorecard and Strategy Maps (BSSM). Using Strategy Analysis (SA). Governance Analysis Using EA. Enterprise Architecture Methods. Using Business-Driven Data Mapping for Integrated Data. Strategic Modeling for Rapid Delivery of EA. Strategic Alignment, Activity and Workflow Modeling, and Business Rules. Using Business Normalization for Future Business Needs. Menu Design, Screen Design, Performance Analysis, and Process Modeling. Enterprise Application Integration Concepts. Enterprise Portal Technologies for Integration. Web Services for Real-Time Integration. Service-Oriented Architecture for Integration. Managing and Delivering EA. Future Directions in EA and Integration

Reference Materials:

1. *Enterprise Architecture for Integration: Rapid Delivery Methods and Technologies* by Clive Finkelstein, Artech House Print on Demand; 1st Edition (March 31, 2006). ISBN-10: 1580537138
2. *Systems Integration (Systems Engineering)* by Jeffrey Grady, CRC-Press; 1st Edition (September 30, 1994). ISBN-10: 0849378311
3. *The Business of Systems Integration* by Andrea Prencipe, Andrew Davies, Mike Hobday. Oxford University Press, USA (June 30, 2005). ISBN-10:019926323X
4. *Enterprise Integration: An Architecture for Enterprise Application and Systems Integration* by Fred A. Cummins, Wiley; 1st Edition (February 14,2002). ISBN-10: 0471400106.

Course Code: BIT-4802

Course Name: Professional Practices

Credit Hours: 02

Course Structure: Lectures 2

Prerequisite: None

Course Outline:

Historical, social, and economic context of Computing (software engineering, Computer Science, Information Technology); Definitions of Computing (software engineering, Computer Science, Information Technology) subject areas and professional activities; professional societies; professional ethics; professional competency and life-long learning; uses, misuses, and risks of Software; information security and privacy; business practices and the economics of software; intellectual property and software law (cyber law); social responsibilities, software related contracts, Software house organization.

Reference Material:

1. *Professional Issues in Software Engineering* M.F. Bott et al.

Item No. 5

Any other item