MAHARSHI DAYANAND UNIVERSITY, ROHTAK
SYLLABUS FOR Ph.D. COURSEWORK

DOCTOR OF PHILOSOPHY (Ph.D.) COMPUTER SCIENCE

Programme Specific Outcomes:

The students upon completion of Pre.Ph.D.(Computer Science) programme will be able to:

PSO1 Produce a well-developed research proposal.
PSO2 Select an appropriate methodology with which to conduct the research and defend the methodology of their selection.
PSO3 Understand the various tasks required to carry out the research.
PSO4 Find the resources needed to perform the research process.
PSO5 Documentation of its findings in the individual research area.
PSO6 Understand the most advanced research in the candidate's specialization area of Computer Science respectively
PSO7 Understand of academic theory and the preparation of high-quality research pertinent to the field of study
PSO8 Appropriately employ methods and existing research results in the development of new knowledge, theories and presentation of research in the individual research area

Scheme of Examination w.e.f. 2017

S.No.	Course Code	Course Title	External Marks	Internal marks	Total Marks	Hour Per Week
1.	17-CSC-PC-1	Research Methodology & Its Relevance in Computer Science	80	20	100	4
2.	17-CSC-PC-2	Elective – I	80	20	100	4
3.	17-CSC-PC-3	Elective - II	80	20	100	4
	Total		240	60	300	12

Elective – I & Elective – II papers are to be selected by the Candidate from the List of Elective Papers given below:

List of Electives
List of Elective-I Papers:

1.	Data Warehousing And Mining
2.	Mobile Computing
3.	BIG Data Analytics
4.	Information Retrieval System
5.	Pattern Recognition
6.	Web Analytics & Intelligence

List of Elective-II Papers:

1.	Software Testing And Quality Assurance
2.	Adhoc and Sensor Networks
3.	Embedded Systems
4.	Digital Image Processing
5.	Software Design And Engineering
6.	Information Security

More Elective Papers may be added from time to time depending upon the availability of the Expertise in the Department and its suitability for the researchers.

SUBJECT: RESEARCH METHODOLOGY & ITS RELEVANCE IN COMPUTER SCIENCE
PAPER CODE: 17-CSC-PC-1

Course Outcomes:
By the end of the course the students will be able to:

- CO1 Learn the concept of research, research process, types of research, research models and basics formats of report writing.
- CO2 Learn the use of statistical analytic techniques for data analysis and testing of hypothesis.
- CO3 Identify the differences between measurement and scaling and how sample is selected and determined using various approaches.
- CO4 To understand sources of data collection and how data is collected from different sources.
- CO5 To understand the concept of interpretation and role of computer in mathematical and statistical analysis with applications of relevant research methodologies used in computer science.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Types, Research process and steps in it, Hypothesis, Research proposals and aspects. Research **Design:** Need, Problem Definition, variables, research design concepts, Literature survey and review, Research design process, Errors in research.

Research Modeling: Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling. Report Writing: Pre writing considerations, Thesis writing, Formats of report writing, formats of publications in Research journals.

UNIT- II

Design of Experiments: Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles-replication, randomization, blocking, Guidelines for design of experiments; Single Factor Experiment: Hypothesis testing, Analysis of Variance (ANOVA) components for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking, Chi-Square Test.

Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two-factor factorial design; Models-Effects, means and regression, Hypothesis testing.

UNIT- III

Measurement and Scaling Techniques: Measurement: concept, Levels and components of Measurement, Techniques of Developing Measurement Tools, sources of Error in measurement, Tests of Sound Measurement. Scaling: Meaning of Scaling, Bases of Scales- classification, important scaling techniques-Rating and Ranking. Approaches of the scale construction, different types of scales-Arbitrary Scales, Differential Scales, Summated Scales, Cumulative Scales, factor Scales.

Sampling: Sampling Theory, Sandler's A-test, Concept of standard errors, Estimating Population mean (μ), Sample size and its Determination.

UNIT- IV

Qualitative Research: Themes of qualitative Research, Research Strategies; Data collection Techniques, combining qualitative and quantitative research.

Data Analysis and Interpretation of Data: Data Analysis: Paramedic and Nonparametric data, Descriptive and Inferential Analysis. Interpretation of Data: Forms of Interpretation, Prerequisites for Interpretation, Precautions in Interpretation, conclusions and Generalizations, sources of Errors in Interpretations, Mathematical and statistical analysis using software tools like MAT Lab, SPSS or free wares tools. The computer: Its role in research.

Suggested Books:

1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India)
2. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley India)
3. Kothari C.K. (2004), 2/e, Research Methodology- Methods and Techniques (New Age International, New Delhi)
4. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Resarach Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
5. The complete reference Office Xp – Stephan L. Nelson, Gujulia Kelly (TMH)
6. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH)
7. Book for Open Office.

LIST OF ELECTIVE-I PAPERS:
COURSE CODE: 17-CSC-PC-2
EL-1.1 DATA WAREHOUSING AND MINING

Course Outcomes:
By the end of the course the students will be able to:

CO1 Identify the need of Data Warehouse System and its benefits.
CO2 Preprocess the Input data set by applying different pre-processing approaches.
CO3 Perform data analysis by selecting the most appropriate attributes.
CO4 Analyze and evaluate the data mining results by using different performance evaluators.
CO5 Present the derived results by using different presentation tools.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours
Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit**.**

UNIT- I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining.
Data Preprocessing: Need for Preprocessing; the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT- II

Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Further Development of Data Cube Technology, From Data Warehousing to Data Mining Different types of Cubes and Data Generalization: Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction.

UNIT -III

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining.
Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Associative Classification, Lazy Learners, Other Classification Methods, Prediction, Accuracy and Error measures, Evaluating the accuracy of a Classifier or a Predictor, Ensemble Methods

UNIT- IV

Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods. Introduction to different applications of Data Mining: Time Series and Sequence Data Mining, Graph Mining, Social Network Analysis, Spatial Data Mining, Multimedia Data Mining, Text Mining, Mining the World Wide Web. Additional Themes on Data Mining and Social Impacts of Data Mining.

Suggested Books:

1. Data Mining – Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, 2nd Edition, 2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.
3. Data Warehousing in the Real World – Sam Aanhory & Dennis Murray Pearson Edn Asia.
4. Data Warehousing Fundamentals – Paulraj Ponnaiah Wiley student Edition
5. The Data Warehouse Life cycle Tool kit – Ralph Kimball Wiley student edition
6. Building the Data Warehouse By William H Inmon, John Wiley & Sons Inc, 2005.
7. Data Mining Introductory and advanced topics –Margaret H Dunham, Pearson education
8. Data Mining Techniques – Arun K Pujari, University Press.

EL-1.2 MOBILE COMPUTING

Course Outcomes:

By the end of the course the students will be able to:

CO1 Describe the basic concepts and principles in mobile computing.
CO2 Understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks.
CO3 Understand positioning techniques and location-based services and applications and describe the important issues and concerns on security and privacy.

CO4 Apply the fundamental design paradigms and technologies to mobile computing applications and Explain the structure and components for Mobile IP and Mobility Management

CO5 Appraise the quality and performance of mobile applications, MANET and assess and implement security principles in mobile applications.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit**.**

UNIT- I

Network Technologies and Cellular Communications: HIPERLAN: Protocol architecture, physical layer, Channel access control sub-layer, MAC sub-layer, Information bases and networking .WLAN**:** Infrared vs. radio transmission, Infrastructure and ad hoc networks, IEEE 802.11. Bluetooth**:** User scenarios, Physical layer, MAC layer, Networking, Security, Link management GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. Mobile Computing (MC): Introduction to MC, novel applications, limitations, and architecture

UNIT- II

Wireless) Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, near and far terminals); SDMA, FDMA, TDMA, CDMA;

Mobile Network Layer: Mobile IP: Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations, Dynamic Host Configuration Protocol (DHCP).

UNIT- III

Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

Database Issues: Hoarding techniques, caching invalidation mechanisms; client server computing with adaptation; power-aware and context-aware computing; transactional models, query processing, recovery, and quality of service issues.

UNIT- IV

Data Dissemination: Communications asymmetry: classification of new data delivery mechanisms, push based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, unicast and multicast routing algorithms, DSR, AODV, OLSR, CEDAR, ODMRP Protocols and Tools: security in MANETs, Wireless Application Protocol-WAP: Introduction, protocol architecture, and treatment of protocols of all layers. Bluetooth: User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME.

Suggested Books:

1. Jochen Schiller, “Mobile Communications”, Pearson Education., second edition, 2004
2. “Raj kamal, “Mobile Computing”, OXFORD Universit y Press

3. Asoke Talukder, Roopa Yavagal "Mobile Computing", ISBN: 0070588074, tata McGraw Hill
4. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004,
5. C.Siva Ram murthy, B.S. Manoj "Adhoc wireless networks, architectures and protocols" peason education
6. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002

EL-1.3 BIG DATA ANALYTICS

Course Outcomes:

By the end of the course the students will be able to:

CO1 To classify, visualize and forecast the data after analysis.
CO2 Perform the predictive analysis on the Big Data by using Hadoop.
CO3 Differentiate between the Online analytical processing & Online transactional processing.
CO4 Perform statistical analysis of Big Data using R software.
CO5 Implement the Big Data on Cloud and to provide security to Big Data.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours
Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction to Data Analytics: Data and Relations, Data Visualization, Correlation, Regression, Forecasting, Classification and Clustering.
Big data Technology: Fundamentals of Big Data, Types, Big Data Technology Components, Big Data Architecture, Big Data Warehouse, Functional vs Procedural Programming Models for big data.

UNIT- II

Big Data Analytics: Introduction to Big Data Analytics, Framework for Big Data Analysis, Approaches for big data analysis, ETL in Big Data. Understanding Text Analytics and Big Data, Predictive Analysis on Big Data, Role of Data Analyst. Introduction to Hadoop Ecosystem: HDFS, Map reduce programming.

UNIT- III

Business Intelligence: Introduction to Business Intelligence, Business View of IT Applications, Digital Data, Introduction to Online Analytical Processing & OLAP vs OLTP. Business Intelligence Concepts: BI roles and responsibilities, BI framework and components, BI Project life cycle, Business Intelligence vs Business Analytics.

UNIT- IV

Implementation of Big Data: Big data implementation: Big data workflow. Variant data types: Operational databases, Graph databases in big data environment, Real Time Data Stream and Complex Event Processing. Introduction to Statistical Analysis with R Software. Big Data

Computation and its limitations. Applications of Big data: Business Scenario, Big data on Cloud and Security and Governance of Big data.

Suggested Books:

1. Minelli M., Chambers M., Dhiraj A., Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for today's Businesses, Wiley CIO, 2013.
2. Viktor Mayer-Schonberger, Kenneth Cukier, Big Data: A Revolution that will transform how we live, work and think.
3. Big Data Black Book by DT Editorial Services, dreamtech publications 2015.
4. Seema Acharya & Subhashini Chellappan, Big data and Analytics, Wiley publishers

EL-1.4 INFORMATION RETRIEVAL SYSTEMS

Course Outcomes:

By the end of the course the students will be able to:

- CO1 To identify Data Base Management systems and data ware houses
- CO2 To use knowledge of data structures and indexing methods in information retrieval Systems
- CO3 To choose clustering techniques for different data base systems
- CO4 To choose searching techniques for different data base systems
- CO5 To Explain different types of search algorithms like Hardware text search systems and software text search systems

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction: Definition, Objectives, Functional Overview, Relationship to DBMS, Digital libraries and Data Warehouses, Information Retrieval System Capabilities - Search, Browse, Miscellaneous.

UNIT- II

Cataloging and Indexing: Objectives, Indexing Process, Automatic Indexing, Information Extraction, Data Structures: Introduction, Stemming Algorithms, Inverted file structures, N-gram data structure, PAT data structure, Signature file structure, Hypertext data structure - Automatic Indexing: Classes of automatic indexing, Statistical indexing, Natural language, Concept indexing, Hypertext linkages

UNIT- III

Document and Term Clustering: Introduction, Thesaurus generation, Item clustering, Hierarchy of clusters - User Search Techniques: Search statements and binding, Similarity

measures and ranking, Relevance feedback, Selective dissemination of information search, Weighted searches of Boolean systems, Searching the Internet and hypertext - Information Visualization: Introduction, Cognition and perception, Information visualization technologies.

UNIT- IV

Text Search Algorithms: Introduction, Software text search algorithms, Hardware text search systems; Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

Multimedia Information Retrieval: Models and Languages: Data Modeling, Query Languages, Indexing and Searching Libraries and Bibliographical Systems – Online IR Systems, OPACs, Digital Libraries.

Suggested Books:

1. Information Storage and Retrieval Systems: Theory and Implementation by Kowalski, Gerald,
2. Mark T Maybury Kluwer Academic Press, 2000.
3. Modern Information Retrival By Ricardo Baeza-Yates, Pearson Education, 2007.
4. Information Retrieval: Algorithms and Heuristics By David A Grossman and Ophir Frieder, 2nd
5. Edition, Springer International Edition, 2004.
6. Information Retrieval Data Structures and Algorithms By William B Frakes, Ricardo Baeza-Yates,
7. Pearson Education, 1992.
8. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons.
9. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan,
10. Cambridge University Press, 2008.

EL-1.5 PATTERN RECOGNITION

Course Outcomes:

By the end of the course the students will be able to:

- CO1 Identify areas where Pattern Recognition and Machine Learning can offer a solution 2. Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems
- CO2 Describe genetic algorithms, validation methods and sampling techniques
- CO3 Describe some discriminative, generative and kernel based techniques
- CO4 Describe and model sequential data. Implement learning algorithms for supervised tasks. Solve problems in regression and classification
- CO5 Conduct, document and present a literature review on a topic related to Machine Learning and Pattern Recognition

SUBJECT: PATTERN RECOGNITION

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction: Pattern Recognition Systems, Design Cycle, Applications of pattern recognition, Learning and Adaption-Supervised, Unsupervised and Reinforcement Learning: Tree Classifiers Getting our feet wet with real classifiers: Decision Trees: CART, C4.5, ID3.Random Forests Bayesian Decision. Parametric Techniques. Non-Parametric Techniques. Component Analysis and Dimension Reduction. The Curse of Dimensionality and Principal Component Analysis.

UNIT- II

Probability: Introduction to Probability, Probability of events, Random variables, Probability Distributions, Joint Distribution and Densities, Moments of Random Variables, Estimation of Parameters from samples, Minimum Risk Estimators.

UNIT- III

Statistical Decision Making: Bayes' Decision Theory, Multiple Features, Conditionally Independent Features, Decision Boundaries, Unequal costs of Error, Estimation of Error Rates, Leaving-one-out Technique, Confusion Matrix, Characteristic Curves. Classifiers: Hidden Markov Model, Support Vector Machine, Artificial Neural network-back Propagation Algorithm and Fuzzy based classifiers.

UNIT- IV

Non Parametric Decision Making: Introduction, Histograms, Kernel and window Estimators, Nearest Neighbor classification Technique, Adaptive Decision Boundaries, Adaptive Discriminate Functions, Minimum Squared Error Discriminate Functions. Clustering: Introduction, Hierarchical clustering, Partitioning Clustering.

Suggested Books:

1. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh and Steve Jost, PHI, 1996.
2. Pattern Classification, Richard O Duda, Peter E. Hart and David G. Stork, John Wiley, 2000.

EL-1.6 WEB ANALYTICS AND INTELLIGENCE

Course Outcomes:

By the end of the course the students will be able to:

CO1 Characterize the web data as visit or content type.
CO2 Understand to apply the conversion metrics offline as well as online web.
CO3 Collect the data of different kinds: web logs, web beacons and stream data.

CO4 Create packets and to perform the packet sniffing, identification of unique page.
CO5 Apply different metrics to count hits, views, bounce and to generate different kinds of reports.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction: Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, On site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

Data Collection: Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT- II

Qualitative Analysis: Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys.

Web Analytic fundamentals: Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT- III

Web Metrics: Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI.

Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

UNIT- IV

Web Analytics 2.0:Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

Suggested Books:

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed.
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

LIST OF ELECTIVE-II PAPERS
COURSE CODE: 17-CSC-PC-3

EL-2.1 SOFTWARE TESTING AND QUALITY ASSURANCE

Course Outcomes:

By the end of the course the students will be able to:

CO1 Knowledge of various Software Testing techniques.
CO2 Use Software Testing Strategies and Metrics for Software testing.
CO3 Knowledge of Object Oriented Testing strategies.
CO4 Knowledge of Software Reliability, and Software Quality Assurance.
CO5 Knowledge of Quality management standards and methods.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT-I

A perspective on Testing, STLC, Functional testing: Boundary value testing, Equivalence –class testing, Decision Table Testing etc., Retrospective on Functional Testing; Structural testing: path testing, data flow testing, mutation testing, etc. Retrospective testing, Levels of testing: Integration testing, system testing, acceptance testing, stress testing, Regression testing-β testing.

UNIT-II

Object-oriented Testing, Interaction testing, Testing of Web Applications, Testing metrics, Testing Paradigms: Scripted testing, Exploratory testing, Test planning, Supporting Technologies: Defect taxonomies, Testing tools and standards, Case studies.

UNIT-III

Introduction to Software Quality, Quality Models: McCall's Model , Hierarchical model FCMM , Measuring Software Quality, Quality Metrics: Process, Product, Quality Control Tools, Quality assurance concept, importance, Requirements for SQA works,

UNIT-IV

Pareto Principle to SQA, Costs of Software Quality, SQA metrics, Audit Review, Walk through, Inspection techniques, SQA plan., Quality standards:SEI-CMM, ISO 9000 series, comparison between SEI CMM and ISO 9000.

Suggested Books:

1. A Practitioner's Guide to Test Case Design by LEE Copland, Artech House Publishers, Boston - London.
2. Software Testing – A Craft's man Approach, Paul C. Jorgensen, A CRC Press LLC.
3. Software Quality Theory and Management by Alan C. Gillies, Chapman & Hall.
4. Software Quality by Galrry S. Marliss , Thomson.
5. Metrics and Models in Software Quality Engineering by Stephen H. Kan , Pearson Education.
6. Handbook of Software Quality Assurance by G. Gordon Sculmeyer, Artech House Publishers, Boston –London

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EL-2.2 ADHOC AND SENSOR NETWORKS

Course Outcomes:

By the end of the course the students will be able to:

- CO1 Understand the needs of Wireless Adhoc and Sensor Network in current scenario of technology.
- CO2 Describe current technology trends for the implementation and deployment of wireless Adhoc/sensor networks.
- CO3 Discuss the challenges in designing MAC, routing.
- CO4 Transport protocols for wireless Ad-hoc/sensor networks.
- CO5 Explain the principles and characteristics of wireless sensor networks

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction to Ad Hoc Networks: Characteristics of MANETs, Applications of MANETs and challenges of MANETs - Routing in MANETs: Criteria for classification, Taxonomy of MANET routing algorithms, Topology based routing algorithms, Position based routing algorithms, Other routing algorithms.

UNIT- II

Data Transmission: Broadcast storm problem, Broadcasting, Multicasting and Geocasting. TCP over Ad Hoc: TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT- III

Basics of Wireless, Sensors and Applications: Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer.

UNIT- IV

Data Retrieval in Sensor Networks: Routing layer, Transport layer, High-level application layer support; Adapting to the inherent; dynamic nature of WSNs; Sensor Networks and mobile robots. Security: Security in Ad Hoc networks, Key management, Secure routing, Cooperation in MANETs, Intrusion Detection systems.

Sensor Network Platforms and Tools: Sensor Network Hardware, Berkeley motes, Sensor Network Programming Challenges, Node-Level Software Platforms - Operating System: TinyOS – Imperative Language**:** nesC, Dataflow style language: TinyGALS, Node-Level Simulators, ns-2 and its sensor network extension, TOSSIM.

Suggested Books:

1. Ad Hoc and Sensor Networks – Theory and Applications, *Carlos Corderio Dharma P.Aggarwal,* World Scientific Publications, March 2006, ISBN – 981-256-681-3
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman

EL-2.3 EMBEDDED SYSTEMS

Course Outcomes:

By the end of the course the students will be able to:

- CO1 To acquire knowledge about microcontrollers embedded processors and their applications.
- CO2 Interfacing of different peripheral devices with Microcontrollers.
- CO3 To write the programs for microcontroller.
- CO4 To understand the role of embedded systems in industry.
- CO5 To understand the design concept of embedded systems.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction to Embedded Systems: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software, Complex System

Design, and Design Process in Embedded System, Formalization of System Design, and Classification of Embedded Systems

UNIT -II

8051 and Advanced Processor Architecture: 8051 Architecture, 8051 Micro controller Hardware, Input /Output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/ Output, Interrupts, Introduction to Advanced Architectures, Real World Interfacing, Processor and Memory organization.

Devices and Communication Buses for Devices Network: Serial and parallel Devices & ports, Wireless Devices, Timer and Counting Devices, Watchdog Timer, Real Time Clock, Networked Embedded Systems, Internet Enabled Systems, Wireless and Mobile System protocols

UNIT- III

Embedded Programming Concepts: Software programming in Assembly language and High Level Language, Data types, Structures, Modifiers, Loops and Pointers, Macros and Functions, object oriented Programming, Embedded Programming in C++ & JAVA.

UNIT- IV

Real – Time Operating Systems: OS Services, Process and Memory Management, Real – Time Operating Systems, Basic Design Using an RTOS, Task Scheduling Models, Interrupt Latency, Response of Task as Performance Metrics. RTOS Programming: Basic functions and Types of RTOSES, Windows CE.

Embedded Software Development Process and Tools: Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-Design Testing, Simulation and Debugging Techniques and Tools: Testing on Host Machine, Simulators, Laboratory Tools

Suggested Books:

1. Embedded Systems, Raj Kamal, Second Edition TMH.
2. Embedded/Real-Time Systems, Dr.K.V.K.K.Prasad, dreamTech press
3. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson.
4. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.
5. An Embedded Software Primer, David E. Simon, Pearson Education.
6. Micro Controllers, Ajay V Deshmukhi, TMH.
7. Microcontrollers, Raj kamal, Pearson Education.
8. Introduction to Embedded Systems,Shibu K.V,TMH.

EL-2.4 DIGITAL IMAGE PROCESSING

Course Outcomes:

By the end of the course the students will be able to:

CO1 Quantize and to perform sampling on given images.

CO2 Transform and filter the digital image for improving the image quality.

CO3 Generate Color images by applying different image characteristics.
CO4 Compress the digital images by applying different lossless and lossy compression techniques.
CO5 Identify different representations of digital images.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours
Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Fundamental steps of image processing, components of an image processing of system, the image model and image acquisition, sampling and quantization, station ship between pixels, distance functions, scanner.

UNIT- II

Statistical and spatial operations, Grey level transformations, histogram equalization, smoothing & sharpening-spatial filters, frequency domain filters, homomorphic filtering, image filtering & restoration. Inverse and weiner filtering FIR weiner filter. Filtering using image transforms, smoothing splines and interpolation.

UNIT- III

Morphological and other area operations, basic morphological operations, opening and closing operations, dilation erosion, Hit or Miss transform, morphological algorithms, extension to grey scale images.
Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edge detection, gradient operators, compass and laplace operators, edge linking and boundary detection, thresholding, region based segmentation, segmentation by morphological watersheds.

UNIT- IV

Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression, image data compression-predictive technique, pixel coding, transfer coding theory, lossy and lossless predictive type coding. Basics of color image processing, pseudocolor image processing, color transformation, color smoothing and sharpening, color segmentation, color image compression, compression standards.
Image Transforms - Fourier, DFT, DCT, DST, Haar, Hotelling, Karhunen -Loeve, Walsh, Hadamard, Slant. Representation and Description, Chain codes, Polygonal approximation, Signatures Boundary Segments, Skeltons, Boundary Descriptors, Regional Descriptors, Relational Descriptors, PCA.

Suggested Books:

1. Digital Image Processing – by Rafael.C.Gonzalez & Richard E.Woods, 3rd edition, Pearson Education, 2008
2. Fundamentals of Digital Image Processing – by A.K. Jain, PHI
3. Digital Image Processing – William K, Part I - John Wiley edition.

4. Digital Image Processing using MATLAB – by Rafael.C.Gonzalez, Richard E.Woods, & Steven
5. L.Eddins, Pearson Education, 2006

EL-2.5 SOFTWARE DESIGN AND ENGINEERING

Course Outcomes:

By the end of the course the students will be able to:

CO1 appreciate the engineering nature of software development
CO2 describe key activities in software development and the role of modelling
CO3 explain key concepts in software development such as risk and quality
CO4 explain the basics of an object-oriented approach to software development
CO5 describe a simple workflow for interacting with the published literature on software development.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours
Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit.

UNIT- I

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, legacy software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models.
Process models: The waterfall model, Incremental process models, Evolutionary process models, specialized process models, The Unified process. Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management.

UNIT- II

Role of Software Design: The nature of the design process; transferring design knowledge; constraints upon the design process and product, recording design decisions, designing with others, context for design, economic factors, assessing design qualities, quality attributes of the design product, assessing the design process.
Transferring Design Knowledge-Representing abstract ideas; design viewpoints, the architecture concept, design methods, design patterns, Design representations, and rationale for design methods. Design Processes and Strategies: The role of strategy in design methods, describing the design process –The D – Matrix, design by top-down decomposition, design by composition and organizational influences upon design.

UNIT- III

Designing with objects and components: Designing with objects: design practices for object-oriented paradigm, Object- oriented frame works, Hierarchal object oriented design process and heuristics, the fusion method, the unified process. Component – based design: The component concept, designing with components, designing components, COTS, Performing User interface design-The Golden rules, Interface analysis and design models, user and task analysis, analysis of display content and work environment, applying interface design steps, user interface design issues, design evaluation.

UNIT- IV

Project Management and Metrics: Project Management: The management spectrum: people, product, process and project, W5HH principle, critical practices. Metrics for Process and Projects: Process metrics, project metrics, size-oriented metrics, function oriented metrics, Object-oriented and use-case metrics, metrics for software quality, integrating metrics within the software process.

Project Scheduling and Risk Management: Project Scheduling: Basic concepts, project scheduling, defining a task set and task network, timeline Charts, tracking the schedule, tracking the progress for an OO project, Earned value analysis. Risk Management: reactive vs. Proactive risk strategies, software risks, risk identification, risk Projection, risk refinement, risk mitigation and monitoring, the RMMM plan.

Suggested Books:

1. Software design, David Budgen, second edition, Pearson education, 2003.
2. Software Engineering: A practitioner's Approach, Roger S Pressman, seventh edition Mc-Graw Hill International Edition, 2009.
3. Software Engineering, Ian Sommerville, seventh edition, Pearson education,2004.
4. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition,Tata Mc-Graw Hill,2006
5. The art of Project management, Scott Berkun, O'Reilly, 2005.

EL-2.6 INFORMATION SECURITY

Course Outcomes:

By the end of the course the students will be able to:

- CO1 Identify some of the factors driving the need for network security
- CO2 Identify and classify particular examples of attacks
- CO3 Define the terms vulnerability, threat and attack
- CO4 Identify physical points of vulnerability in simple networks
- CO5 Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

Maximum marks: 100 (**External: 80**, **Internal: 20**) **Time:** 3hours

Note: The Examiner is required to set eight questions in all with two questions from each Unit and the candidate shall be required to attempt five questions in all by selecting at least one question from each Unit**.**

UNIT- I

Security Goals, Security Attacks Interruption, Interception, Modification and Fabrication Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internet work security, Internet Standards and RFCs

UNIT- II

Conventional Encryption Principles & Algorithms(DES, AES, RC4), Block Cipher Modes of Operation, Location of Encryption Devices, Key Distribution, Public key cryptography principles, public key cryptography algorithms(RSA, RABIN, ELGAMAL,Diffie-Hellman, ECC), Key Distribution.

UNIT- III

Approaches of Message Authentication, Secure Hash Functions (SHA-512, WHIRLPOOL) and HMAC Digital Signatures: Comparison, Process- Need for Keys, Signing the Digest, Services, Attacks on Digital Signatures, Kerberos, X.509 Directory Authentication Service.

UNIT- IV

Email Security: Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3, Intruders, Viruses and related threats, Virus Countermeasures Firewall Design principles, Trusted Systems, Intrusion Detection Systems

Suggested Books:

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education,2008.
2. Cryptography & Network Security by Behrouz A. Forouzan, TMH 2007.
3. Information Security by Mark Stamp, Wiley – India, 2006.
4. Information Systems Security,Godbole,Wiley Student Edition.
5. Cryptography and Network Security by William Stallings, Fourth Edition,Pearson Education 2007.
6. Fundamentals of Computer Security , Springer.
7. Network Security: The complete reference, Robert Bragg, Mark Rhodes, TMH
8. Computer Security Basics by Rick Lehtinen, Deborah Russell & G.T.Gangemi Sr., SPD O'REILLY 2006.
9. Modern Cryptography by Wenbo Mao, Pearson Education 2007.
10. Principles of Information Security, Whitman, Thomson.