Scheme and Syllabus

for

PhD course work

offered

at

University School of Information, Communication & Technology
Guru Gobind Singh Indraprastha University, Delhi
From
AY 2018-19
Rules of Course work as mentioned in PhD ordinance 2017, Clause 7

Credit requirements, number duration, syllabus, minimum standards for completion etc.

7.1 The credit assigned to the PhD course work shall be minimum of 08 credits and a maximum of 16 credits

7.2 In the course work, a minimum of four credits shall be assigned to one or more courses on research methodology which could cover areas such as quantitative methods, computer application, research ethics and review of published research in the relevant field, training field work etc, other course shall be advanced level course preparing the student for PhD degree

7.3 The detailed course work for PhD shall be designed and recommended by concerned SRC and approved by the concerned BoS.

7.4-75 M.Phil related

7.6 The SRC governing the discipline in which the scholar pursue his/her research shall prescribe the course(s) to him/her based on the recommendation of the RAC of the research scholar.

7.7 All candidates admitted to PhD programmes shall be required to complete the coursework prescribe by the SRC during the initial one or two semesters. The maximum period for completion of the course work shall be two years from the academic session in which the scholar is admitted. If a scholar fail in any course/paper, the scholar shall reappear as and when the course/paper examination is scheduled subsequently.

7.8-7.9 M.Phil related

7.10 The grading system and divisions for the course work shall be as specified in the ordinance 11 of the university. Each paper/course of the course work shall be of maximum of 100 marks. The teacher's continuous evaluation component shall be of 25 marks and end-term semester examination component shall be of 75 marks. Attendance requirement in the course work shall be of minimum 75% of the classes held, the SRC may condone up to 5% of the attendance in specific instances, with reasons recorded in writing. Under no circumstances, a scholar with less than 70% attendance in the course shall be allowed it to appear in the end-term semester examination by the SRC . The list of detained scholars shall be notified at least 5 working days before the commencement of end-term examination, by the chairperson of the SRC with a copy to the controller of examination for non-issuance of admit card.

7.11 The teacher's continues evaluation of 25 marks, for every course shall be conducted by the concerned faculty who is allocated the responsibility of teaching the course by the SRC. The concerned faculty shall communicate their marks to the controller of examination through the Dean, within a week of the completion of the semester.

For the rest 75 marks, the Controller of examination shall conduct the examination. The panel of paper setter, as approved by the BoS shall be communicated to the controller of Examination. The controller of Examinations shall declare the result combining the teacher's continuation evaluation and the end-term semester examination. The duration of the semester shall be of 15 weeks.

7.12 A PhD scholar has to obtain a minimum of B+ grade in the course work in order to be eligible to continue in the programme and submit the thesis. If, a scholar does not obtain the minimum grade, the scholar may reappear in one or more course work paper/course to improve the grad. The reappear fee applicable shall be as notified for other examination of the university. If the minimum grade required is not obtained in the maximum of duration for the course work as specified the registration/admission of the scholar shall be automatically cancelled.
Scheme and syllabus for PhD course work in accordance with PhD ordinance 2017 is approved in 98th SRC dated 6th April, 2018 and 47th BoS dated 13th April 2018, and 44th AC held on 3rd May, 2018 (Agenda item no. AC44.22) wef 2018-19.

<table>
<thead>
<tr>
<th>Paper Code</th>
<th>Particulars</th>
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<td>COMPULSORY PAPER</td>
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<td>CWICT-101</td>
<td>Research Methodology</td>
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<td>Advanced Data Warehousing &amp; Data Mining</td>
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<td>Advanced Electromagnetic Engineering</td>
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<td>MEVS-601</td>
<td>Digital System Design with Verilog</td>
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<td>Robotics Engineering</td>
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<td>MEEC-626</td>
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### PhD Course Work of USIC&T, GGS Indraprastha University, Delhi

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<td>MERA-721</td>
<td>Machine Learning</td>
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<td>MECS-703</td>
<td>Advanced Software Testing</td>
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<td>MECS-711</td>
<td>Software Quality Management</td>
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<td>MERA-602</td>
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<td>PHDICT-102</td>
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<td>PHDICT-104</td>
<td>Deep learning</td>
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<tr>
<td>PHDICT-106</td>
<td>Advanced Semantic Web</td>
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PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper Code: CWICT-101
Subject: Research Methodology

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**INSTRUCTIONS TO PAPER SETTERS:**

MAXIMUM MARKS: 75

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 23 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks

**Unit I**

**Descriptive statistic:** Data measurements, Data graph: Line graph, Bar Graph, pie chart, histograms, Measure of central tendency: Mean, Median and Mode. Measure of variability: Range, Quartile deviation, standard deviation, average deviation and coefficient of variation. Measure of relative position: percentile ranks, standards scores and T-score.

**Probabilities Set Theory:** Applying Set Theory to Probability, Probability Axioms, Some Consequences of the Axioms, Conditional Probability, Independence. **Correlation:** Karl Pearson’s Product Moment Correlation Coefficient (r), Spearman’s Rank order correlation coefficient (rho).

**Unit II**


**Statistical Distributions:** Properties and applications of Normal, log-normal and t-distributions, Chi-Square and F distributions, properties of normal curve, applications of normal curve. Measure of shape: skewness and Kurtosis.

**Unit III**

**Statistical Inference:** Concept of standard error and its uses. The significances of statistical measures, Test of the significance difference between two means: Z-Test, T-Test, Analysis of variance and analysis of covariance: Assumptions of ANOVA, one way ANOVA, two way ANOVA. Post Hoc tests: Duncan’s multiple range test, Tukey’s test. Non-parametric tests: chi-square test, medium test, Friedman test, Wilcoxon test, Nemenyi test.

**Unit IV**

**Regression:** The Simple Regression Model, Multiple Regression Analysis: Estimation, Multiple Regression Analysis: Inference, Multiple Regression Analysis: OLS Asymptotics. Multiple Regression Analysis with Qualitative Information: Binary (or Dummy) Variables. Heteroskedasticity.

Text Books:

Reference Books:

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UNIT I

UNIT II
Transport layer & Security protocols

UNIT III
Wire Sensor Networks: Introduction and overview of WSN, Applications of Sensor Networks, Sensor network architecture, Architecture of WSNs Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, some examples of sensor nodes, Network Architecture: Sensor networks scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.

UNIT IV
Communication Protocols:

Text Book(s):

Reference Book(s):
[R2] Handbook of Ad Hoc Wireless Network, By Mohmad Illayas, CRC press

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PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper Code: MECS-601  
Paper: Advanced Data Structure  

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INSTRUCTIONS TO PAPER SETTERS:  
MAXIMUM MARKS: 75

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.

2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 10 marks.

UNIT I

UNIT II
Binary Heaps, Amortized analysis of Data structures, Balanced Search Trees, AVL trees, augmented data structure, Red Black Trees and properties.

UNIT III
Graph representation and implementation, searching of a graph, application of BFS and DFS 
Data structure for Sets, Disjoint Set and Union – find problem and implementation, Basic Hash function and collision resolution Hash Tables (Universal Hashing, Perfect Hashing) implementation and Applications

UNIT IV
External sorting, Multiway search trees, B and B + Trees implementation, Digital Search Trees, Multiway Tries, Suffix Trees and applications

Text Book(s):

Reference Book(s):

Scheme and syllabus for PhD course work in accordance with PhD ordinance 2017 is approved in 98th SRC dated 6th April, 2018 and 47th BoS dated. 13th April 2018, and 44th AC held on 3rd May, 2018 (Agenda item no. AC44.22) wef 2018-19.
UNIT I
Review of Data Warehousing:
Introduction to Data Warehousing: Evolution of Data Warehousing, Data Warehousing concepts, Benefits of Data Warehousing, Comparison of OLTP and Data Warehousing, Why Have a Separate Data Warehouse, Problems of Data Warehousing.
Data Warehousing Architecture
Architecture: Operational Data and Data store, Load Manager, Warehouse Manager, Query Manager, Detailed Data, Lightly and Highlysummarised Data, Archive/Backup Data, Meta-Data, 2-tier, 3-tier and 4-tier data warehouse architecture

UNIT II
Multidimensional Data Modeling
Principles of dimensional modeling: From Tables and Spreadsheets to Data Cubes, the STAR schema, STAR Schema Keys, Advantages of the STAR Schema Dimensional Modeling: Updates to the Dimension tables, miscellaneous dimensions, the snowflake schema, Fact Constellations, aggregate fact tables, families of STARS, Measures: Their Categorization and Computation, Concept Hierarchies, OLAP Operations in the Multidimensional Data Model, A StarNet Query Model for Querying Multidimensional Databases

UNIT III
Data Warehouse Implementation,
Efficient Computation of Data Cubes, Indexing OLAP Data, Efficient Processing of OLAP Queries, Metadata repository, Data warehouse back-end tools and utilities
Data Preprocessing
Why preprocess the data? Data cleaning, Missing values, Noisy data, Inconsistent data, Data integration and transformation, Data reduction: Data cube aggregation, Dimensionality reduction, Data compression, Numerosity reduction
Discretization and concept hierarchy generation for numeric data and categorical data

UNIT IV
Data Mining Basics: What is Data Mining, The knowledge discovery process, OLAP versus data mining, data mining and the data warehouse, Major Data Mining Techniques, Cluster detection, decision trees, memory-based reasoning, link analysis, neural networks, genetic algorithms, moving into data mining, Data Mining Applications, Benefits of data mining, applications in retail industry, applications in telecommunications industry, applications in banking and finance.

Text Books:
1. Morgan Kaufmann - Data Mining - Concepts and Technique

Reference Books:
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper Code: MERF-601
Subject: Advanced Electromagnetic Engineering

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 23 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks.

MAXIMUM MARKS: 75

UNIT I
The Source Concept, Duality, Uniqueness, Image Theory, The Equivalence Principal, Fields in Half-space, The Induction Theorem, Reciprocity, Green’s Function

UNIT II
The Wave Function, Plane Waves, The Rectangular Waveguide, Alternative Mode Sets
The Rectangular Cavity, Partially Filled Waveguide, The Dielectric-Slab Waveguide, Surface-Guided Waves, Modal Expansion of Fields, Current in Waveguides

UNIT III
Other Guided Waves, Source of Cylindrical Waves, Two-dimensional Radiation, Waves Transformations, Scattering by Cylinders, Scattering by Wedges, Three-dimensional Radiation

UNIT IV
The Wave Function, The Spherical Cavity, Orthogonality Relationships, Space as a Waveguide, Other Radial waveguide, Other resonators

Text Book(s):

Reference Book(s):
UNIVERSITY OF DELHI

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2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks.

UNIT I
Biological analogy, Architecture classification, Neural Models, Learning Paradigm and Rule, single unit mapping and the perception.

Unit-II
Feed forward networks – Review of optimization methods, back propagation, variation on Backpropagation, FFANN mapping capability, properties of FFANN’s Generalization.

Unit-III
PCA, SOM, LVQ, Adaptive Resonance Networks.

Unit-IV
Hopfield Networks, Associative Memories, RBF Networks.

Applications of Artificial Neural Networks: Regression, applications to function approximation, Classification, Blind Source Separation.

Text Book(s):

Reference Book(s):
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper Code: MECS-705
Subject: Cloud Computing

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INSTRUCTIONS TO PAPER SETTERS: MAXIMUM MARKS: 75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 23 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks.

UNIT I
Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering &Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS, Cloud computing platforms: Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure.

UNIT II
Introduction to Cloud Technologies, Study of Hypervisors, SOAP, REST, Compare SOAP and REST, Webservices, AJAX and mashups-Web services, Mashups: user interface services, Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization, Multi-entity support, Multi-schema approach, Multi-tenance using cloud data stores, Data access control for enterprise applications.

UNIT III

UNIT IV

Text Book(s):
[T3] Cloud Security & Privacy by Tim Malhar, S.Kumaraswamy, S.Latif (SPD,O’REILLY)

Reference Book(s):
[R1] Cloud Computing Bible by Barrie Sosinsky, Wiley India
[R2] Cloud Applications by George Reese, O’REILLY Publication
[R3] Cloud Security by Ronald Krutz and Russell Dean Vines, Wiley-India
UNIT I
Introduction :Introduction to Cyber World, Types of cyber-attacks, Cyber Crime and Digital Fraud, Cyber-attacks and cyber security , Information warfare and cyber terrorism, Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations)

UNIT II

UNIT III

UNIT IV
Computer Forensics Tools and Software: Helix, DTsearch, S-tools, Camouflage, Recovery of Deleted files in windows and Unix , Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap , Netscan etc. Password recovery e.g. Passware, Mobile forensic tools , DOS file systems and Forensic tools, Password encryption analyzer

Text Book(s):

Reference Book(s):
[R2] Windows Forensic Analysis DVD Toolkit (Book with DVD-ROM), Harlan Carvey, syngress Publication
Paper Code: MEVS-601
Subject: Digital System Design with Verilog

INSTRUCTIONS TO PAPER SETTERS:

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 23 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks.

UNIT I
ASIC Design Flow, Architecture and configuration of (Xilinx)Virtex series FPGA, Principles Hardware Description Languages, Y-Chart, Review of Synchronous and Asynchronous Design, Types of HDLs, Introduction to Verilog, Language Constructs .Modeling style, Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators,

UNIT II
Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter. Behavioral Modeling: Functional Bifurcation, Initial & Always Construct, multiple always blocks, Program flow control and looping, Parallel blocks, force-release construct, design of sequential circuits using verilog: Register, Counters, Timing and Delays model, path delay modeling, timing check

UNIT III
Introduction of behavioral modelling, functional bifurcation, initial & always construct, procedural assignment statement, Delay in Procedural statements, Timing Control Statements, If and If-else, case statement assign-deassign, repeat construct, loop construct: repeat, for, while & forever, sequential and parallel blocks, force-release construct, design of flip flop, shift register and counters using Verilog

UNIT IV
Data Subsystems, Storage Modules, Functional Modules, Data paths, Control Subsystems, Micro programmed Controller, Structure of a micro programmed controller, Micro instruction Format, Micro instruction sequencing, Micro instruction Timing, Basic component of a micro system, memory subsystem design.

Text Book(s):

Reference Book(s):

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UNIT I - Introduction
History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom; Mechanisms and transmission, End effectors, Grippers- different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT II - Drive systems and Sensors
Drive systems- hydraulic, pneumatic and electric systems
Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT II - Kinematics and Dynamics of Robots
2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems.

UNIT IV - Robot Control, Programming and Applications
Robot controls- Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control.
Introduction to Robotic Programming, On-line and off-line programming, programming examples.
Robot applications- Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

References:
UNIT I
Clean room technology - Clean room concept – Growth of single crystal Si, surface contamination, Chemical Mechanical Polishing, wafer preparation, DI water, RCA and Chemical Cleaning. Processing considerations: Chemical cleaning, getting the thermal Stress factors etc.
Epitaxy: Physical Vapour Deposition, Vapors phase Epitaxy Basic Transport processes & reaction kinetics, doping & auto doping, equipments, & safety considerations, epitaxial defects, molecular beam epitaxy, equipment used, film characteristics, SOI structure.

UNIT II
Diffusion: Diffusion from a chemical source in vapor form at high temperature, diffusion from doped oxide source, Ion Implantation, Annealing and diffusion from an ion implanted layer.

UNIT III
Lithography

UNIT IV
Etching
Reactive plasma etching, AC & DC plasma excitation, plasma properties, chemistry & surface interactions, feature size control & apostrophic etching, ion enhanced & induced etching, properties of etch processing. Reactive Ion Beam etching, Specific etches processes: poly/polyamide. Trench etching.
Metallisation - Different types of metallization, uses & desired properties

Text Book(s):

Reference Book(s):
UNIT I
Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Networks signaling.
Global system for Mobile Communication (GSM) system overview: GSM Architecture, Mobility Management, Network signaling.

UNIT II
General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes. Enhanced Data rates for GSM Evolution (EDGE), Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.

UNIT III

UNIT IV
Global Mobile Satellite Systems: Case studies of IRIDIUM and GLOBALSTAR systems.

Text Book(s):

References Book(s):
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper Code: MECS-606
Subject: Advanced Algorithm Analysis & Design

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INSTRUCTIONS TO PAPER SETTERS:

MAXIMUM MARKS: 75

UNIT I

UNIT II

UNIT III

UNIT IV

Text Book(s):

Reference Book(s):
Paper Code: MEDC-602
Subject: Advanced Information Theory & Coding

L T C
4 - 4

INSTRUCTIONS TO PAPER SETTERS: MAXIMUM MARKS: 75
1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 23 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 13 marks.

UNIT I
Measure of Information, Information contents of discrete memoryless sources, Entropy & Mutual Information, Source coding theorem: Huffman coding, Shannon-Fano coding, Lempel-Ziv algorithm, Prefix codes,

UNIT II
Channel Coding theorem, Channel capacity theorem, Channel models, BSC, DMC, Lossless, Noiseless channels, Linear Block codes, Systematic & Non-Systematic codes, Repitition codes, Hamming codes, Cyclic codes, Cyclic Redundancy check (CRC) codes, Golay codes, BCH Codes, Read-Solomon codes.

UNIT III
Convolutional codes, Polynomial representation of Convolutional codes, Tree, State and Trellis diagrams, Maximum-likelihood/ Viterbi Decoding of Convolutional codes, Concept of Interleaving, Turbo Codes, Turbo decoding.

UNIT IV
Combined coding and Modulation, Trellis Coded Modulation (TCM), Mapping by set partitioning, TCM decoder, TCM for fading channels, Concept of Space time Trellis Codes.

Text Book(s):
[T2] Introduction to Error Control Codes by Salvatore Gravano, Oxford University Press

Reference Book(s):
UNIT I
Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals; Multiple access with collision avoidance, Polling, Inhibit sense multiple access; CDMA; Spread Aloha multiple access

UNIT II

UNIT III
Mobile Transport Layer: Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction oriented TCP.

UNIT IV

Text Book(s):

Reference Book(s):
1. Rappaport, "Wireless Communications Principals and Practices”.
3. K. Pahlavan, P. Krishnamurthy, "Principles of Wireless Networks”.
UNIT I

UNIT II

UNIT III
Frequency Domain Realization of Digital Filters, Radix-2 FFT Algorithm. Introduction to Multirate digital signal processing

UNIT IV

Text Book(s):

References Book(s):
UNIT I
Introduction to Software Project Management: Software development as a project; Stakeholders in software project; Software product, process, resources, quality, and cost; Objectives, issues, and problems relating to software projects. Overview of Project Planning: Steps in project planning; Defining scope and objectives; work breakdown structure; Deliverables and other products; time, cost, and resource estimation; Alternatives in planning. Project Evaluation: Strategic assessment; Technical assessment; Cost-benefit analysis; Cash flow forecasting; Cost-benefit evaluation techniques; Break-even analysis; Risk evaluation. Selection of Appropriate Project Approach: Choosing development technology and methodology; choice of process model; Rapid application development; Waterfall model; V-process model; Spiral model; Prototyping.; Incremental delivery.

UNIT II
Software Effort Estimation: Problem in software estimation; Effort estimation techniques; Expert judgement; Estimation by analogy; Delphi technique; Algorithmic methods; Top-down and bottom-up estimation; Function point analysis; Object points; COCOMO model. Activity Planning: Network planning model; Activity-on-arrow network; Precedence network; Forward pass; Backward pass; Critical path; Slack and float. Risk Analysis and Management: Nature and categories of risk in software development; risk Identification; Risk assessment; Risk mitigation, monitoring, and management; Evaluating schedule risk using PERT.

UNIT III
Recourse Allocation: Nature of project resources; Identifying resource requirement of activities; Allocating and scheduling resources; cost of resources; Standard, planned, and actual cost; Cost variance; time-cost trade-off. Project Tracking and Control: Measurement of physical and financial progress; Earned value analysis; Status reports; Milestone reports; Change control. Contact Management: Outsourcing of products and services; Types of contracts; Stages in contract placement; Terms of contract; Contract monitoring; Acceptance testing.

UNIT IV
Managing People and Organizing Teams: Organizational behaviour; Recruitment and placement; Motivation; Group behaviour; Individual and group decision making; Leadership and leadership styles; forms of organizational structures. Software Quality Assurance: Planning for quality; Product versus process quality management; Procedural and quantitative approaches; Defect analysis and prevention; Statistical process control; Pareto analysis; Causal analysis; Quality standards; ISO 9000; Capability Maturity Model; Quality audit. Configuration Management: Configuration management process; Software configuration items; Version control; change control; Configuration audit; Status reporting.

Text Books:

Reference Books:
UNIT I

Introduction: Basic principle of MOS transistor, Introduction to large signal MOS models (long channel) for digital design.

MOS Circuit Layout & Simulation and manufacturing: scaling, MOS SPICE model and simulation, CMOS layout: design rules, Transistor layout, Inverter layout, NMOS and CMOS basic manufacturing steps.

UNIT II

The MOS Inverter: Inverter principle, the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, switching characteristics, Propagation Delay, Power Consumption.

Combinational MOS Logic Design: Static MOS design, Ratioed logic, Pass Transistor logic, complex logic circuits.

UNIT III

Sequential MOS Logic Design
Static latches, Flip flops & Registers, Dynamic Latches & Registers, CMOS Schmitt trigger, Astable Circuits.
Memory Design: ROM & RAM cells design Dynamic MOS design: Dynamic logic families and performances.

Clock Distribution
Clock Distribution. Input and Output Interface circuits.

UNIT IV

Subsystem design
Design styles, design concepts: Hierarchy, Regularity, Modularity, Locality. CMOS Sub system design: Adders, Multipliers.

Text Book(s):

Reference Books
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

INSTRUCTIONS TO PAPER SETTERS:

MAXIMUM MARKS: 75

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   Each question should be 13 marks.

UNIT I

UNIT II

Image Enhancement in the Frequency Domain:
Introduction to Fourier Transform and its properties, Fast Fourier Transform, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.

UNIT III

Image Compression:

UNIT IV
Image Segmentation: Detection of Discontinuities - point, lines and edge segmentation, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation.

Representation and Description:
Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description,

Morphological Image Processing: Erosion and dilation, Some basic Morphological Algorithms.

References:
UNIT I

UNIT II

Unit-III


UNIT IV

Applications of Fuzzy Logic:

Text Book(s):

Reference Book(s):
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### UNIT I
Classification of transmission lines: Planar, quasiplanar and 3-D structures, their basic properties, field distribution and range of applications. Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation Numerical analysis, Hybrid mode analysis, Substrate materials and fabrication steps in MIC

### UNIT II
Introduction to microstrip line, slot line and coplanar wave guide
Microstrip circuit design: Introduction, Impedance transformers, Directional couplers, branch line couplers, filters, resonators. Design and Fabrication of Lumped elements for MICs, Comparison with distributed circuits

### UNIT III
Non-reciprocal components and active devices for MICs: Ferromagnetic substrates and inserts, Microstrip circulators, Phase shifters, Microwave transistors, Parametric diodes and Amplifiers, PIN diodes, Transferred electron devices, IMPATT, BARITT, Avalanche diodes

### UNIT IV
MMIC technology: Fabrication process of MMIC, Hybrid MICs, Configuration, Dielectric substances, thick and thin film technology, Testing methods, Encapsulation and mounting of Devices.

### Text Book(s):

- [T2] Microwave Microwave Engineering By D.M.Pozar,

### Reference Books:

- [R2] Liao S.Y.: Microwave Circuits & Devices, PHI
Paper Code: MECS-602
Subject ; Object Oriented Analysis & Design

INSTRUCTIONS TO PAPER SETTERS:

UNIT I
Object Oriented Design Fundamentals: The object model - Classes and Objects, Complexity, Classification, Notation, Process - Pragmatics - Binary and entity relationship, Object types - Object state, OOSD life cycle

UNIT II
Object Oriented Analysis: Overview of Object Oriented Analysis, Shaler/Mellor, Coad/Yourdon, Rumbaugh, Booch’s Approach towards the analysis, UML, Use case, Conceptual model, Behaviour, Class, Analysis patterns, Overview, Diagrams, Aggregation.

UNIT III

UNIT IV
Managing Object Oriented Development Managing analysis and design - Evaluation testing - Coding - Maintenance Metrics, case Studies In Object Oriented Development Design of foundation class libraries - Object Oriented databases - Client/Server computing - Middleware.

Text Book(s):

Reference Books:
[R1] Yogesh Singh, Ruchika Malhotra , Object oriented software engineering, PHI 2012
UNIT I
Introduction: Statement of an Optimization problem, Classification of Optimization problems

UNIT II
One-Dimensional Minimization Methods: Elimination Methods, Unrestricted Search Method, Fibonacci Methods, Interpolation Methods – Quadratic and Cubic Interpolation Methods

UNIT III
Constrained Minimization Methods: Characteristics of a constrained problem, Direct Methods of feasible directions, Indirect Methods of interior and exterior penalty functions

UNIT IV
Genetic Algorithm: Introduction to GA, fitness function, GA operators, Unconstrained and constrained optimization using Genetic algorithm, Global optimization using GA.

Text Books

References Book(s):
[R2] “Optimization for Engineering Design: Algorithms and Examples”, Kalyanmoy deb, PHI publication
UNIT I


UNIT II

UNIT III

UNIT IV
Rough Sets: Introduction, Imprecise categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.

Text Book(s):

Reference Book(s):
UNIT I
Introduction:
What is measurement and why do it? Measurement in software engineering, scope of software metrics.
The Basics of Measurement:
Representational theory, Measurement & Models, Measurement Scales and Scale Types, Meaningfulness in Measurement

UNIT II
A Goal Framework for Software Measurement:
Classifying software measures, Determining what to measure, Applying the framework Empirical Investigation
 & Data Collection:
Four Principles of Investigation, Planning formal experiments, What is good data, How to define the data, How to collect data, When to collect data.

UNIT III
Analyzing Software Measurement Data:
Analyzing the results of experiments, Analysis Techniques, Overview of statistical tests.Measuring Internal Product Attributes, Size and Structure:
Aspects of Software Size, Length, Reuse, Functionality, Complexity, Types of Structural Measures, Modularity and information flow attributes, Object Oriented Metrics

UNIT IV
Measuring External Product Attributes:
Modeling Software Quality, Measuring aspects of quality
Measurement and Management:
Planning a measurement program, Measurement in practice, empirical research in software engineering.

Text Book(s):
Reference Books:
INSTRUCTIONS TO PAPER SETTERS: Maximum Marks : 75
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UNIT I
Introduction to software life cycle, Management activities in a software project,

Requirements engineering: Requirements Elicitation, Requirement Elicitation techniques, Requirement Analysis, Requirement Analysis Models, Requirement Documentation, Requirement Management

UNIT II
Size Estimation: Function Point Analysis from DFD’s, ER diagram, Function Point Analysis from Use Case Diagram & Class Diagram, Mask II FPA, LOC estimation, Conversion between size measures

UNIT III
Effort, schedule & cost estimation: Estimation factors, COCOMO-II, Estimation by Analogy, Validating Software Estimates
Tools: Software Estimation Tools

UNIT IV
Industry Resources; IFPUG, UQAM-SEMRL, COSMIC, IEEE, Two latest Research papers to be covered

Text Books:

Reference Books:
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

INSTRUCTIONS TO PAPER SETTERS:

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Maximum Marks: 75

Unit-I
Introduction:
Introduction to artificial intelligence and intelligent agents, categorization of AI

Problem solving:
Production systems and rules for some AI problems: water jug problem, missionaries-cannibals problem etc.
Solving problems by searching: state space formulation, depth first and breadth first search, iterative deepening

Unit-II
Intelligent search methods:
A* and its memory restricted variants

Heuristic search:
Hill climbing, best-first search, problem reduction, constraint satisfaction.

Game Playing:
Minimax, alpha-beta pruning

Unit-III
Knowledge and reasoning:
Propositional and first order logic, semantic networks, building a knowledge base, inference in first order logic, logical reasoning systems

Planning:
Components of a planning system, goal stack planning, non-linear planning strategies, probabilistic reasoning systems, Baysian networks

Unit-IV
Learning:
Overview of different forms of learning, Inductive learning, learning decision trees, computational learning theory, Artificial neural networks.
Evolutionary computation: Genetic algorithms, swarm intelligence, particle swarm optimization.

Applications:
Robotics, Natural language processing etc.

Text Book:

Reference book:
UNIT-I
Introduction: well posed learning problem, designing a learning system: training experience, target function, final design. Issues in machine learning
Concept, Learning and General to specific ordering: concept learning task, concept learning as search, version spaces and candidate elimination, inductive bias

UNIT-II
Decision Tree learning (DTL): introduction, decision tree representation, problems for DTL, DTL algorithm, hypothesis space search, inductive bias in DTL, issues in DTL.
Bayesian Learning: Introduction, Bayes Theorem, concept learning, least square hypothesis, predicting probabilities, Bayes optimal classifiers, EM algorithm

UNIT-III
Instance Based Learning: introduction, K-nearest neighbor learning, locally weighted regression, case based reasoning.
Learning set of rule: introduction, sequential covering algorithm, learning rule sets, first order rules

UNIT-IV
Analytical learning: introduction, perfect domain theory, explanation based learning. Inductive analytical approaches to learning.

Text Book:

References:
1. Introduction to machine learning: EthemAlpaydin PHI learning, 2008
3. Pattern Classification - Duda, Hart and Stork, 2000
4. The Elements of Statistical Learning - Hastie, Tibshirani, Friedman, Springer 2001
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### UNIT I


**Graph Theory:** Graph, Matrix representation, Paths and Independent paths, Generation of graph from program, Identification of independent paths.

**Functional Testing:** Boundary Value Analysis, Equivalence Class Testing, Decision Table Based Testing, Cause Effect Graphing Technique.

### UNIT II

**Structural Testing:** Control flow testing, Path testing, Data Flow Testing, Slice based testing, Mutation Testing

**Software Verification:** Verification methods, SRS verification, SDD verification, Source code reviews, User documentation verification, Software project audit.

### UNIT III

**Creating Test Cases from Requirements and use cases:** Use case diagram and use cases, Generation of Test cases from use cases, Guidelines for generating validity checks, Strategies for data validating, Database testing, Regression Testing: What is Regression Testing?, Regression test cases selection, Reducing the number of test cases, Risk analysis, Code coverage prioritization technique

**Software Testing Activities:** Levels of Testing, Debugging, Software Testing Tools, and Software test Plan

### UNIT IV


**Automated Test Data Generation:** What is automated test data generation? Approaches to test data generation, Test data generation, using genetic algorithm, Test Data Generation Tools.

### Text Books:


### Reference Books:


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**Scheme and syllabus for PhD course work in accordance with PhD ordinance 2017 is approved in 98th SRC dated 6th April, 2018 and 47th BoS dated. 13th April 2018, and 44th AC held on 3rd May, 2018 (Agenda item no. AC44.22) wef 2018-19.**

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### Paper Code: MECS – 703

**Subject:** Advanced Software Testing

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UNIT I

UNIT II
Tailoring the Software Quality Assurance Program: Reviews, Walkthrough, Inspection, and Configuration Audits.
Evaluation: Software Requirements, Preliminary design, Detailed design, Coding and Unit Test, Integration and Testing, System Testing, types of Evaluations.

UNIT III
Trend Analysis: Error Quality, Error Frequency, Program Unit Complexity, Compilation Frequency.

UNIT IV
Corrective Action as to Cause: Identifying the Requirement for Corrective Action, Determining the Action to be Taken, Implementing the Correcting the corrective Action, Periodic Review of Actions Taken.

Text Books:

Reference Books:
UNIT-I Introduction of Mobile Robotics, Mechanics and Locomotion: A brief history of mobile robotics, applications and market. Recent advances in the mobile robotics for RISE (Risky Intervention and Surveillance Environment) applications, Locomotion, Key issues in locomotion, legged, wheeled and aerial mobile robots.

Mobile Robot Kinematics: Introduction, kinematic models and constrains, mobile robot workspace, beyond basic kinematics, motion control (kinematic control). [T1, T2, T3]

UNIT-II Perception, robotics Architectures and Robot Learning: Sensors Classification, sensor characterization, wheel/motor encoders, heading/orientation sensors, ground based beacons, active ranging, motion/speed sensors, vision based sensors. Low level control, Control architectures, software frameworks, Robot Learning, case studies of learning robots. [T1, T2, T3]

UNIT-III Mobile Robot Localization: Introduction, the challenge of localization: Noise and aliasing, to localize or not to localize: localization based navigation versus programmed solutions, map representation, probabilistic map, map based localization, autonomous map building. Planning and navigation: Planning and reaction, obstacle avoidance, D* algorithm, Navigation architecture, case studies. [T1, T2, T3, R2]


Text Books:

Reference Books:
PhD Course work of USIC&T, GGS Indraprastha University, Delhi

Paper code: PhDICT-102  
Subject: STATISTICAL COMPUTING  
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Unit-I

Unit-II
Sampling Distributions & Descriptive Statistics: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z). Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test and Chi-Square test - - Analysis of variance ANOVA – One way and two way classifications. Tabular data- Power and the computation of sample size-

Unit-III

Unit-IV

References:
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Unit - I
Introduction to Data Science: - Big Data and Data Science, Datafication - Current landscape of perspectives, Statistical Inference - Populations and samples - Statistical modeling, probability distributions, fitting a model - Intro to R, exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA - Philosophy of EDA –

Unit – II
The Data Science Process - Case Study: RealDirect (online real estate firm), Three Basic Machine Learning Algorithms - Linear Regression - k-Nearest Neighbors (k-NN) - k-means, Motivating application: Filtering Spam - Why Linear Regression and k-NN are poor choices for Filtering Spam - Naive Bayes and why it works for Filtering Spam - Data Wrangling: APIs and other tools for scrapping the Web

Unit -III
Feature Generation and Feature Selection (Extracting Meaning From Data) - Motivating application: user (customer) retention - Feature Generation (brainstorming, role of domain expertise, and place for imagination) - Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests Recommendation Systems: Building a User-Facing Data Product - Algorithmic ingredients of a Recommendation Engine - Dimensionality Reduction - Singular Value Decomposition - Principal Component Analysis - Exercise: build your own recommendation

Unit - IV
Mining Social-Network Graphs - Social networks as graphs - Clustering of graphs - Direct discovery of communities in graphs - Partitioning of graphs - Neighbourhood properties in graphs, Data Visualization - Basic principles, ideas and tools for data visualization, Data Science and Ethical Issues - Discussions on privacy, security, ethics - A look back at Data Science

Text Book:

Reference Books:

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Unit-I
Introduction, DL successes, Gradient descent, logistic regression, Probability, continuous and discrete distributions, maximum likelihood, cost function hypothesis and tasks, training data, max. likelihood cost, cross entropy, MSE cost, feed-forward networks, MLP, Sigmoidal units, neuroscience inspiration, output vs hidden layers; linear vs non-linear networks, learning via gradient descent; recursive chain rule (backpropagation); if time: bias-variance tradeoff, regularization; output units: linear, softmax; hidden units: tanh, RELU; GPU training, regularization, etc;

Unit-II
RLUs, dropout, batch normalization, How to use the SCC cluster; introduction to Tensorflow..Convolutional neural networks; Convolutional nets continued; case studies; probabilistic methods Applications of Deep Belief Nets and related models recurrent neural networks; sequence modeling; backpropagation through time; vanishing/exploding gradient problem; gradient clipping, long-short term memory (LSTM) more intuition about RNNs, LSTMs; toy addition problem; language modeling; bi-directional RNN

Unit-III
Autoencoders Gated recurrent unit; bi-directional RNN; encoder-decoder RNN; neural machine translation Attention; neural Turing machines; Reading: Neural Turing Machines paper; Neural Machine Translation by Jointly Learning to Align and Translate paper;

Generative Adversarial Networks, Reading: Andrew Ng’s reinforcement learning lecture; Andrej Karpathy’s blog post on policy gradient; Deep Mind’s Playing Atari with Deep Reinforcement Learning paper. image and video captioning vision for autonomous driving

Parsing, Recursive Neural Networks ResNets and WaveNet Gender prediction using character level language models

Unit-IV

Text book:
1. Deep Learning, by Ian Goodfellow, Yoshua Bengio, Aaron Courville. MIT press

References:
UNIT – I
Web and Semantic web origins, basic concepts of web & semantic web, Semantic Web roadmap, its vision and objectives, from today’s web to semantic web, various concerns, Need and possibilities, applications, W3C, contributions of Sir Tim Berner’s LEE, myths/hypes/fallacies of semantic web.

UNIT – II
Architecture of Semantic Web (various versions), Gerber's evaluation criteria, various semantic web technologies and tools. XML, XMLS, XML Query Language, RDF as a data model of semantic model, RDFS, RDF/XML, URI, Cryptography concerns and issues.

UNIT – III
Ontology and its operations, Ontology Engineering along with Ontology design and development concerns, Querying the semantic web, SPARQL Query processing, optimization and execution along with implementation illustrations for filtering RDF using Jena and twinkle tool, Linked Open Data and 5-star LOD scheme by Tim Berner's Lee.

UNIT – IV

TEXT BOOKS:

REFERENCES