

SYLLABUS OF MASTER OF ENGINEERING IN SOFTWARE ENGINEERING

First Semester

Category - Departmental / Specialization Basket

Paper - I

PG / SWE / T / 111A Information Systems Engineering

Introduction to Information Systems: Data / Information / Knowledge, organizational structure based on management activity, types of information systems : Transaction Processing / Management Information Systems / Executive Information Systems / Decision Support Systems, Enterprise Resource Planning, Knowledge Management.

Information Systems and Technology Planning Methodology: Enterprise Analysis: Data Collection, 7S model, Viable Systems Analysis -Enterprise Modeling: Zachman's Framework, Information Model, Create-use matrix, IS & Information Technology Strategy –Implementation (Hardware sizing)

Introduction to Decision Support Systems (DSS), Modeling Decision Processes.

Systems Perspective of DSS: Information quality issues in DSS design, elements of DSS architecture. Design and Build DSS: DSS analysis and design process, DSS development process, tools for DSS development. Evaluation of DSS, DSS implementation strategy, risks in DSS implementation.

Executive Information Systems: EIS characteristics, EIS sources and determination, EIS development framework, EIS limitations.

Data Warehousing: Data Store, Data Mart, characteristics of a data warehouse, data warehouse architecture, Extract / Clean / Transform / Load (ETL), metadata of a data warehouse and its components.

PG / SWE / T / 111B Formal Methods in Software Engineering

Integer functions: floors, ceiling, mod.

Number Theory: Divisibility and Primes, Stirling numbers, Eulerian numbers, Harmonic numbers, Bernoulli numbers, Fibonacci numbers

Generating Functions: Solving recurrences, Special generating functions, Convolutions, Exponential generating functions.

Probability. Stochastic processes: Classification, Bernoulli processes, Markov Chains and Markov processes(birth and death process etc.), queuing models.

Calculating programs from specifications; Review and Introduction of Z notation: Propositional and Predicate Logic, Equality, Sets, Relations, Functions, Groups, Sequences; Predicates and Programming: Specifications: pre-conditions, postconditions and the Hoare Triple, Weakest preconditions; Proofs about Programs: Proof of correctness of assignment statements, proof of conditional expressions, Proof of loop expressions - Invariant of a loop; Calculating Programs from Specifications: calculating expressions in assignments, calculating Conditionals, calculating Loops; Schemas:

Structuring and Composing Descriptions, Schema Operators, Promotion, Preconditions on Schemas; Implementation: Refinement, Refinement with Schemas, Refinement Calculus; Objects, Classes, Inheritance: Object- Z and Object Oriented Specifications, Forward declaration, recursion, Contrast Z with Object-Z; Case Studies.

Paper - II

PG/ SWE / T / 112A Principles of Software Engineering

Importance of Software Engineering Paradigms; Life Cycle Models- Waterfall Model, Prototyping Model, Spiral Model, RAD; Requirement Analysis – Functional Modelling and Data Flow, Data Modelling, Mechanics of Structured Analysis- Logical and Physical DFDs, ERD, Data Dictionary; Design Process- Transform and Transaction Analysis, Structure Chart, Modularity; Other methods – Jackson Structured Programming (JSP) and System Development (JSD).

Software Project Planning – Software Metric, Cost Estimation – COCOMO Model; Software Quality Assurance – White Box and Black Box Testing, Test Case Design, Unit Testiion, Integration Testing, Verification and Validation of Software.
User Interface Design, Component Level Design

Paper - III

PG/ SWE / T / 113A Operating Systems and Kernel Programming

Recapitulation of Operating Systems: I/O Programming, Interrupt structure and processing, Multiple processors. Concurrent processes: Synchronization and Communication Threads and Processes. Memory Management- Partitioned Allocation, Paged Allocation, Demand Paged Allocations, Segmented Allocation, Processor Management- Scheduling, Multiple-Processor scheduling; File Systems; Virtual Machines, Device Drivers

Case Study: UNIX/LINUX

Shell programming.

System calls for shared memory, semaphore, queues and other IPCs, POSIX Threads programming.

Kernel Structure and Interface, Memory Management, Process Management, Interrupt Handling, Timing and Synchronization, Device Driver, File System, Linux Inter Process Communication, Security Architecture

Category – Inter - Disciplinary Basket

Paper –IV

PG/ SWE / T / 114A Algorithms and Data Structures

Preliminaries: Order Notation, Recurrence, Counting and Probability, Elementary Data Structures such as lists, stacks, queues, binary search trees.

Data Structures :Rooted trees, Hash Table, AVL Tree, Red Black Trees, Augmenting data structures e.g., Interval Trees and their applications

Sorting Algorithms: External Sorting

Branch & Bound Method

Dynamic Programming, Greedy Algorithms, Amortized analysis

Advanced data structures: Sets, B Trees, B+ Tree

Graph Algorithms: Traversals, Minimal Spanning Trees, Single Pair Shortest Path, All pair shortest paths, Maximal flow

NP-Completeness, Approximation algorithms.

Paper-V

PG / SWE / T / 115A Network Technologies

HUB Technology : Intelligent HUBS and Their Components, Switching Architectures for LAN and Internetworking. Ethernet switches, Switching Network Management, Bridges

Access and High Speed Networking Technologies : ISDN, CABLE MODEM SYSTEMS, DSL (Digital Subscriber Technology).

Routing Protocols : Routing Tables and Routing Mechanism, Subnet Routing, Internet Routing, Gateway Routing Protocols RIP, OSPF and BGP.

Internet Technology: IP and Datagram, Internet Addressing, gateway ,Addressing, Mapping of Physical and IP Addresses. IP Routing , Mobile IP , ICMP and IPV6.TCP , TCP Headers and services, Connection establishment and termination, Flow Control and Window Size Advertisement, TCP –Time out and retransmission

Internet Standard Services : FTP, SMTP, HTTP, POP3 , DNS , Recent Advances in Domain Name Services, IMAP , MIME

Communication and Network Security : Network management (SNMP, RMON, DHCP) Cryptography, Firewalls.

Wireless and Mobile Data Services: Overview of Wireless Technology Why wireless, what makes wireless Network Different and Introduction to Mobile communication.

Paper- VI

PG / SWE / T / 116A Advanced Data Bases

Overview of database management systems: (Recapitulation - Data Models, Architecture, Normalization, Query languages)

Query Processing and optimization

Transaction processing, Concurrency Control , Recovery Techniques

Database Security and Integrity

Storage Structure and File organization

Distributed Database Management System: Distributed database design, Query processing and optimization in distributed databases, Concurrency control and reliability, Data replication, Data integration, Peer-to-peer systems, Distributed information retrieval

Introduction to Object Oriented Database Management System.

Data Mining and Warehousing: Association Rule algorithms, Algorithms for sequential patterns; Clustering and classification in data mining, Basic Structure of a Data Warehouse, Extension of E-R Model, materialistic View Creation , Online Analytical processing and Data Cube, Deductive databases , Recursive Query Construction , Logical database Design and Datalog

Recent Topics: Temporal Database, Multimedia Database, Text Retrieval and Mining , Web Mining.

PG / SWE / T / 116B Evolutionary Algorithms

Knowledge representation using Predicate Calculus; Resolution and Theorem Proving Introduction to Production systems , Search : Uninformed Search and Informed Search: Heuristic search, A* Algorithm, AND/OR Graph, AO* algorithm, Introduction to Logic Programming Language : Prolog

Genetic algorithms :(Gas), evolution strategies (Ess), evolutionary programming (EP), genetic programming (GP); selection, Genetic operators crossover, Inversion ,mutation, Bitwise operator; schema analysis; analysis of selection algorithms; convergence; Markov and other stochastic models; classifier systems; constraint handling; multi-objective and multimodal optimization. Real Life problem, Differences and similarities between GA and other traditional Methods, Advances in GA and other recent optimization Techniques.

Fundamentals of Neural Network: Brain Style Computing Origins and issues, Neural Network Architecture (single layer , Multilayer, Recurrent Networks), Mc -Culloch Pits model of Neuron Feed Forward Network and Supervised Learning, Learning Methods and hybrid learning algorithms; Backpropagation Networks - Feed forward and feedback networks , Back propagation Algorithm and their applications, Radial basis function network , Attractor Neural networks: associative Learning, Hopfield Network, Applications of Hopfield Network, Example of Recall of Memories , ART: adaptive Resonance Theory, Neural Networks and the Soft computing paradigm.

Category – Sessional Courses

Sessional 1

PG / SWE / S / 111 Software Laboratory

Assignments will include a mix of problems from among the following subjects: (i) Data Structures, (ii) Data base Management Systems, (iii) Programming in UNIX

Sessional 2

PG / SWE / S / 112 Seminar

Second Semester

Category - Departmental / Specialization Basket

Paper – VII

PG / SWE / T/ 127A Object Oriented Software Systems

Object Oriented Modeling: Life Cycle, abstraction, encapsulation, modularity, inheritance, polymorphism, composition, aggregation. Use cases, classification, and identification of objects. UML Notation: Class diagram, object diagram, sequence diagram, collaboration diagram, activity diagram, packages, States Transition diagram, UML model, Metal Model. Object Oriented quality assurance, metrics; UML Metamodel; Design and Architectural Patterns.

Paper – VIII

PG / SWE / T/ 128A Distributed Software Architecture

Client-server, N-tier, peer-to-peer, and super-peer Architectures. Architectural styles, architectural patterns, analysis of architectures, formal descriptions of software architectures, architectural description languages and tools, scalability and interoperability issues, Web application architectures: Web Clients, Web Servers, Object Models, Protocols with case studies. Distributed and Mobile Middleware Systems with case studies.

Paper – IX

PG / SWE / T/ 129A Software Quality Management

Software Quality assurance, Software Metrics, Software Validation, Static and dynamic Analysis, Symbolic Equation, Mutation Analysis, Dynamic Testing, unit Testing, White-box and black box testing, Test Case Generation, Integration Testing. Bottom-up & Top-down Testing. System Testing, Function Testing, Performance Testing, Acceptance Testing, Installation Testing, theoretical foundation of Testing, Formal verification, Test Tools.

Module Introduction, objectives of Usability, How to approach usability, designing with usability in mind, Measuring usability, Guidelines for user interface design, User Interface Elements, Dialog Design, SSADM : Methodology for Dialog Design, Prototyping tools

Software Reliability: Reliability, Hazard, MTTF, Repair and Availability, Steady-state Availability, Estimation of residual errors, Reliability Models, Software Complexity, Cyclomatic Complexity, Halstead's Metrics.

Issues in Project Management - Management Functions, Software Project Management Plan, Software management Structures, Personnel Productivity. Software project complexity, software Metrics - Basic Considerations Size Oriented, Function Point Oriented, Software cost estimation techniques. Algorithmic cost modeling. The COCOMO model.

Software project scheduling and the establishment of relationships among the different tasks. Tasks, dependencies and conflict resolution. Resource management and allocation.

Risk assessment and its impact in the planning and scheduling of software projects.

Software configuration management and its importance in the management of large software projects.

Software Risk and Reliability

ISO 9001 and SEI's Capability Maturity Model.

Total Quality Management, six sigma.

PG / SWE / T/ 129B Information & Network Security

Security Concepts, Classical Information Security, Symmetric Key Encryption , Public Key encryption, Hashing, Digital Signature,

Fundamental Framework for network Security, Authentication Applications, Electronic Mail Security, IP Security, Web Security, System Security, Intruders, Malicious Software, Firewalls, Standards and Standards-Setting Organizations,.

Packet Filters. Enterprise Network Security. Anatomy of a Hack

Category – Inter - Disciplinary Basket

Paper - X

Real Time Embedded System

From the inter-disciplinary basket of Power Engineering.

PG / SWE / T/ 1210B Parallel Processing

Introduction to Parallel Processing. Architectural classifications and Techniques. Arithmetic and Instruction Pipelines, Pipelining Hazard and Scheduling Theory, Super Scalar Architectures, asynchronous Pipelines. Interconnection Networks, Hyper cubes, Shuffle Exchanges, Trees, Meshes and Butterfly networks, Parallel Algorithm for linear Algebra, Sorting, Fourier Transform, Systolic Arrays. Vector Processors. Shared Memory Multiprocessor Systems. Data Flow Architectures. Parallel Processing - Software Issues, Operating Systems for Parallel Processors. Control and Data Parallel approach; Adahl's law and effect, multi-computer and clustering, different parallel programming languages, Foster design methodologies. Thread Programming, MPI programming, C* programming Selected Case Studies of Parallel computing Systems.

PG / SWE / T/ 1210C

Mobile and Wireless Systems and Protocols

Physical Layer Overview , FH, DHSS, Wireless Media Access Control , Wireless LANs-802.11 standards and MAC fundamentals, 802.11 Framing , Wireless Management operations , Power Optimization in Routing Protocols For Wireless and Mobile Networks, Mobility in wireless, Wireless Security Protocols, LAN and Indoor wireless environments, Mobile IP protocols and Network layer ,Data Dissemination and Broadcasting in Radio Networks, Emerging Wireless Technologies – Bluetooth, WiMAX

Mobile computing Architecture- GSM and similar Architectures, GPRS, Types of Handoffs in Mobile wireless Network, Location management in cellular Network. , Data Synchronization in Mobile Computing Systems, Mobile Devices: Server and Management, Mobile Adhoc and Sensor Networks, Mobile Internet Connectivity, and Personal Area Network.

Category – Sessional Courses

Sessional 1

PG / SWE / S / 121

Term Paper Leading to Thesis

Each student will be given a problem (design / analysis / software development / large laboratory assignments). He/she has to work on literature survey, scope of problem, and has to submit a report at the end of the semester.

Sessional 2

PG / SWE / S / 122

Seminar

Each student will be given a topic in the second semester. He/she has to submit a write-up and deliver a lecture in the semester.

Third and Fourth Semester

Sessional 1

PG / SWE / TH / 21

Thesis Work

Each student will devote full time on an assigned research problem or design and development work under the supervision of a faculty member. He/she has to submit a project report at the end of the semester. The report will be evaluated by internal examiner and an external examiner. Examiners will also conduct a viva-voce examination after the evaluation of the thesis.

Sessional 2

PG / SWE / VV / 22 Viva – Voce