

DEPARTMENT OF SOFTWARE ENGINEERING

SYLLABI OF COURSES

FOR

**B.E. (SOFTWARE)
DEGREE PROGRAMME**

BATCH: 2016-2017 Onward

**NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,
KARACHI-75270, PAKISTAN**

BACHELOR OF SOFTWARE ENGINEERING SCHEME OF STUDIES

Subject to changes and modifications by the University, the courses of studies for the present batch are as follows:

FIRST YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hrs
1	CT - 153	Programming Languages	3 (2+1)
2	CT - 174	Fundamentals of Information Technology	3 (2+1)
3	CT - 162	Discrete Structures	3 (3+0)
4	HS - 104	Functional English	3 (3+0)
5	MT - 173	Calculus	3 (3+0)
6	HS - 105 HS - 127	Pakistan Studies OR Pakistan Studies (for Foreigners)	2 (2+0)

FIRST YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 157	Data Structure Algorithms & Applications	4 (3+1)
2	SE - 201	Object Oriented Concepts & Programming	4 (3+1)
3	EL - 134	Basic Electronics	4 (3+1)
4	PH – 122	Applied Physics	4 (3+1)
5	HS - 205 HS - 209	Islamic Studies OR Ethical Behaviour	2 (2+0)

SECOND YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 251	Logic Design & Switching Theory	4 (3+1)
2	SE - 202	Computer Graphics	4 (3+1)
3	SE - 207	Software Engineering	3 (3+0)
4	MT - 273	Differential Equations & Linear Algebra	3 (3+0)
5	HS - 208	Business Communications & Ethics	3 (3+0)

SECOND YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 252	Computer Architecture & Organization	4 (3+1)
2	CT - 258	Financial & Cost Accounting	3 (3+0)
3	SE - 208	Software Requirement Engineering	3 (3+0)
4	SE - 204	Database Management Systems	4 (3+1)
5	SE - 206	Web Engineering	4 (3+1)

THIRD YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	IF - 301	Applied Economics for Engineers	3 (3+0)
2	MT - 331	Probability & Statistics	3 (3+0)
3	SE - 308	Software Design & Architecture	3 (2+1)
4	SE - 302	Human Computer Interaction	3 (3+0)
5	SE - 303	Operating Systems	4 (3+1)

THIRD YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 351	Computer Communication Networks	4 (3+1)
2	CT - 361	Artificial Intelligence & Expert Systems	4 (3+1)
3	SE - 309	Software Quality Engineering	3 (2+1)
4	SE - 310	Software Project Management	3 (3+0)
5	SE - 311	E-Commerce	3 (3+0)

FINAL YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 460	Network & Information Security	4 (3+1)
2	SE - 405	Modeling & Simulation	3 (3+0)
3	SE - 406	Distributed Computing	4 (3+1)
4	SE - 407	Data Warehousing & Mining	4 (3+1)
5	SE - 499	*Software Engineering Project	-

* Duration one academic year: Requires literature survey and preliminary work during this Semester.

FINAL YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	HS - 403	Entrepreneurship	3 (3+0)
2	MT -442	Numerical Methods	3 (3+0)
3	SE - 408	Design Patterns	3 (3+0)
4	SE - ###	Elective Course	3 (3+0)
5	SE - 499	Software Engineering Project	6 (0+6)
		Elective Courses: SE - 484 Software Testing Strategies & Techniques SE - 485 Software Reliability Engineering & Safety Critical Systems SE - 486 Information Systems Engineering	

FIRST YEAR

CT-153 PROGRAMMING LANGUAGES

Credit Hours: 2,1

Language: Definition, structures, Survey of some programming languages, special and general purpose languages, data types. Comparative study by means of primitive and composite data structures, Control structures by means of expression of algorithms.

Recommended Books:

1. “*Python 3 Object Oriented Programming*”, Dusty Phillips, 3rd Edition, 2018, Packt Publishing.
2. “*Let us C*”, Yashavant P. Kanetkar, Jones & Bartlett Publishers, 15th Edition, 2016.

CT-157 DATA STRUCTURE ALGORITHMS & APPLICATIONS

Credit Hours: 3,1

A detailed study of the basic data structures commonly used in data processing; Techniques for data manipulation in structures such as stacks, queues, linked lists trees and graphs, management of memory space and overflow, sorting, and hash table methods; Searching and merging files, implementation and evaluation of various programming assignments.

Recommended Books:

1. “*A Common-Sense Guide to Data Structures and Algorithms: Level Up Your Core Programming Skills*”, Jay Wengrow, Pragmatic Bookshelf, 1st Edition, 2017.
2. “*Data Structures with C*”, Seymour Lipschutz, McGraw-Hill, 2011.
3. “*Data Structures and Algorithms*”, Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Pearson Education Inc., Fourth Impression, 2010.

CT-162 DISCRETE STRUCTURES

Credit Hours: 3,0

Mathematical logic, Sets, Functions, Algorithms, Complexity of Algorithms, Mathematical reasoning, Induction, Recursion, Sequences and Sums, Recursive Definitions, Recursive Algorithms, Counting, The Pigeonhole Principal, Permutations and Combinations, Binomial Coefficients, Discrete Probability, Expected Value and Variance, Recurrence Relations, Solving Recurrence Relations, Divide-and-Conquer Relations, Generating Functions, Inclusion-Exclusion Relations and their Properties, Representing Relations, Closures of Relations, Equivalence Relations, Partial Ordering, Introduction to Graphs, Graph Terminology, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problems, Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees, Boolean Algebra, Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits, Modeling Computation, Languages and

Grammars, Finite-State Machines with Output, Finite-State Machines with No Output, Language Recognition.

Recommended Books:

1. “*Discrete Mathematics and its Applications*”, Kenneth H. Rosen, McGraw Hill Science/Engineering/Math, 7th Edition, 2012.
2. “*Mathematical Structures for Computer Science*”, Judith L. Gersting, W. H. Freeman, 7th Edition, 2014.

CT-174 FUNDAMENTALS OF INFORMATION TECHNOLOGY Credit Hours: 2,1

Introduction to IT, recent advances in IT, IT systems, Development of the modern Computer. Introduction to Software, data structures, coding. Programming and problem solving algorithms. Data types and representation. Basic organization of Computer, Number systems. Introduction to Data Communication, Database, I.S & MIS, Networks and Internet concepts.

Recommended Books:

1. “*Fundamentals of Information Technology*”, Anoop Mathews, Alpha Science International Limited, 2013.
2. “*Introduction of Computers*”, Peter Norton, Glencoe/McGraw-Hill, 6th Edition, 2004.

SE-201 OBJECT ORIENTED CONCEPTS & PROGRAMMING Credit Hours: 3,1

Evolution of Object Oriented (OO) Programming, OO concepts and principles, benefits of OO, problem solving in OO paradigm, OO programme design process, classes, methods, objects and encapsulation; constructors and destructors, operator and function overloading, virtual functions, derived classes, inheritance and polymorphism, I/O and file processing, exception handling, OOP concepts implementation using C++.

Recommended Books:

1. “*C++: How to Program*”, Paul Deitel and Harvey Deitel, Pearson, 10th Edition, 2017.
2. “*The object oriented thought process*”, Matt Weisfeld, Addison Wesley, 2013.
3. “*C++ Programming: From Problem Analysis to Program Design*”, D.S. Malik, Course Technology, 5th Edition, 2010.

EL-134 BASIC ELECTRONICS Credit Hours: 3,1

Semiconductor Diodes: Donor and Acceptor Impurities, Zero biased, Forward biased and Reverse biased junction Diodes, Junction Diode Current Equation. Depletion barrier width and junction capacitance, diffusion capacitance, Zener and Avalanche breakdown, Hall effect.

Power Supply Circuits: Half-wave & Full wave rectification, smoothing capacitor and filters, Ripple, Regulation and Regulated Power Supplies.

Bipolar & Field Effect Transistors: Bipolar & FET Principles, Basic circuit configuration, Voltage, Current and Power gains, Concept of input and output impedance, Low Frequency High Frequency small signal models, h-pattern Bandwidth. Introduction to amplifier coupling and feedback.

Oscillators: Principle of oscillation. Transistors & IC oscillators. Stability in oscillation.

Recommended Books:

1. “*Electronic Devices*”, Thomas L. Floyd, Prentice Hall, 9th Edition, 2011.
2. “*Microelectronics Circuits*”, Adel.S. Sedra and Kenneth.C. Smith, Oxford University Press, 2014.

MT-173 CALCULUS

Credit Hours: 3,0

Vectors

Review of vectors, Vector derivatives. Line and surface Integrals. Gradient of a Scalar.

Complex Number

Argand diagram, De Moivre formula, root of polynomial equations, curve and regions in the complex plane, standard functions and their inverses (exponential, circular and hyperbolic functions).

Limits and Continuity

Bounds and bounded sets, Limit point of sets, Sequences, Convergence of sequences monotonic sequences, Function and their graph, limit of function and continuous functions.

Differential Calculus

Differentiation and Successive differentiation and its application; Leibnitz theorem, Taylor and Maclaurin theorems with remainders in Cauchy and Lagrange form, Taylor and Maclaurin series, L’Hopitals Rule, extreme values of a function of one variable using first and second derivative test, asymptotes of a function, curvature and radius of curvature of a curve, partial differentiation, exact differential and its application in computing errors, Multivariate functions, Maxima and Minima for multivariate functions, Maxima Minima under certain conditions (Lagrange Multiplier).

Integral Calculus

Indefinite integrals and their computational techniques, reduction formulae definite integrals and their convergence, Beta and Gamma functions and their identities, double and triple integration with applications. (Area, volume, centroid, inertia, arc length).

Vector Algebra

Scalar and Vector quantities, physical and geometrical meanings. Algebra of vectors. Scalar and Vector triple products.

Recommended Books:

1. “*Engineering Mathematics*”, Anthony Croft, Robert Davison and Martin Hargreaves, Pearson Education Limited, 3rd Edition, 2001.
2. “*Calculus*”, Thomas & Finney, 3rd Edition, Addison Wesley Longman, 2006.
3. “*Engineering Mathematics*”, K. A. Stroud and Dexter J. Booth, 6th Edition, Industrial Press, 2007.
4. “*Calculus and Analytical Geometry*”, Howard Anton, John Wiley & Sons Inc, 5th Edition, 1998.
5. “*Complex Analysis for Mathematics and Engineering*”, John H. Mathews, Jones and Bartlett Publishers Inc., 5th Edition, 2006.

PH-122 APPLIED PHYSICS

Credit Hours: 3,1

Fundamentals: Kinetics, potential, vibrational and rotational energies.

Electricity and Magnetism: Charge, Ohm’s Law, Direct and Alternating currents, capacitance and inductance (self and mutual inductance), Kirchoff’s Laws, thermo-electricity, Seebeck and Peltier effects. Galvanometer, Ammeter and Voltmeter, Cathode-Ray Oscilloscope, Magnetic Properties (permeability and susceptibility), diamagnetism, paramagnetism and ferromagnetism. Induction coil and transformer.

Electronics: Semiconductors, P-type, N-type semiconductors, PN-diode and its characteristics, PNP and NPN transistors and their characteristics.

Optics & Laser Physics: Interference, diffraction and polarisation phenomena. Laser stimulated emission, population inversion, laser application.

Modern Physics: Atomic structure, Black body radiation, Photon, de-Broglie’s Waves, photoelectric effect, Compton effect, Mass-Energy conversion relation. Nuclear structure, Radioactivity, Alpha, Beta and Gamma particles and their properties. Radio activity. Decay Theorem, Half-life X-Rays, characteristics and applications of X-Rays, Liquid-drop model, Fission and Fusion processes, Nuclear Reactor, Nuclear radiation, Hazards and safety.

Thermodynamics and Cryogenics: Heat, Temperature and internal energy, Laws of thermodynamics (Zeroth, 1st, 2nd and 3rd laws), Concept of entropy, Cryogenics, low temperature, method of production of low temperature (joule-Kelvin Effect, Adiabatic demagnetisation).

Recommended Books:

1. “*Physics Volume 1*”, David Halliday, Robert Resnick and Kenneth S. Krane, Wiley, 5th Edition, 2001.

2. *“Physics Volume 2”*, David Halliday, Robert Resnick and Kenneth S. Krane, Wiley, 5th Edition, 2001.

HS-104 FUNCTIONAL ENGLISH

Credit Hours: 3,0

Listening: Types of Listening, Problems in listening and coping strategies, Listening skills, Sub skills, Practice in Listening

Note taking: Techniques for taking notes (from lectures, from books), Note taking in different forms paragraphs (points, figures, processes, tables, graphs etc.)

Vocabulary development: Enhancing current vocabulary to reflect a better usage of words in spoken and written language, Tips / strategies in vocabulary enhancement, Practice in vocabulary development.

Reading: Reading skills, Sub skills, Reading comprehension levels, Reading strategies, Reading practice through variety of reading texts and comprehension exercises, Beyond reading [outline, précis, speech and presentation]

Writing: Process of Writing, Informal Writing strategies.

Writing Correctly: Sentence structure and punctuation, Error correction.

Paragraphs: Structure, Types, Topic and the topic sentence, Unity, Adequate development and coherence in paragraphs.

Essays: Types, Five paragraphs, long essays, Structure (thesis statement and the paragraphs)

Short Reports: Structure, Format and types (informational and analytical)

Letters: Elements, Styles, Formatting (digital letter writing), Organization and structure of the letter, Types (Routine requests and intimation, invitation, thank you and condolence letters etc.)

Recommended Books:

1. *“Oxford Practice Grammar”*, John Eastwood, Oxford University Press, 2006.
2. *“A Quick English Reference”*, J. S. Hooper, Oxford University Press, 1981.

HS-105 PAKISTAN STUDIES

Credit Hours: 2,0

Historical and Ideological Perspective of Pakistan Movement

Two Nation Theory: Definition - Claim of Muslims of being a separate nation from Hindus based upon cultural diversity significance. Cultural diversity and threats posed to Muslims rights and interests led to the demand of Pakistan – The Lahore Resolution.

Creation of Pakistan: Factors leading to the creation of Pakistan. Quaid-e-Azam and the demand of Pakistan.

Land of Pakistan: Geophysical conditions. Geopolitical and strategic importance of Pakistan. Natural resources-Minerals, Water and Power.

Constitutional Process: Early efforts to make constitution-problems and issues. Constitution of 1956 and its abrogation. Constitution of 1962 and its abrogation. Constitutional and Political crisis of 1971. Constitution of 1973. Recent Constitutional developments.

Contemporary issues in Pakistan:

Social issues: Literacy and education in Pakistan. State of science and technology with special reference to IT education. Pakistan; society and culture.

A brief survey of Pakistan's Economy: Agricultural and industrial development in Pakistan. Internal and external trade, Economic planning and prospects.

Environmental issues: Hazards of atmospheric pollution. Other forms of environmental degradation and their causes and solution. Pakistan's role in preservation of nature through international conventions/efforts.

Foreign Policy: Relations of Pakistan with neighbours. Relation of Pakistan with Super Powers. Relations of Pakistan with the Muslim World.

Human Rights

Conceptual foundations of Human Rights: What are Human Rights? Definition, significance and importance. Comparative analysis of Islamic and Western Perspective of Human rights.

UN Systems for Protection of Human Rights. An overview: UN Charter. International Bill of Human rights. Implementation mechanism.

Other Important international treaties and conventions: The Convention on the elimination of all forms of discrimination against women. International Convention on the rights of child(CRC).Convention against torture(CAT).Refugee Convention.

Pakistan's response to Human Rights at national and international level: Constitutional Provisions. Pakistan's obligations to international treaties and documents. Minority Rights in Pakistan. Pakistan's stand on violation of Human Rights in the international perspective.

Cultural Development in Pakistan: Definition, Contents and Contributing factors in culture. Development of Art, Philosophy and Literature.

Foreign Policy: Relation with neighbours, Super Powers and the Muslim World.

Recommended Books:

1. *"Pakistan Studies"*, M. R. Kazmi, Oxford University Press, 2007.

2. “*Constitutional and Political History of Pakistan*”, Hamid Khan, Oxford University Press, 2nd Edition, 2009.
3. “*Pakistan’s Foreign Policy*”, Abdul Sattar, Oxford University Press, USA, Illustrated Edition, 2007.
4. “*Issues in Pakistan’s Economy*”, Akbar Zaidi, Oxford University Press, USA, 2nd Edition, 2006.

HS-127 PAKISTAN STUDIES (FOR FOREIGNERS)

Credit Hours: 2,0

Land of Pakistan: Land and People – Strategic importance, Important beautiful sights, National resources.

A brief Historical Background: A brief historical survey of Muslim community in the sub continent, British rule and its impacts, Indian reaction, Two nation theory, Origin and development factors leading towards the demand of a separate Muslim state, Creation of Pakistan.

Government and politics in Pakistan: Constitution of Pakistan: A brief outline, Government structure Federal and Provisional – Local Government Institution Political History, A brief account.

Language and Culture: Origin of Urdu Language, Influence of Arabic and Persian on Urdu Language and Literature, A short history of Urdu literature.

Recommended Books:

1. “*Pakistan Affairs*”, Ikram Rabbani, Caravan Book House, Lahore, 1997.
2. “*Old Roads, New Highways: 50 Years of Pakistan*”, Victoria Schofield, Oxford University Press, Pakistan, 1997.

HS-205 ISLAMIC STUDIES

Credit Hours: 2,0

Thematic Study of Holy Quran

Basic Islamic Beliefs

Tauheed: Al-Ambiya – 22, Al Baqarah – 163 – 164

Prophethood: Al-Imran – 79, Al-Hashr – 7, Al- Madina – 3

Hereafter: Al-Hajj – 5, Al- Baqarah – 48, and two Ahadith.

Basic Islamic Practices: Al-Mu’minun – 1-11

Amer-bil-Ma’roof wa Nahi Anil Munkar: The concept of Good and Evil; Importance and Necessity of Da’wat-e-Deen, Al-Imran – 110; Method of Da’wat-e-Deen. An-Nehl – 125, Al – Imran – 104. and two Ahadith.

Unity of the Ummah: Al-Imran – 103, Al-Hujurat – 10, Al-Imran – 64, Al-An'am – 108, and two Ahadith.

Kasb-e-Halal: Ta ha-81, Al-A'raf-32-33, Al-Baqarah-188, and two Ahadith.

Huquq-ul- Ibad

Protection of Life: Al-Maidah – 32

Right to Property: An-Nisa – 29

Right to Respect & Dignity: Al-Hujurat – 11-12

Freedom of Expression: Al-Baqarah – 256

Equality: Al-Hujurat – 13

Economic Security: Al-Ma'arij – 24-25

Employment Opportunity on Merit: An-Nisa – 58

Access to Justice: An-Nisa - 135

Women Rights: An-Nehl - 97, Al-Ahzab - 35, An-Nisa - 7

Relation With Non-Muslims: Al-Mumtahanah – 8-9, Al-Anfal – 61, and The last sermon of Hajj of Holy Prophet (PBUH) at Arafat on 10th Zil Haj – Relevant extracts.

Seerat (life) of the Holy Prophet (PBUH): Birth, life in Makkah, declaration of Prophethood, preaching and its difficulties, migration to Madina, Brotherhood (Mawakhat) and Madina Charter, the Holy Wars of the Prophet (Ghazwat-e-Nabawi), Hujjat-ul-Wida, the Last Sermon of Khutbat-ul-Wida: Translation and important points.

Islamic Civilisation:

In the Sub-Continent – Pre-Islamic civilization. The political, social and moral impacts of Islamic Civilisation.

In the World - Academic, intellectual, social and cultural impacts of Islam on the world.

Recommended Books:

1. *“Thematic Study of Holy Quran and Hadith”*, Saeedullah Qazi, Reprinted by NED University.
2. *“Life of the Prophet”*, Ibne Ishaq, Alfred Guillaume (Translator), Oxford University Press, 2002.

HS-209 ETHICAL BEHAVIOUR

Credit Hours: 2,0

Introduction to Ethics: Definition of Ethics; Definition between normative and positive science; Problem of Freewill; Method of Ethics; Uses of Ethics.

Ethical Theories: History of Ethics - Greek Ethics, Medieval, Modern Ethics. Basic Concept of right and wrong: good and evil; Unilateralism, hedonism, Self-realisation – Egoism, intuitionism; Kant’s moral philosophy.

Ethics & Religion: The relation of Ethics to Religion; Basic ethical principles of major religions: Hinduism, Judaism, Buddhism, Zoroastrianism, Christianity, Islam.

Ethics, Society, and moral theory: Ethical foundation of Rights and Duties; Applied Ethics; Society as the background of moral life; Universalism and Altruism; Theories of punishment.

Recommended Books:

1. “*An Introduction to Ethics*”, William Lillie, Barnes & Noble, 3rd Edition, reprinted 1974.
2. “*Philosophy: The Basics*”, Nigel Warburton, Routledge, London, 4th Edition, 2004.

SECOND YEAR

SE-202 COMPUTER GRAPHICS

Credit Hours: 3,1

Architecture and implementation of display interactive devices; Functional capabilities of graphics package. 2D and 3D viewing , clipping and transformation, human factors; Raster graphics scan conversion algorithms; Hidden surface and edges removal algorithms; Shading and texturing techniques; Application using commercial packages.

Recommended Books:

1. “*Computer Graphics with Open GL*”, Hearn D., Baker M.P. and Carithers W., Pearson Education, 2015.
2. “*Computer Graphics using OpenGL*”, Francis S. Hill and Stephen M. Kelley, Prentice Hall, 3rd Edition, 2006.
3. “*Schaum’s Outline Series of Computer Graphics*”, Zhigiang Kiang and Roy A. Plastock, McGraw-Hill, 2nd Edition, 2000.
4. “*Computer Graphics*”, Francis S. Hill, Prentice Hall, 3rd Edition, 2006.
5. “*Computer Graphics*”, Roy A. Plastock, McGraw-Hill, 2nd Edition, 2000.

SE-208 SOFTWARE REQUIREMENT ENGINEERING

Credit Hours: 3,0

Definition of requirements engineering and role in system development, Fundamental concepts and activities of requirements engineering, Information elicitation techniques, Modelling scenarios.

Fundamentals of goal-oriented requirements engineering, Modelling behavioral goals, Modelling quality goals, Goal modelling heuristics, Object modelling for requirements engineering, Object modelling notations, Object modelling heuristics, Identifying objects from goals, Modelling use cases and state machines, Deriving operational requirements from goals, Requirements Specification, Requirements verification and validation.

Management of inconsistency and conflict, requirements engineering risks, the role of quality goals in the requirements selection process, Techniques for requirements evaluation, selection and prioritization; Requirements management; Requirements traceability and impact analysis.

Recommended Books:

1. *“Requirements Engineering”*, Elizabeth Hull, Kenneth Jackson and Jeremy Dick, Springer, 3rd Edition, 2011.
2. *“Software Requirements”*, Karl E. Wieggers, Microsoft Press, 3rd Edition, 2013

SE-204 DATABASE MANAGEMENT SYSTEMS

Credit Hours: 3,1

File structures and file testing methods sequential, random and indexed sequential methods. Relational, Networks and Hierarchical data models, Organization, storage and retrieval methods. Functional dependency and normalization of database. Query processing and manipulation. Practical assignments and a project.

Recommended Books:

1. *“Fundamentals of Database Systems”*, Ramez Elmasri, Shamkant Navathe, Pearson, 7th Edition, 2015.
2. *“Fundamentals of Database Management Systems”*, Mark.L.Gillenson, Wiley Publisher 2nd Edition, 2011.
3. *“Database Systems”*, Thomas M. Connolly, Addison Wesley, 5th Edition, 2009.

SE-207 SOFTWARE ENGINEERING

Credit Hours: 3,0

Evolving role of Software, Definition and need of Software Engineering, Software Development Process, Software Process Models, Project Management concepts – People, Problem and Process, Software project estimations concepts & techniques. Metrics concepts types & their role, Software Quality Assurance, Introduction to Software testing concepts, Brief comparison of conventional methods for Software Engineering and new methods such as Object Oriented Software Engineering.

Recommended Books:

1. *“Software Engineering: A Practitioner’s Approach”*, Roger S. Pressman, McGraw-Hill, 8th Edition, 2014.
2. *“Software engineering”*, Ian Sommerville, Addison Wesley, 10th Edition, 2015.

SE-206 WEB ENGINEERING**Credit Hours: 3,1**

WWW Technology: Internet and WWW History; The Internet and Intranets; Web Browsers & Web Servers; Web Application; URLs and navigation; TCP/IP and ports; HTTP Interaction; Client Request and Server Response; MIME; The Dynamic HTTP Protocol; Static vs. Dynamic Content; 3-Tier / n-Applications.

Web Site - Planning and Development: Web-site Goals; Planning Stages; Content Development; Site Map Development; Web-Site Design Principles; Making the site easy to navigate; Style Guides; Web-Site Hosting; Web-Site Design Tools; Web Page Programming Tools; Data Processing Tools; Maintaining and Monitoring the Web-Site.

Client Side Programming: HTML and DHTML – Tags, Linking, Forms, Event, Dynamic Style, Positioning; Document Object Model; Client Side Scripting Language - Data, Loops, Objects, Methods, Events; Java Script / VBScript; Browsers Variations; Java Script / VBScript Samples; Embedding Multimedia in Web Pages; Using ActiveX in Web.

Server Side Programming: Server Side Scripting Language; Web Server Configuration; Java / Active Server – Page Processing, Cookies, Built-in Objects; Web database access; ODBC and JDBC; Active Data Objects; Database Queries – SQL; Data Exchange and Interoperability – XML.

Concepts of Multimedia: Multimedia Hardware – Input and Capturing Devices, Output Devices Communication Devices; Multimedia Elements- Text Image Animation, Sound and Video; Text in Multimedia – Fonts. Its Attributes, Character Set, Mapping, Fonts Files: TTF, OTF; Image in Multimedia – Color Types, Compression File Formats: BMP, JPEG, GIF; Sound in Multimedia – Recording Sound, Quality, MIDI, Digital Sound, File Formats: WAV, MP3; Video in Multimedia – Broadcast Standards, Digital Video, Compression, Recording Formats, File Format: AVI, MPEG, MOV.

Web Tools: Site Builders- Dreamweaver: Introduction, Working with Layers, Tables, Images, Forms and Frames, CSS, Site Navigation, Working with Layers, Behaviour; Web Animation – Flash: Drawing and Coloring tool, Animation in Flash, Treeing, Getting Interactive, Flash Scripting; File Transference – Cute FTP: Configuring web-site, Logs, Searching Transferring files, Stopping and Resuming, Scheduling.

Multimedia Tools

Font Editing Tools – Fontlab: Creating Font, Encoding Glyphs, Transformation, Hinting, Editing Font Metrics, Exporting.

Image Drawing and Editing Tools - Photoshop: Layers in Photoshop, Image Modifying and Adjusting, Using Channels, Masks and Action, Working with Filters.

Sound Editing Tools – Sound Forge: Sampling, Features, Mixing Sound Files, Recording, Filters.

Video Editing Tools – Premier: Video Clipping Joining, Slicing, Manage Time Line.

Recommended Books:

1. *“Web Enabled Commercial Application Development Using, HTML, DHTML, Java Script, Perl, CGI”*, Ivan Bayross, BPB Publications, 2009.
2. *“Principles of Web Design”*, Joel Sklar, Course Technology, 5th Edition, 2015.
3. *“Web Engineering: The Discipline of Systematic Development of Web Applications”*, Gerti Kappel, Birgit Proll and Seigfried Reich, John Wiley & Sons, 2006.

CT-258 FINANCIAL & COST ACCOUNTING

Credit Hours: 3,0

Structure of accounting, classification of accounting frameworks, Accounting principles, Accounting Cycle, Preparation and use of worksheet, the concept and procedures of adjusting, reversing and closing entries, preparation and analysis of classified and incorporated financial statements.

Basic concepts of Cost Accounting, types of cost, cost assignments, costing methods, budgeting and planning, standard cost and variance analysis. Job order costing, process costing, ABC and JIT techniques, material, labour and overhead costing.

Includes a practical component of 1 Credit Hour.

Recommended Books:

1. *“Accounting: The Basis for Business Decisions”*, Robert Meigs and Mary Meigs, McGraw-Hill Co., 10th Edition, 1996.
2. *“Fundamentals of Cost Accounting”*, William N. Lanen, Shanon W. Anderson and Michael Maher, McGraw-Hill/Irwin, 5th Edition, 2016.
3. *“Cost Accounting: Planning and control”*, Adolph Matz and Milton F. Usry, Wadsworth Publishing Co. Inc., 9th Revised Edition, 1989.

CS-251 LOGIC DESIGN & SWITCHING THEORY

Credit Hours: 3,1

Truth Functions: Binary connectives, Evaluation of Truth Functions, Physical realisations, Sufficient set of connectives. Truth Functional calculus. Boolean Algebra, Duality, Fundamental Theorems of Boolean Algebra, Switches and Relays, Logic Circuits, Speed and Delays in Logic Circuits. Minimization of Boolean Functions: Minterm and Maxterm, Karnaugh map, Simplification of Boolean Functions, POS and SOP expressions. Tabular Minimization: Prime Implicants. Sequential Networks: Latches, Fundamental Mode, Synthesis of Sequential

Networks, Minimization of the number of states, Clocked networks, Special realizations and codes: Binary adders, Coding of numbers, Decoders and code conversion. ROMS, NAND and NOR Implementation, Parity Checkers.

Recommended Books:

1. “*Digital Logic and Computer Design*”, Morris M. Mano, Prentice Hall, 5th Edition, 2015.
2. “*Digital Fundamentals*”, Thomas Floyd, Prentice Hall, 11th Edition, 2014.

CS-252 COMPUTER ARCHITECTURE & ORGANIZATION Credit Hours: 3,1

Computer Evolution, Historical developments, System Buses, RAM, Access Methods, Performance Parameters, Cache Memory, Replacement Algorithms, Mapping Functions, Input & Output, I/O Modules. DMA, Computer Automatic Instruction sets: Characteristics and *Function*, RISC Control Unit Operation.

Recommended Books:

1. “*Computer Organization & Architecture*”, William Stallings, Prentice Hall, 10th Edition, 2015.

MT-273 DIFFERENTIAL EQUATIONS & LINEAR ALGEBRA Credit Hours: 3,0

Linear Algebra

Linearity and Linear dependence of vectors, basis, dimension of a vector space, field matrix and types of matrices (singular, non-singular, symmetric, non-symmetric, upper, lower, diagonal tridiagonal matrix), Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix, determination of consistency of a system of linear equation using rank, transitions matrix. Geometric representation of vector, norm of vector, Euclidean inner product, projections and orthogonal projections, Euclidean n spaces n properties Cauchy-Schwartz inequality, Euclidean transformations, apply geometric transformations to plane figure, composition of transformations. Eigen value and Eigen space.

Ordinary Differential Equations

Definitions (differential equation, general solution, particular solution, initial condition, boundary condition, initial homogenous and non-homogenous linear differential equations with constant coefficients, solutions of Euler differential equation, computation of particular integral of non-homogenous differential equations with problems.

Partial Differential Equations

Formation of partial differential equations, Solutions of first order linear and special types of second and higher order differential equations. Homogenous partial differential equations of order one. Lagrange multiplier.

Recommended Books:

1. “*Elementary Linear Algebra: Applications Version*”, Howard Anton and Chris Rorres, John Wiley & Sons Wiley, 11th Edition, 2013.
2. “*Differential Equations with Boundary Value Problems*”, Dennis G. Zill and Michael R. Cullen, Thomson Brooks/Cole Publishing, 8th Edition, 2012.
3. “*Advanced Engineering Mathematics*”, Erwin Kreyszig, John Wiley & Sons, 9th Edition, 2006.
4. “*Differential Equations: A modeling Perspective*”, Robert L. Borelli and Courtney S. Coleman, Wiley, 2nd Edition, 2004.

HS-208 BUSINESS COMMUNICATION & ETHICS

Credit Hours: 3,0

Writing formal and business letters; Writing formal memos; Drafting notices and minutes of meetings; Drafting tender notice; Theoretical knowledge and comprehension of contracts and agreements; Preparing proposals and technical reports; Conducting and writing a project report on a mini research (sessional work); Conducting seminars and interviews; Writing and presenting conference papers; Solving IELTS type papers.

Communication Skills

Ways and means communicating; Using English for describing objects, procedures etc. oral and written language; Importance and elements of effective communication in business (oral and written communication).

Practice in report writing (business reports, documentation related to software engineering); Practice in conducting meetings and writing minutes; Practice in making effective presentations; Writing business letters and memos.

Ethics

Introduction: Objectives of the course; Definitions of (i) a code, (ii) ethics; Defining needs for a code of ethics.

Need for a Code of Ethics: For who and why; Review of Code of Ethics of other professional bodies of Pakistan. Summative analysis of ethics for professionals in general.

Recommended Books:

1. “*Business Communication*”, Mary Ellen Guffey, South-Western College Pub, 6th edition, 2007.
2. “*Business Communication*”, Kitty Locker, McGraw-Hill/Irwin, 6th Edition, 2013.

THIRD YEAR

SE-308 SOFTWARE DESIGN & ARCHITECTURE

Credit Hours: 2,1

Introduction - Putting Software Architecture in Context, Software Architecture as a Design Plan, and as an Abstraction, Four Views of Software Architecture, Engineering concerns addressed by different views.

Role of Architect - The Architect as a Key Technical Consultant, The Architect Makes Decisions, The Architect Coaches, The Architect Coordinates, The Architect Implements, The Architect Advocates, Software Architecture as a Career.

Global Analysis - Overview of Global Analysis Activities. Analysis Factors. Develop Strategies. Analyze Organizational, Product & Technical Factors.

Design activities for Conceptual/Module/Execution and Code Architecture Views; Design Activities and Central/Final Design Tasks for each type.

Recommended Books:

1. *“Software Engineering Design: Theory and Practice”*, Carlos Otero, CRC Press, 2012.
2. *“Software Architecture Design - Methodology and Styles”*, Lixin Tao, Xiang Fu and Kai Qian, Stipes Publishing L.L.C., 2006
3. *“Applied Software Architecture”*, Christine Hofmeister, Robert Nord and Dilip Soni, Addison Wesley Professional, 1st Edition, 2009.
4. *“Software Architecture and Design Illuminated”*, Kai Qian, Xiang Fu and Lixin Tao, Jones & Bartlett Publishers, 2009.

SE-302 HUMAN COMPUTER INTERACTION

Credit Hours: 3,0

Background to human-computer interaction and concepts. Principles of human-computer interaction from psychology and cognitive science. User oriented perspective instead of system oriented. Task analysis: User-centred design, Usability engineering processes; conducting experiments, Conceptual models and metaphors, Designing interfaces: Coding techniques using colour, fonts, sound, animation, screen layout, response time, feedback, error messages. Technology: I/O, interaction styles, devices. Designing interfaces for special devices. Use of voice I/O, Internationalization and localization, help systems. User interface software architectures, Expressing design rationale for user interface design. Evaluation techniques. Communication between users and system developers.

Recommended Books:

1. “*Interaction Design: Beyond Human Computer Interaction*”, Jenny Preece, Yvonne Rogers and Helen Sharp, John Wiley & Sons, 2015.
2. “*HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science*”, John Carroll, Morgan Kaufmann, 1st Edition, 2003.
3. “*Usability Engineering: Scenario-Based Development of Human Computer Interaction*”, Mary Beth Rosson and John Carroll, Academic Press, 1st Edition, 2002.

SE-303 OPERATING SYSTEMS**Credit Hours: 3,1**

Introduction to Operating System, Operating System Structure; Concurrent Processes; CPU Scheduling; Deadlocks, Memory Management; Virtual Memory; File System; Emphasis on Character Base OS (i.e., Dos and UNIX).

Recommended Books:

1. “*Operating Systems Concepts*”, Abraham Silberschatz, Peter B. Galvin and Greg Gagne, John Wiley & Sons, 9th Edition, 2013.
2. “*Operating Systems: Internals and Design principles*”, William Stallings, Prentice Hall, Global Edition, 2017.
3. “*Modern Operating Systems*”, Andrew S. Tanenbaum, Prentice Hall, Global Edition, 2014.

SE-309 SOFTWARE QUALITY ENGINEERING**Credit Hours: 2,1**

Introduction to SQA, The Quality Challenge, Quality Control and Quality Assurance, Quality Assurance in Software Projects (Phases), Principles and Practices, Quality Management, Quality Assurance and Standards, Quality Planning and Quality Control, Verification and Validation, Planning Verification and Validation, Reliability Validation, Safety Assurance, Security assessment, Planning for SQA, SQA Plans, Software Testing, Specification based test construction techniques, White-box and grey-box testing, Software testing techniques for SDLC, Clean-room approach to quality assurance, Product Quality and Process Quality, Standards for process quality and standards for product quality, Walkthroughs and Inspections, Structure, Checklist, Audits, Roles and Responsibilities (Reviews, Inspections, etc), How to make Reviews and Inspections most effective

Recommended Books:

1. “*Software Quality Assurance: Principles and Practice*”, Nina S. Godbole, Alpha Science International, 2nd Revised Edition, 2016..
2. “*Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement*”, Jeff Tian, Wiley-IEEE Computer Society Press, 2005.

SE-310 SOFTWARE PROJECT MANAGEMENT

Credit Hours: 3,0

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

Recommended Books:

1. *“Software Project Management”*, Bob Hughes, Mike Cotterell and Rajib Mall, McGraw-Hill Higher Education, 6th Edition, 2017.
2. *“The Software Project Manager's Handbook - Principles that work at work”*, Dwayne Phillips, Wiley-IEEE Computer Society Press, 2nd Edition, 2004.

SE-311 E-COMMERCE

Credit Hours: 3,0

Introducing E-Commerce: E-Commerce and E-Business Overview; Internet History and E-Commerce Development; Business-to-Business E-Commerce; Business-to-Consumer E-Commerce; E-Commerce Stages and Processes; E-Commerce Challenges and Opportunities

Internet Hardware, Software and Communication

Hardware - Servers, Communications Media, Storage Area Networks (SANs).

Connecting to the Internet - DSL, Broadband, ISDN, T-1 and T-3 Lines.

Software - Application Service Providers (ASPs), Databases.

Operating Systems - UNIX, Microsoft Windows, Linux, Mac OS X.

Enhancing Business Communication - Intranets and Extranets, Streaming Audio and Video, Internet Telephony, Web Casting and Web Conferencing.

E-Commerce Technologies

Generic trade cycles.

Electronic Markets- Electronic markets, the trade cycle Advantages and Disadvantages.

Electronic Data Interchange - EDI trade cycle, Benefits of EDI, EDI standards, EDI communications, EDI implementation, EDI privacy and security, EDI and business, EDI trading patterns.

Internet Commerce.

E-Commerce with Business Perspective

The Value Chain - The supply chain, e-commerce in the value chain.

Competitive advantage - IT and competitive advantage, IT and competitive advantage cases.

Business strategy - Corporate strategy, Strategy formulation, Business environment, e-Commerce implementation, e-Commerce facilities for business.

Inter-Organisational Transactions - Inter-organisational transactions, Credit transaction trade cycle, variety of transactions, Inter-organizational e-Commerce.

Consumer Trade Transactions - Internet e-Commerce, the e-Shop, Internet Shopping, the Trade Cycle e-Commerce sales.

The Elements of E-Commerce

E-Visibility - Site Name, Conventional Advertising, Portals, Malls, Search Engines.

E-Shop - Online information, customer registration, site navigation, product database

Order Processing.

Online Payment - Credit Cards, e-Cash and other.

Security - encryption, SSL, digital signatures.

Delivery System - E-fulfillment.

After-Sales Services.

Internet Marketing: Online and Offline Market Refresh; Data Collection; Domain Names; Advertising Option; E-Mail Marketing; Search Engines; Web-Site Monitoring.

Online Monetary Transaction: Electronic Payment Issues; E-Cash; E-Wallets; Credit Card Issues; Merchant Accounts; Online Payment Services; Transaction Processing; Taxation Issues; Developing Payment Standards

Internet Security: Security Issues and Threats; Security Procedures; Encryption; Digital Certificates; Digital Signature; Security Protocol - SSL and SET Technologies; Authentication and Identification; Security Providers; Privacy Policies; Legal Issues.

Customer Service: Customer Service Issues; Frequently Asked Question (FAQ) Pages; E-Mail Support; Telephone Support; Live Help Service; Customer Discussion Forums; Value-Added Options.

Legal, Social and Global Issues

Legal Issues - Privacy on the Internet, Tracking Devices, Employer and Employee, Protecting your Business, Intellectual Property: Patents and Copyright, Trademark and Domain Name Registration, Children and the Internet.

Social Issues - Online Communities, Online Activism, Disabilities and the Web.

Global Issues - Intent Taxation, Creating an e-Business with Global Capabilities.

Recommended Books:

1. "*E-Commerce*" by Kenneth Laudon and Carol Guercio Traver, Prentice Hall; 8 th Edition 2011.

2. *“e-Business and e-Commerce How to Program”*, Harvey M. Deitel, Paul J. Deitel and Tem R. Neito, Prentice Hall, 2000.
3. *“The Complete E-Commerce Book”*, Janice Reynolds, CMP Books, 2nd Edition, 2004.

CT-361 ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS Credit Hours: 3,1

Introduction to Artificial Intelligence, Branches of A.I. Application of A.I. knowledge, types of knowledge, acquisition of knowledge, Knowledge engineering. Problem representation and problem solving strategic, state spaces, searching techniques. Blind search techniques. Informed search techniques. Knowledge representation techniques. Frames, Scripts, Semantic networks. Implementation of knowledge representation using PROLOG. Fundamental of Expert System. Component of Expert System Developments, Cycle of Expert System. Case studies Elize, Mycin. Natural language processing, Speech processing, Introduction to Robotics, Computer vision, Neural Networks, and Machine learning.

Recommended Books:

1. *“Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases”*, Denis Rothman, Packt Publishing, 1st Edition, 2018.
2. *“Artificial Intelligence: Structures and Strategies for Complex Problem Solving”*, George F. Luger, Addison Wesley, 6th Edition, 2008.
3. *“Artificial Intelligence: A Modern Approach”*, Stuart Russel and Peter Norvig, Prentice Hall, 3rd Edition, 2009.

CS-351 COMPUTER COMMUNICATION NETWORKS Credit Hours: 3,1

Introduction to Networking. Networks ISO/OSI reference Model. Performance Models of communication Networks. Design Protocols, Virtual circuit/ datagram. Routing cogestion control. Flow control local Networks satellite protocols, Broadcast Networks.

Recommended Books:

1. *“Computer Networks”*, Andrew S. Tanenbaum and David J. Wetherall, Prentice Hall, 5th Edition, 2010.

MT-331 PROBABILITY & STATISTICS Credit Hours: 3,0

Statistics

Introduction, Types of data & variables, presentation to data, object, classifications, Tabulation, Frequency distribution, Graphical representation, Simple & Multiple Bar diagrams, Sartorial & Pie-Diagram, Histogram, Frequency Polygon, Frequency Curves & their types.

Measures Of Central Tendency And Dispersion

Statistics Averages, Median Mode, Quartiles, Range, Moments, Skew ness & Kurtosis, Quartile Deviation, Mean Deviation, Standard Deviation, Variance & its coefficient, Practical Significance in related problems.

Curve Fitting

Introduction, fitting of a first and second degree curve, fitting of exponential and logarithmic curves, related problems. Principle of least squares, Second order Statistics & Time series not in bit detail.

Simple Regression & Correlation

Introduction, Scatter diagrams, Correlation & its Coefficient, Regression lines, Rank Correlation & its Coefficient, Probable Error (P.E), Related problems.

Sampling And Sampling Distributions

Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors, Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem with practical significance in related problems.

Statistical Inference And Testing Of Hypothesis

Introduction, Estimation, Types of Estimates, Confidence interval, Tests of Hypothesis, Chi-Square distribution/test, one tails & two tails tests. Application in related problems.

Probability

Basic concepts, Permutation & Combination, Definitions of probability, Laws of probability. Conditional probability, Baye's Rule. Related problems in practical significance.

Random Variables

Introduction, Discrete & Continuous random variables, Random Sequences and transformations. Probability distribution, Probability density function, Distribution function, Mathematical expectations, Moment Generating Function (M.G.F.), Markove random walks chain/ Related problems.

Probability Distributions

Introduction, Discrete probability distributions, Binomial Poisson, Hyper geometric & Negative binomial distributions. Continuous probability distribution, Uniform, Exponential & Normal distributions & their practical significance.

Recommended Books:

1. *“Probability & Statistics for Engineers and Scientists”*, Ronald E. Walpole and Raymond H. Myers, Sharon L. Myers and Keying Ye, Prentice Hall, 8th Edition, 2006.

2. “*Applied Statistics & Probability for Engineers*”, Douglas C. Montgomery, 4th Edition, 2006.

IF-301 APPLIED ECONOMICS FOR ENGINEERS

Credit Hours: 3,0

Programming aspects, economic aspects, human relations aspects, software trends: cost, social impact, the plurality of SE Means, The GOALS Approach to Software Engineering, The Software Work Breakdown Structure (WBS), Software Maintenance, definitions and assumptions, development effort and schedule, phase distribution, The Rayleigh Distribution, interpolation, basic software maintenance effort estimation. Performance Models, Optimal Performance, Sensitivity Analysis, Cost-Effectiveness Models.

Recommended Books:

1. “*Software Engineering Economics*”, Barry W. Boehm, Prentice Hall, 1981.
2. “*Making the Software Business Case: Improvement by the Numbers*”, Donald J. Reifer, Addison Wesley Professional, 1st Edition, 2001.

FINAL YEAR

SE-405 MODELING AND SIMULATION

Credit Hours: 3,0

Performance Modeling and Evaluation, Bench Marking, Performance Evaluation of High Parallel Systems Architecture. Application of Performance Evaluation.

Measurement Techniques, Hardware Monitoring, Software Monitoring, Hybrid Monitoring

Fundamentals of Queuing Models.

Structure and performance parameters. Operational Analysis of Queuing Models. General features of Queuing Models. Birth and Death process M/M/1 and M/G/1 systems. Dependability Modeling.

Analysis of Reliable, Available and High Assurance systems. Fault-tolerant Techniques. Software Reliability Modeling.

Petri Net-Based Performance Modeling. Classical Petri Nets. Discrete, Timed Petri Nets. Generalised Stochastic Petri Nets. Modeling of multiprocessors systems.

Recommended Books:

1. “*Simulation Modeling and Analysis*”, A. M. Law and W. D. Kelton, Fifth edition, 2014.
2. “*A First Course in Mathematical Modeling*”, Frank R. Giordano, Cengage/Brooks Publishing, 3rd Edition, 2003.
3. “*Theory of Modeling and Simulation*”, Bernard P. Ziegler, Herbert Praehofer and Tag Gon Kim, Academic Press, 2nd Edition, 2000.
4. “*Mathematical Modeling and Simulation: An Introduction for Scientists and Engineers*”, Kai Velten, Wiley-VCH, 2009.

SE-406 DISTRIBUTED COMPUTING

Credit Hours: 3,1

Advantages and disadvantages of Distributed Database (DDB); Database Security Issue; Design Approach of DDB; Internet Addressing, Low-level Communication using UDP; Connecting to Server using TCP; Connecting to an SMTP Mail Server; Connecting to an HTTP Web Server; WWW support via Class URL; Writing Server Programs using Server Socket.

Recommended Books:

1. “*Distributed Systems: Concepts and Design*”, George Coulouris, JeanDollimore, Tim Kindberg, Gordon Blair, 5th Edition , 2011
2. “*Distributed Database Manaement Systems: A Practical Approach*”, Saeed K. Rahimi and Frank S. Haug, Wiley- IEEE Computer Society, 2010.
3. “*Principles of Distributed Database Systems*”, M. Tamer Ozsu, Brooks/Cole Cengage Learning, 3rd Edition, 2003.

SE-407 DATA WAREHOUSING & MINING

Credit Hours: 3,1

Introducing the Data warehouse; The Data warehouse Methods; Quality Data warehouse process; Data warehouse Methodology; Data warehouse Administration; Performance Management, Managing the Data warehouse, Data warehouse Project Management; Data Handling: Distribution and Transformation; Data Integration and Data Semantics; Data Warehouse Architecture; Meta data, Types of Meta data, control change control in the Data warehouse

Recommended Books:

1. “*Data Warehousing Fundamentals for I.T. Professionals*”, Paulraj Ponniah, 2nd Edition, 2010.
2. “*Data Warehousing Fundamentals*”, M. Tamer Ozsu, Brooks/Cole Cengage Learning, 3rd Edition, 2003.
3. “*Data Mining Concepts and Techniques*”, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufman Publishers, 3rd Edition, 2012.

SE-408 DESIGN PATTERNS**Credit Hours: 3,0**

Introduction to Object-Oriented Software Development, The Object-Oriented Paradigm, UML- The Unified Modeling Language, Introduction to Design Patterns, The Facade Pattern, The Adapter Pattern, The Strategy Pattern, The Bridge Pattern, The Abstract Factory Pattern, Thinking in Patterns, The Principles and Strategies of Design Patterns, Commonality and Variability Analysis, The Analysis Matrix, The Decorator Pattern, The Observer Pattern, The Template Method Pattern, The Factory Method Pattern.

Recommended Books:

1. “*Java Design Patterns: A tour of 23 gang of four design patterns in Java*”, Vaskaran Sarcar, Apress, 2016.
2. “*Elemental Design Patterns*”, Jason McColm Smith, Addison-Wesley Professional, 1st Edition, 2012
3. “*Design Patterns Explained: A New Perspective on Object-Oriented Design*”, Alan Shalloway and James R. Trott, Addison-Wesley Professional, 2nd Edition, 2010.
4. “*Design Patterns in C#*”, Steven J. Metsker, Addison-Wesley Professional, 2nd Edition, 2004

SE-499 SOFTWARE ENGINEERING PROJECT**Credit Hours: 0,6**

Market oriented Software Engineering Project, spread over two semesters.

CT-460 NETWORK & INFORMATION SECURITY**Credit Hours: 3,1**

Introduction to simple Cryptosystems and their Cryptanalysis

Shift, Substitution, Affine, Vigenere, Hill, Permutation and stream ciphers.

Shannon’s Theory

Elementary Probability theory, entropy, perfect secrecy, unicity distance.

Block Ciphers and Advance Encryption Standard

Chaining; Substitution-permutation networks, Feistel networks; Linear cryptanalysis of an SPN.

Cryptographic hash functions

Security requirements, collisions; Security uses: passwords, message and data integrity, notaries; MD5, SHA; Message authentication codes; Birthday attack.

The RSA Cryptosystems

Primes, GCDs and the Extended Euclidean Algorithm, modular exponentiation and inverses, Euler totient function, Euler's theorem, Introduction to public-key cryptography; RAS: basic implementation details.

Digital signature schemes

EIGamal, DSA; Elliptic Curve DSA; One-time Signatures, Undeniable Signatures Zero-Knowledge proofs, Bit communication; Pseudorandom number generation.

Network communication concepts.

Network overview, specific networking protocols, transmission media and networking hardware.

Optimizing and fine tuning for performance

Ways to speed up an existing server, Stress testing techniques. Threat of computer crimes.

Network security issues

Techniques to increase security, Internet related security issues.

Trouble shooting and preventive maintenance

Basic element of troubleshooting, hardware troubleshooting tools, Software troubleshooting tools, Diagnosing real world problems, Troubleshooting the physical network, Troubleshooting WANS.

Recommended Books:

1. "*Cryptography and Network Security Principles and Practices*", William Stallings, Prentice Hall, 7th Edition, 2016.
2. "*Cryptography Theory & Practice*", Douglas R. Stinson, Chapman & Hall/CRC, 2nd Edition, 2002.
3. "*Network Security Fundamentals*", Peter Norton and Mike Stockman, Sams, 1st Edition, 1999.
4. "*Network Security: A Beginners Guide*", Eric Maiwald, McGraw-Hill Osbourne, 2nd Edition, 2003.
5. "*Network Security Bible*", Eric Cole, John Wiley & Sons, 2nd Edition, 2009.

MT-442 NUMERICAL METHODS

Credit Hours: 3,0

Error analysis: types of errors (relative, absolute, inherent, round off, truncation), significant digits and numerical instability, flow chart, use any computational tools to analysis the numerical solutions. linear operators: functions of operators, difference operators and the derivative operators, identities, difference equations: linear homogeneous and non-homogeneous difference equations, solution of non-linear equations: numerical methods for finding the roots of transcendental and polynomial equations (secant, Newton – Raphson Chebyshev and Graeffe's root squaring methods), rate of convergence and stability of an iterative method, solution of

linear equations: numerical methods for finding the solutions of system of linear equations (Gauss-elimination, Gauss-Jordan elimination, triangularization, Cholesky, Jacobi and Gauss-Seidel), interpolation &- curve fitting lagrange's, newton, hermit, spline, least squares approximation, (linear and non-linear curves), numerical integration & differentiation: computation of integrals using simple trapezoidal rule, 1/3th Simpson's Rule, 3/8th Simpson's Rule, composite Simpson's and trapezoidal rules, computation of solutions of differential equations using (Euler method, Euler modified method, Runge Kutta method of order 4), numerical solutions of partial differential equations, optimization problem (simplex method), steepest ascent and steepest descent methods.

Recommended Books:

1. *“Applied Numerical Analysis”*, Curtis F. Gerald and Patrick O. Wheatley, Pearson Education, 7th Edition, 2003.
2. *“Numerical Methods for Engineers”*, Steven C. Chapra and Raymond P. Canale, McGraw-Hill Higher Education, 7th Edition, 2014.
3. *“Advanced Engineering Mathematics”*, Dennis G. Zill, John Wiley & Sons, 9th Edition, 2016.

HS-403 ENTREPRENEURSHIP

Credit Hours: 3,0

Understanding the Entrepreneurship Mind-Set: The Revolutionary Impact of Entrepreneurship, The Individual Entrepreneurship Mind-Set, Corporate Entrepreneurship Mind-Set, The Social and Ethical Perspectives of Entrepreneurship, Launching Entrepreneurial Ventures: Creativity and Innovation, Methods to Initiate Ventures, Legal Challenges in Entrepreneurship, The Search for Entrepreneurship Capital, Formulation of Entrepreneurial Plan: The Assessment Function with Opportunities, The Marketing Aspects of New Ventures, Financial Statements in New Ventures, Business Plan preparation for New Ventures, Strategic Perspectives in Entrepreneurship: Strategic Growth in Entrepreneurship, Valuation Challenge in Entrepreneurship, Final Harvest of a New Venture

Recommended Book:

1. *“Introduction to Entrepreneurship”*, Donald F. Kuratko, South Western College, 10th Edition, 2016.
2. *“The Entrepreneurial Mindset”*, Rita G. McGrath and Ian C. MacMillan, Harvard Business School Press, 2000.
3. *“Startup: A Silicon Valley Adventure”*, Jerry Kaplan, Replica Books, 2001.
4. *“A Good Hard Kick in the Ass: Basic Training for Entrepreneurs”*, Rob Adams, Crown Business, 2002.
5. *“Technology Ventures: From Ideas to Enterprise”*, Thomas H. Byers, Richard C. Dorf and Andrew J. Nelson, McGraw-Hill, 3rd Edition, 2010.

ELECTIVE COURSES

Choice of one of the following three courses: SE-481, SE-482 or SE-483.

SE-484 SOFTWARE TESTING STRATEGIES & TECHNIQUES Credit Hours: 3,0

Introduction and overview: Testing and inspection concepts, Testing categories, Inception process: Objective of formal inspection Organizing Test cases: Decision Tables, Black box and white box testing Unit testing, Integration testing, Regression testing, System testing, user acceptance testing, Metrics and complexity, State based testing, Syntax testing; Use of software testing tools.

Recommended Books:

1. *“Introduction to Software Testing”*, Paul Ammann and Jeff Offutt, Cambridge University Press, 2nd Edition, 2016.
2. *“Software Testing”*, Ron Patton, Sams Publishing, 2nd Edition, 2005.

SE-485 SOFTWARE RELIABILITY ENGINEERING & SAFETY CRITICAL SYSTEMS Credit Hours: 3,0

Introduction, Key Concepts, Definition, Reliability related Costs, Software failure mechanisms, The bathtub curve for software reliability, Available tools, techniques, and metrics Software reliability Models, Software reliability metrics, Software reliability improvement techniques, Concepts of Reliability Engineering, Analysis, Prediction, Reliability, Availability, Maintainability and Safety (RAMS).

Recommended Books:

1. *Systemic Decision Making: Fundamentals for Addressing Problems and Messes (Topics in Safety, Risk, Reliability and Quality)*, Patrick T. Hester and Kevin MacG. Adams, 2nd Edition, 2017.
2. *“Software Safety and Reliability: Techniques, Approaches, and Standards of Key Industrial Sectors”*, Debra S. Herrmann, Wiley-IEEE Computer Society, 1st Edition, 2000.
3. *“Reliability, Quality and Safety of Software-Intensive Systems”*, Dimitris Gritzalis, Chapman & Hall, 2013.
4. *“System Software Reliability”*, Hoang Pham, Springer-Verlag, 2010.
5. *“Software Reliability Engineering”*, John D. Musa, McGraw-Hill, 2nd Edition, 2005.

SE-486 INFORMATION SYSTEMS ENGINEERING Credit Hours: 3,0

History and development of information systems. The key elements and processes required for designing, analyzing, developing, and integrating complex information systems. The systems

engineering approach with specific emphasis on design, development, and deployment. Requirements engineering, architecture development, security engineering, cost-benefit analysis, information and networking technologies, and operations. How information systems are engineered in today's environment through the analysis of the underlying processes of information systems engineering. Real world examples of successes and failures in information systems engineering. Broad range of technology that is used today for information systems.

Recommended Books:

1. *“Service Systems Management and Engineering: Creating Strategic Differentiation and Operational Excellence”*, Ching M. Chang, John Wiley & Sons, 2018.
2. *“Managing and Using Information Systems: A Strategic Approach”*, Keri E. Pearlson and Carol S. Saunders , John Wiley & Sons, Binder Ready Version, 2016.