

**DEPARTMENT OF SOFTWARE ENGINEERING**

**SYLLABI OF COURSES**

**FOR**

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

**BATCH: 2019 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 - 175	Programming Fundamentals	4 (3+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	SE - 201	Object Oriented Concepts & Programming	4 (3+1)
2	SE - 207	Software Engineering	3 (3+0)
3	PH – 122	Applied Physics	4 (3+1)
4	HS - 115	Academic Reading & Writing	3 (3+0)
5	HS - 205 HS - 209	Islamic Studies OR Ethical Behaviour	2 (2+0)
6	HSK - I	Chinese Language	NC

### SECOND YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	CT - 157	Data Structure Algorithms & Applications	4 (3+1)
2	CT - 258	Financial & Cost Accounting	3 (3+0)
3	SE - 208	Software Requirement Engineering	3 (3+0)
4	MT - 273	Differential Equations & Linear Algebra	3 (3+0)
5	HS - 218	Business Communication	3 (2+1)
6	HSK - II	Chinese Language	NC

### SECOND YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	SE - 204	Database Management Systems	4 (3+1)
2	SE - 308	Software Design & Architecture	3 (2+1)
3	SE - 206	Web Engineering	4 (3+1)
4	MT - 331	Probability & Statistics	3 (3+0)
5	HS - 219	Professional Ethics	2 (2+0)

### THIRD YEAR – Fall Semester

S. No.	Course Code	Title	Credit Hours
1	IF - 301	Applied Economics for Engineers	3 (3+0)
2	SE-312	Software Construction & Development	3 (2+1)
3	SE - 302	Human Computer Interaction	3 (3+0)
4	SE - 303	Operating Systems	4 (3+1)
5	SE - 313	Formal Methods in Software Engineering	3 (3+0)

### THIRD YEAR – Spring Semester

S. No.	Course Code	Title	Credit Hours
1	CS - 351	Computer Communication Networks	4 (3+1)
2	SE - 309	Software Quality Engineering	3 (2+1)
3	SE - 310	Software Project Management	3 (3+0)
4	SE - 311	E-Commerce	3 (3+0)
5	SE - ####	Elective I	4 (3+1)

### 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 - 409	Software Re-Engineering	3 (3+0)
4	SE - ####	Elective II	4 (3+1)
5	SE - 499	*Software Engineering Project	3 (0+3)

\* 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	SE -410	Stochastic Processes	3 (3+0)
3	SE - 408	Design Patterns	3 (3+0)
4	SE - ####	Elective III	3 (3+0)
5	SE - 499	Software Engineering Project	6 (0+3)

#### Elective Courses

Course Code	Elective – I, Elective – II (3+1)
SE-202	Computer Graphics
CT-361	Artificial Intelligence & Expert Systems
SE-406	Distributed Computing
SE-407	Data Warehousing & Mining
SE-487	Mobile Application Development
SE-488	Computer Vision Fundamentals

Course Code	Elective - III (3+0)
SE-484	Software Testing Strategies & Techniques
SE-485	Software Reliability Engineering
SE-486	Information Systems Engineering
SE-489	Cloud Computing

## FIRST YEAR

### 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, 7<sup>th</sup> Edition, 2012.
2. *“Mathematical Structures for Computer Science”*, Judith L. Gersting, W. H. Freeman, 7<sup>th</sup> 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, 6<sup>th</sup> Edition, 2004.

### CT-175 PROGRAMMING FUNDAMENTALS

Credit Hours: 3,1

Introduction to programming languages, Different generations of Languages (1GL, 2GL, 3GL, 4GL, 5GL), Basic Programming Constructs, Introduction to problem solving, role of compiler and linker, Pre-processor Directives, introduction to algorithms, Basic data types, Variables,

(Local and Global), Constants input/output constructs, Types of Operators (Unary, Binary, Ternary), Relational Operators, Arithmetic Operators, Assignment Operators, Logical Operators, prefix and Postfix Increment and Decrement Operators, Repetition Structures, Loops (FOR, WHILE, DO WHILE), Conditional Structures (If, If-Else, Switch), Break and Continue, Introduction to Arrays, Multidimensional arrays, Functions and Procedures, Function Overloading, how to pass an array to a function (Pass by value and Pass By reference), Introduction to modular programming, string and string operations, Structures, pointers/references, static and dynamic memory allocation, File I/O operations

**Recommended Books:**

1. “*Python 3 Object Oriented Programming*”, Dusty Phillips, 3<sup>rd</sup> Edition, 2018, Packt Publishing.
2. “*Let us C*”, Yashavant P. Kanetkar, Jones & Bartlett Publishers, 15<sup>th</sup> Edition, 2016.
3. Paul J. Deitel and Harvey Deitel, ” *C++ How to Program*”, 10<sup>th</sup> Edition, Prentice Hall , 2017.

**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, 10<sup>th</sup> 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, 5<sup>th</sup> Edition, 2010.

**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, 8<sup>th</sup> Edition, 2014.
2. “*Software engineering*”, Ian Sommerville, Addison Wesley, 10<sup>th</sup> Edition, 2015.

## 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, 3<sup>rd</sup> Edition, 2001.
2. "*Calculus*", Thomas & Finney, 3<sup>rd</sup> Edition, Addison Wesley Longman, 2006.
3. "*Engineering Mathematics*", K. A. Stroud and Dexter J. Booth, 6<sup>th</sup> Edition, Industrial Press, 2007.
4. "*Calculus and Analytical Geometry*", Howard Anton, John Wiley & Sons Inc, 5<sup>th</sup> Edition, 1998.
5. "*Complex Analysis for Mathematics and Engineering*", John H. Mathews, Jones and Bartlett Publishers Inc., 5<sup>th</sup> 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, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> 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, 5<sup>th</sup> Edition, 2001.
2. "Physics Volume 2", David Halliday, Robert Resnick and Kenneth S. Krane, Wiley, 5<sup>th</sup> 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, 2<sup>nd</sup> 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, 2<sup>nd</sup> Edition, 2006.

## **HS-115 ACADEMIC READING & WRITING**

**Credit Hours: 3,0**

**Reading and Critical Thinking:** Reading academic texts effectively, Using strategies for extracting and locating information in text and visuals; identifying main idea and purpose; separating main points from supporting details; drawing inferences and conclusions in a

text. Identifying the writer's intent (cause and effect, reasons, comparison and contrast, exemplification etc.). Interpreting charts and diagrams.

Making appropriate notes using strategies mind maps, tables, lists, graphs. Reading and carrying out instructions for tasks, assignments and examination questions. Enhance academic vocabulary using appropriate skills and strategies; and identifying pronunciation through pronunciation key.

Writing Academic Texts. Planning writing task: identifying audience, purpose and message (content). Collect information in various forms such as mind maps, tables, charts, lists. Argumentative, narrative, expository and descriptive forms of writing. Write good topic and supporting sentences and effective conclusions. Achieving unity, coherence, adequate development in writing. Use appropriate cohesive devices such as reference words and signal markers. Order & Organize information: Chronology for a narrative, listing, Stages of a process, from general to specific and vice versa, from most important to least important, advantages and disadvantages, comparison and contrast, problem solution pattern, for and against; using different methods of developing ideas like listing, comparison, and contrast, cause and effect, for and against. Revising/Redraft checking content, structure and language. Edit and proof read.

#### **Recommended Books:**

1. "Cambridge vocabulary for IELTS", Pauline Cullen, Cambridge University Press, 2008.
2. "Academic Listening Encounters: Human Behaviour", Miriam Espeseth, CUP, 2004.
3. "Study Listening", Lynch, 2<sup>nd</sup> Ed., Cambridge University Press, 2007.
4. "Study Reading", Glendining and Holmstrom, 2<sup>nd</sup> Ed., CU P, 2007.
5. "Writing and the Writer", Frank Smith, Heinemann Educational Books, 1994.

#### **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 10<sup>th</sup> 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, 3<sup>rd</sup> Edition, reprinted 1974.
2. “*Philosophy: The Basics*”, Nigel Warburton, Routledge, London, 4<sup>th</sup> Edition, 2004.

**SECOND YEAR****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, 1<sup>st</sup> 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.

**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, 3<sup>rd</sup> Edition, 2011.
2. “*Software Requirements*”, Karl E. Wiegers, Microsoft Press, 3<sup>rd</sup> 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, 7<sup>th</sup> Edition, 2015.
2. “*Fundamentals of Database Management Systems*”, Mark.L.Gillenson, Wiley Publisher 2<sup>nd</sup> Edition, 2011.
3. “*Database Systems*”, Thomas M. Connolly, Addison Wesley, 5<sup>th</sup> Edition, 2009.

## **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, 5<sup>th</sup> Edition, 2015.
3. *“Web Engineering: The Discipline of Systematic Development of Web Applications”*, Gerti Kappel, Birgit Proll and Seigfried Reich, John Wiley & Sons, 2006.

**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, 1<sup>st</sup> Edition, 2009.
4. *“Software Architecture and Design Illuminated”*, Kai Qian, Xiang Fu and Lixin Tao, Jones & Bartlett Publishers, 2009.

**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., 10<sup>th</sup> Edition, 1996.
2. “*Fundamentals of Cost Accounting*”, William N. Lanen, Shanon W. Anderson and Michael Maher, McGraw-Hill/Irwin, 5<sup>th</sup> Edition, 2016.
3. “*Cost Accounting: Planning and control*”, Adolph Matz and Milton F. Usry, Wadsworth Publishing Co. Inc., 9<sup>th</sup> Revised Edition, 1989.

### **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, 11<sup>th</sup> Edition, 2013.
2. “*Differential Equations with Boundary Value Problems*”, Dennis G. Zill and Michael R. Cullen, Thomson Brooks/Cole Publishing, 8<sup>th</sup> Edition, 2012.



3. “*Advanced Engineering Mathematics*”, Erwin Kreyszig, John Wiley & Sons, 9<sup>th</sup> Edition, 2006.
4. “*Differential Equations: A modeling Perspective*”, Robert L. Borelli and Courtney S. Coleman, Wiley, 2<sup>nd</sup> Edition, 2004.

## **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, 8<sup>th</sup> Edition, 2006.
2. *“Applied Statistics & Probability for Engineers”*, Douglas C. Montgomery, 4<sup>th</sup> Edition, 2006.

## **HS-218 BUSINESS COMMUNICATION**

**Credit Hours: 2,1**

Foundations of Business Communication: Definitions: communication, organization, business; understanding the need and scope of business, professional and organizational communication, Conditions, properties, process, tools, modes, levels, types of communication; Principles of Effective Communication & Building goodwill (You attitude, positive emphasis and unbiased language); Listening, non-verbal communication. Communication dilemmas and problems; Feedback and its types; Audience Analysis. Oral Communication: Group Discussions and interpersonal skills, Meetings, Interviews, Making presentations. Business & Technical Writing: Types of messages: Formats (Letter and memorandum); Letter and memorandum elements and formats. Three Types of Business Messages (routine, negative and persuasive communications). Organizational Plans: Direct, Indirect & AIDA approach; Writing business messages (e-mails, inquiries, requests, replies, regrets, declining offers, letters, routine messages, etc.); Meetings: notice, agenda and minutes. Job applications and resumes. Research/scientific reports (structure, layout, writing process)

### **Recommended Books:**

1. *“Business and Professional Communication”*, Roach, Gant & Allyn Perrigo & Bacon, Sage Publications, 2014.
2. *“Essentials of Business Communication”*, Guffey, Mary Ellen, and Dana Loewy, Cengage Learning, 2012.
3. *“Business Communication Essentials”*, Bovee, Courtland V., and John V. Thill, (6<sup>th</sup> edition), Prentice Hall, 2013

## **HS-219 PROFESSIONAL ETHICS**

**Credit Hours: 2,0**

Introduction to Professional & Engineering Ethics: Definitions - Ethics, Professional Ethics, Engineering Ethics, Business Ethics; Ethics & Professionalism. Need and scope of Engineering

and Professional Ethics through case studies; Development of Engineering Ethics & Major issues in Engineering & Professional Ethics; Moral Reasoning & Ethical Frameworks: Ethical Dilemma; Resolving Ethical dilemmas and making Moral Choices; Codes of Ethics (of local and international professional bodies). Moral Theories: Utilitarianism, Rights Ethics and Duty Ethics, Syllabi of Courses for Bachelor of Engineering (Computer Systems) Batch: 2018 and Onwards Virtue Ethics Self-Realization & Self Interest; Ethical Problem Solving Techniques: Line drawing, flow Charting, Conflict Problems; case studies and applications; Contemporary Professional Ethics: Professional Responsibilities; Risk and Safety as an Ethical Concern for Engineers, Workplace Responsibilities and Ethics: Teamwork, confidentiality and conflicts of interest, Whistleblowing, Bribe and gift, risk and cost - benefit analyses, gender discrimination and sexual harassment; Environmental Ethics; Computer Ethics & the Internet; Honesty: Truthfulness, trustworthiness, academic and research integrity.

**Recommended Books:**

1. “*Ethics in Engineering*”, Mike W. Martin & Roland Schinzinger, (4<sup>th</sup> edition), Tata McGraw-Hill, 2005.
2. “*Engineering Ethics*”, Charles B. Fleddermann, Pearson Publishing, 2012.

## THIRD YEAR

**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, 1<sup>st</sup> Edition, 2003.
3. “*Usability Engineering: Scenario-Based Development of Human Computer Interaction*”, Mary Beth Rosson and John Carroll, Academic Press, 1<sup>st</sup> 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, 9<sup>th</sup> 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, 2<sup>nd</sup> 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, 6<sup>th</sup> 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, 2<sup>nd</sup> Edition, 2004.

## **SE-312 SOFTWARE CONSTRUCTION & DEVELOPMENT Credit Hours: 2,1**

Software development process, Software engineering process infrastructure, Software engineering process improvement, Systems engineering life cycle models, Process

implementation, Levels of process definition, Life cycle model characteristics, Individual and team software process, Lehman's Laws, code salvaging, and configuration management. Martin Fowler's refactoring concepts and their application to small projects. Apply Michael Feathers' "legacy code" concepts. Exception handling, making methods robust by having them check their inputs sent from calling objects. Software configuration management, Release management, Software configuration management processes, Software deployment processes, Distribution and backup, Evolution processes and activities, Basic concepts of evolution and maintenance. Working with legacy systems, Refactoring, Error handling, exception handling, and fault tolerance. Personal reviews (design, code), Peer reviews (inspections, walkthroughs).

**Recommended Books:**

1. *"Software Essentials: Design and Construction"*, Adair Dingle, Chapman and Hall/CRC, 1<sup>st</sup> Edition, 2014.
2. *"Clean Code: A Handbook of Agile Software Craftsmanship"*, Robert C. Martin, Prentice Hall, 2008.

**SE-313 FORMAL METHODS IN SOFTWARE ENGINEERING Credit Hours: 3,0**

Introduction to the use of mathematical models for specification and validation. Finite state machine models.

Models of concurrent systems. Verification of models, and limitations. Analyzing well-formedness (e.g. completeness, consistency, robustness, etc.). Analyzing correctness (e.g. static analysis, simulation, model checking, etc.). Formal analysis. Introduction to VDM-SL, Sets, Sequences, Composite objects, Maps, VDM-SL, Comparative Formal Methods, Proofs. Introduction to Z.

**Recommended Books:**

1. *"Modern Formal Methods and Applications"*, Hossam A. Gabbar, Springer-Verlag 2006.
2. *"Concise Guide to Formal Methods: Theory, Fundamentals and Industry Applications"*, Gerard O'Regan, Springer; 1st edition, 2017.

**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 congestion control. Flow control local Networks satellite protocols, Broadcast Networks.

**Recommended Books:**

1. *"Computer Networks"*, Andrew S. Tanenbaum and David J. Wetherall, Prentice Hall, 5<sup>th</sup> Edition, 2010.

**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, 1<sup>st</sup> 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, 3<sup>rd</sup> Edition, 2003.
3. “*Theory of Modeling and Simulation*”, Bernard P. Ziegler, Herbert Praehofer and Tag Gon Kim, Academic Press, 2<sup>nd</sup> Edition, 2000.
4. “*Mathematical Modeling and Simulation: An Introduction for Scientists and Engineers*”, Kai Velten, Wiley-VCH, 2009.

## **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, 2<sup>nd</sup> Edition, 2010.
4. “*Design Patterns in C#*”, Steven J. Metsker, Addison-Wesley Professional, 2<sup>nd</sup> Edition, 2004

## **SE-409 SOFTWARE RE-ENGINEERING**

**Credit Hours: 3,0**

Understanding the challenges of legacy projects, Refactoring, Re-architecting, The Big Rewrite, Automating the development environment, Extending automation to test, staging, and production environments, Fundamental re-engineering techniques to modernize legacy systems including source code analysis, Quality issues in re-engineering processes, Fundamental re-engineering techniques to modernize legacy systems including source code analysis.

### **Recommended Books:**

1. “*Re-engineering legacy software*”, David Lorge Parnas, Chris Birchall, Safari Books, Shelter Island, NY, 2016.
2. “*Reengineering*”, Priyadarshi Tripathy and Kshirasagar Naik, John Wiley & Sons, Inc., 2015.

**SE-410 STOCHASTIC PROCESSES****Credit Hours: 3,0**

Discrete Markov chains, classification of states, first passage and recurrence times, absorption problems, stationary and limiting distributions. Chapman-Kolmogorov equations, Long run behavior of Markov chains, Absorption probabilities and expected times to absorption, Statistical aspects of Markov chains, The Mover-Stayer model, Application of a Markov chain and mover-stayer model to modeling repayment behavior of bank loans' grantees. Markov Processes in continuous time: Poisson processes, birth death processes. The Kolmogorov differential equations, Limiting behavior of continuous time Markov chains, The Q matrix, Forward and backward differential equations, Imbedded Markov Chain, Stationary distribution. Renewal theory, Brownian Motion and its generalizations, Discrete time martingales, Conditional expectation, Definition of a Martingale and examples, Optional Stopping Theorem, Stochastic calculus.

**Recommended Books:**

1. *"Introduction to Probability Models"*, Sheldon M. Ross, 11<sup>th</sup> edition, Academic Press 2014.
2. *"Essentials of stochastic processes"*, Durrett, Richard, Springer Science & Business Media, 2<sup>nd</sup> edition, 2012.
3. *"Introduction to Stochastic Processes"*, G.F. Lawler, Chapman and Hall, 2<sup>nd</sup> edition, Probability Series, 2006.

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

## **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, 10<sup>th</sup> 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, 3<sup>rd</sup> Edition, 2010.

## **ELECTIVE COURSES**

### **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, 3<sup>rd</sup> Edition, 2006.
3. *“Schaum’s Outline Series of Computer Graphics”*, Zhigiang Kiang and Roy A. Plastock, McGraw-Hill, 2<sup>nd</sup> Edition, 2000.
4. *“Computer Graphics”*, Francis S. Hill, Prentice Hall, 3<sup>rd</sup> Edition, 2006.
5. *“Computer Graphics”*, Roy A. Plastock, McGraw-Hill, 2<sup>nd</sup> Edition, 2000.

### **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, 3<sup>rd</sup> 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, 2<sup>nd</sup> Edition, 2010.
2. *“Data Warehousing Fundamentals”*, M. Tamer Ozsu, Brooks/Cole Cengage Learning, 3<sup>rd</sup> Edition, 2003.
3. *“Data Mining Concepts and Techniques”*, Jiawei Han, Micheline Kamber and Jian Pei, Morgan Kaufman Publishers, 3<sup>rd</sup> Edition, 2012.

**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, 2<sup>nd</sup> Edition, 2016.
2. *“Software Testing”*, Ron Patton, Sams Publishing, 2<sup>nd</sup> 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, 1<sup>st</sup> 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, 2<sup>nd</sup> 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.

**SE-487 MOBILE APPLICATION DEVELOPMENT Credit Hours: 3,1**

Mobile Application Development Platform; HTML5 for Mobiles; Android OS: Architecture, Framework iOS: Architecture, Framework; Application Development with Windows Mobile;

Eclipse; Fragments; Calling Built-in Applications using Intents; Displaying Notifications; Components of a Screen; Adapting to Display Orientation; Managing Changes to Screen Orientation; Utilizing the Action Bar; Creating the User Interface; Listening for UI Notifications; Views; User Preferences; Persisting Data; Sharing Data; Sending SMS Messages; Getting Feedback; Sending Email; Displaying Maps; Consuming Web Services Using HTTP; Web Services: Accessing and Creating; Threading; Publishing, Android Applications; Deployment on App Stores; Mobile Programming Languages; Challenges with Mobility and Wireless Communication; Location-aware Applications; Performance/Power Tradeoffs; Mobile Platform Constraints; Emerging Technologies.

**Recommended Books:**

1. *“Professional Android application development”*, Reto Meier, Wrox Programmer to Programmer, 2015.
2. *“iOS Programming: The Big Nerd Ranch Guide”*, Conway, J., Hillegass, A., & Keur, C., 5th Edition, 2014.
3. *“Android Programming: The Big Nerd Ranch Guides”*, Phillips, B. & Hardy, B , 2<sup>nd</sup> Edition, 2014.

**SE-488 COMPUTER VISION FUNDAMENTALS**

**Credit Hours: 3,1**

**Imaging Geometry:** Translation and Scaling, Rotation, Camera Model, Recovering Camera Parameter.

**Edge Detection:** Type of Edges, Three stages in Edge Detection, Filtering Stage, Detection Stage, Gradient Operators, Facet Model, Properties of Gaussian, Canny’s Edge Detector, Scale Space

**Region Segmentation:** Simple Segmentation, Connected Component Algorithms, Seed Segmentation, Region Growing.

**2-D Shape:** Gaussian Pyramid, Correlation using Pyramid, Quad Trees, Media Axis Transform

**Stereo and Shape from Shading Range Images:** Range Image Formation, Surface Characteristics.

**Image Recognition:** Machine Learning: Artificial Neural Networks, Deep Learning: Convolutional Neural Networks.

**Recommended Books:**

1. *“Fundamentals of Computer Vision”*, Wesley E. Snyder, Cambridge University Press, 2017.
2. *“A Practical Introduction to Computer Vision with OpenCV”*, Kenneth Dawson Howe, Wiley, 1<sup>st</sup> Edition, 2014

**SE-489 CLOUD COMPUTING****Credit Hours: 3,0**

Datacenter Architectures, Cloud Stack , Technology Trends, Consistency, Availability, Partitions, Cluster File Systems, Data-flow Computation Frameworks, Key-Value Store and Interactive Query Systems, Big Data in the Clouds, Geographic distributed Storage, Programming Languages for the Cloud, In-Memory Frameworks, Google file system, Hadoop file system, MapReduce, Clouds Networking topologies, Traffic Management, Transport Protocol Improvements, Security, Scheduling and Resource Management in clouds, Software Level Agreements.

**Recommended Books:**

1. *“Cloud Computing Theory and Practice”*, Dan C. Marinescu, Morgan Kaufmann, 2nd Edition, 2017.
2. *“The Enterprise Cloud: Best Practices for Transforming Legacy IT”*, James Bond , O'Reilly Media; 1st edition, 2015.

**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, 1<sup>st</sup> Edition, 2018.
2. *“Artificial Intelligence: Structures and Strategies for Complex Problem Solving”*, George F. Luger, Addison Wesley, 6<sup>th</sup> Edition, 2008.
3. *“Artificial Intelligence: A Modern Approach”*, Stuart Russel and Peter Norvig, Prentice Hall, 3<sup>rd</sup> Edition, 2009.