Curriculum / Scheme of Studies

of

Bachelor of Science in Information Technology

(BS Information Technology)

(2 Years Program)

(2025)

University of Education, Lahore

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1. Introduction to BS Information Technology (Post ADP)

We are living and breathing in an information age. For many segments of society, the Internet has already changed how people work, think, communicate, or even socialize. Many of the changes can be attributed to information systems that now operate very widely over the Internet and Intranets.

With the widespread commercial availability of computing technologies and machinery, information systems have been the dominant application area of computing. All present day organizations have come to rely on information systems for their day-to-day operation, planning, and decision making. The basic idea is to prepare dynamic leaders and practitioners in computing, teaching and, research having content excellence, pedagogical competence, commitment and integrity who may ensure quality and sustainable development with covering technological needs at all tiers and sectors of education.

Effective use of information technologies has become a critical success factor in modern society. In University of Education BS Information Technology (Post ADP) degree is unique blend of information systems, information technology and education in one program. The program is focused more on practical applications and teaching skills of technology and information systems to support educational institutes and organizations while adding value to their products and offerings.

2. Program Vision Statement

The BS Information Technology (Post ADP) aspires to be a respectable seat of learning at the global level by providing solutions of indigenous and global challenges of the IT domain through collaborative learning and research.

3. Program Mission Statement

The primary mission of the program produces broad-based graduates, able to face the challenges and evolution of Information Technology in organizations. This program will equip the students with firm foundations of Information Technology so that students utilize the knowledge in practical life which will be beneficial for the society.

4. Program Design:

Sr. No.	Categories of Courses	No. of Courses	Credit Hours
1	General Education	1	3
2	Computing Core	2	7
3	Domain IT Core	6	21
4	*Domain IT Elective	5	15
5	*Domain IT Supporting	3	9
6	Thesis / Project	1	6
7	*Deficiency Course for Annual System students only	4	16
Total without Deficiency Courses (for Semester System Students Only)		**18**	**61**
Total with Deficiency Courses (for Annual System Students Only)		**22**	**77**

* Any five IT Elective courses will be chosen from the list of elective courses depending upon the availability of the experts

* Any three IT supporting courses will be chosen from the list of elective courses depending upon the availability of the experts.

* Any four IT deficiency courses will be chosen from the list of deficiency courses depending upon the availability of the experts

5. Program Layout

General Education

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC4141	Professional Practices in IT	3(3+0)

Computing Core

Sr. No.	Course Code	Course Title	Credit Hours
1	COMP4119	Computer Networks	4(3+1)
2	ITEC4111	Network Security	3(3+0)

Domain IT Core

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC3125	Cyber Security	3(3+0)
2	ITEC4144	Database Administration	4(3+1)
3	ITEC3118	IT Project Management	3(3+0)
4	ITEC3123	System and Network Administration	4(3+1)
5	ITEC3124	Virtual Systems and Services	4(3+1)
6	ITEC4142	Fundamentals of Web Engineering	3(3+0)

Domain IT Supporting

Any **three from** the list of IT supporting courses depending upon the availability of the experts. Coverage of relevant prerequisites must be ensured while offering any of the following courses form the category.

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC4114	Enterprise Resource Planning Systems	3(3+0)
2	ITEC4138	Simulation and Modeling	3(3+0)
3	ITEC4115	Formal Methods in Software Engineering	3(3+0)
4	ITEC4139	Operational Research	3(3+0)
5	ITEC4140	Software Requirements Engineering	3(3+0)

Thesis/Project

Sr. No.	Course Code	Course Title	Credit Hours
1	COMP4111	IT Capstone Project*	6(6+0)

* The IT Capstone Project will start in 3rd Semester but the evaluation of project will be carried out at the end of 4th Semester after viva-voce of students.

Deficiency Course Pool for Annual System students only

NOTE: The BS Information Technology (Post ADP) students may take the deficiency courses from the first four semesters of the undergraduate scheme of studies.

Domain IT Electives

Any five IT Elective courses will be chosen from the list of elective courses depending upon the availability of the experts.

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC3117	Internet Architecture and Protocol	3(3+0)
2	ITEC4124	Data Mining	3(3+0)
3	ITEC4119	Artificial Intelligence	3(3+0)
4	COMP3113	Human Computer Interaction	3(3+0)
5	ITEC3115	Object Oriented Analysis and Design	3(3+0)
6	ITEC2111	Technology Management	3(3+0)
7	ITEC4117	Network Design and Management	3(2+1)
8	ITEC4118	Distributed Database Systems	3(3+0)
9	ITEC4120	Electronic Commerce	3(3+0)
10	ITEC4121	Data Warehousing	3(3+0)
11	ITEC4123	Geographical Information System	3(3+0)
12	ITEC4125	Design Patterns	3(3+0)
13	ITEC4126	Business Process Management	3(3+0)
14	ITEC4127	Software CASE Tools and Applications	3(3+0)
15	ITEC4128	Computer Graphics	3(2+1)
16	ITEC4129	Software Design and Architecture	3(3+0)
17	ITEC4131	Distributed Computing	3(3+0)
18	ITEC4132	Computer Architecture	3(3+0)
19	ITEC4133	iOS Applications Development	3(2+1)
20	ITEC3113	Multimedia Systems and Design	3(3+0)
21	ITEC4113	Cloud Computing	3(3+0)
22	ITEC4135	Mobile and Pervasive Computing	3(3+0)
23	ITEC4136	Knowledge Based Systems	3(3+0)
24	ITEC4137	Advanced Programming Techniques	3(3+0)
25	ITEC410	Mobile Application Development	3(2+1)

6. Eligibility Criteria:

The minimum requirements for admission in BS Information Technology (Post ADP) are given as;

- Associate Degree in CS/SE/IT or equivalent under semester system with at least 15 Credit Hours in Computer Science and 6 Credit Hours in Mathematics OR
- BA/B.Sc./ADS 14 years of Education under annual system with Mathematics (200 Marks) and Computer Science (200 Marks)
- The applicants having 3rd division (i.e. less than 45% aggregate marks under the annual system or less than 2.00 CGPA under the semester system or less than 60% marks under the semester system (where CGPA is not available/mentioned)) in the terminal degree are not eligible for admission.
- The candidates with BA/BSC/ADP **under annual system**, have to enroll required courses as per university policy to meet the minimum requirement of 124 Credit hours for the award of degree. The distribution of credit hours for annual system is as follow:

  Annual System Credit Hours: 50/as per HEC policy

  BS Information Technology (Post ADP)

  Credit Hours: 77

  Total Credit Hours: 127

7. Duration of the Program and Award of Degree:

The minimum duration for completion of BS Information Technology (Post ADP) degree is two years. The maximum period of degree completion will be followed as per University of Education, Lahore policy.

Award of Degree

A minimum 2.0 CGPA (Cumulative Grade Point Average) on a scale of 4.0 is required for award of BS Information Technology (Post ADP) Degree.

8. Semester/Study Plan for BS Information Technology (Post ADP):

SEMESTER I

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC4144	Database Administration (IT. Core (1))	4(3+1)
2	ITEC3123	System and Network Administration (IT. Core (2))	4(3+1)
3	ITEC4142	Fundamentals of Web Engineering (IT. Core (3))	3(3+0)
4	ITECXXXX	IT Elective 1	3(3+0)
5	ITECXXXX	IT Elective 2	3(3+0)
6	XXXXXXXX	Deficiency Course for Annual System students only	4(3+1)
		Total without deficiency course	15+2 = 17
		Total with deficiency course	18+3 = 21

SEMESTER II

SN	Course Code	Course Title	Credit Hours
1	ITEC3118	IT Project Management (IT. Core (4))	3(3+0)
2	COMP4119	Computer Networks (Comp. Core (1))	4(3+1)
3	ITECXXXX	IT Elective 3	3(3+0)
4	ITECXXXX	IT Elective 4	3(3+0)
5	ITECXXXX	IT Supportive 1	3(3+0)
6	XXXXXXXX	Deficiency Course for Annual System students only	4(3+1)
		Total without deficiency course	15+1 = 16
		Total with deficiency course	18+2 = 20

SEMESTER III

SN	Course Code	Course Title	Credit Hours
1	ITEC3125	Cyber Security (IT. Core (5))	3(3+0)
2	ITEC4141	Professional Practices in IT (GE-1)	3(3+0)
3	ITECXXXX	IT Elective 5	3(3+0)
4	ITECXXXX	IT Supportive 2	3(3+0)
5	COMP4111	IT Capstone Project*	3(3+0)
6	XXXXXXXX	Deficiency Course for Annual System students only	4(3+1)
		Total without deficiency course	15+0 = 15
		Total with deficiency course	18+1 = 19

* The IT Capstone Project will start in 3rd Semester but the evaluation of the thesis will be carried out at the end of 4th Semester after viva-voce of students.

SEMESTER IV

Sr. No.	Course Code	Course Title	Credit Hours
1	ITEC3124	Virtual Systems and Services (IT. Core (6))	4(3+1)
2	ITEC4111	Network Security (Comp. Core (2))	3(3+0)
3	ITECXXXX	IT Supportive 3	3(3+0)
4	COMP4111	IT Capstone Project	3(3+0)
5	XXXXXXXX	Deficiency Course for Annual System students only	4(3+1)
		Total without deficiency course	12+1 = 13
		Total with deficiency course	15+2 = 17

9. Course Outlines

COURSE OUTLINES (SEMESTER – 1)

Course Title: **DATABASE ADMINISTRATION**

Course Code: **ITEC4144**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- The main objectives of this course are to:
- Give the database administrator (DBA) a firm foundation in basic administrative tasks.
- Gain the necessary knowledge and skills to setup, maintain, and troubleshoot of latest Version of ORACLE database server.

Course Outline:

Introduction: Introduction to oracle family, Relational DBMS concepts, Exploring SQL, Role of DBA in organization.

Exploring the Database Server: Database architecture, Single instance vs. multi instance database architecture, Memory structures, and Process structures.

Oracle Installation and Database Creation: Install the Oracle software by using the Oracle Universal Installer (OUI), Create a database by using the database configuration assistant, The instance, The Database, and the data dictionary.

Managing the Oracle Instance: Stages of Database startup and shutdown, Database initialization parameters, Alert log and trace files, Data dictionary and dynamic performance views

Configuring the Oracle Network Environment: Configure and manage the Oracle network, Use the Oracle shared server architecture.

Managing Database Storage Structures: Understand tables paces and data files, The Oracle data storage model, Segments, Extents, Blocks and rows, Automatic Storage Management (ASM), Create and manage table spaces, Create, Alter and drop tablespace, Manage space in table spaces.

Administering User Security: Create and manage database user accounts, Grant and revoke privileges, System privileges, Object privileges, Create and manage roles, Create and manage profiles.

Managing Schema Objects: Create and modify tables, Users, User accounts, Schemas, and Schema Objects, Naming schema objects, Object namespaces, Data types, Creating tables, Manage constraints, Create indexes, Create and use temporary tables.

Managing Data and Concurrency: Manage data using DML, Database transactions, Executing SQL statements, Transaction control, COMMIT, ROLLBACK, SAVEPOINT, Monitor and resolve locking conflicts.

Managing Undo Data: Explain the purpose of undo, understand how transactions generate undo, manage undo, Flashback Query, Creating and managing undo table spaces. **Implementing Oracle Database Security:** Database security and principle of least privilege, Work with standard Database auditing.

Database Maintenance: Use and manage optimizer statistics, Use and manage the automatic workload repository, Use the advisory framework, Manage alerts and thresholds.

Performance Management: Use automatic memory Management, Use memory Advisors, Troubleshoot invalid and unusable objects.

Backup and Recovery Concepts: Types of failure, Ways to tune instance recovery, Importance of checkpoints, Redo log files, Flash recovery area.

Performing Database Backups: Create consistent Database backups, Backup your Database without shutting it down, Create incremental backups, Automate database backups, Manage backups, View backup reports, and monitor the flash recovery area.

Performing Database Recovery: Overview of data Recovery advisor, Use data Recovery advisor to perform recovery.

Moving Data: Describe and use methods to move data (SQL Loader, Directory objects, External Tables)**,** Explain the general architecture of Oracle Data pump, Use data pump export and import to move data between Oracle Databases.

Recommended Books:

1. John Watson, (2008) OCA Oracle Database 11g: Administration I Exam Guide, McGraw-Hill Osborne Media, 1stedition.
2. Craig S. Mullins (2002), Database Administration: The Complete Guide to Practices and Procedures, Addison Wesley, ISBN: 0201741296.
3. Donald K. Burleson (2002), Oracle9i UNIX Administration Handbook, McGraw-Hill, ISBN: 007222304.

4. C. J. Date (1994), Database Systems, Addison-Wesley.
5. Korth and Silberschatz (2007), Database Systems Concepts, McGraw Hill.Peter Rob, Course Technology; 8thedition.
6. Dan Wood, Chris Leiter, Paul Turley, (2006).Beginning SQL Server 2005 Administration,Wrox.
7. Peter Rob, Carlos Coronel.(2007). Database Systems: Design, Implementation, and Management, Course Technology, 8th edition..

Course Title: **SYSTEM AND NETWORK ADMINISTRATION**

Course code: **ITEC3123**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Understand the role and responsibilities of a system administrator
- Configure the Linux operating system
- Describe the system boot process
- Setup and manage user accounts and groups
- Manage the resources and security of a computer running Linux
- Make effective use of Unix utilities, and scripting languages
- Configure and manage simple network services on a Linux system
- Develop an appreciation of the documentation available as part of an installed Unix/Linux system

Course Outline:

Introduction: Setting up and Managing User Accounts, Securing Resources with NTFS Permissions. Administering Shared Folders, Using Windows 8/8.1/10 Tools: Working with Services, Using Event Viewer, Using Scheduled Tasks, Using Remote Desktop and Remote Assistance

Linux File System: Linux File System Layout, Running Command and Getting Help, The what is Command, The –help Option, System Manual Pages, System Info Pages, The man Command, The info Command, Managing Linux Files, Directories, and Archives, Managing Users in Linux, Vi and Joe Editor: Overview, Starting Vi and Vim, Three Modes of Vi and Vim, Cursor Movement, Entering Insert Mode, Leaving Insert Mode, Change, Delete and Yank, Paste, Undo Changing, Searching for Text, Saving and Exiting, Software Managementin Linux: The Red Hat Package Manager, Adding, Removing Packages, Update Packages, Querying and Verifying Packages.

Configuration of Network Management Tools: Understanding Network Management, Analysis Tools, Web based Configurations, Traffic Management, Configuring DNS Server and Clients, Configuring DHCP Server and Clients Managing Web Services: Benefits of Using IIS, Key IIS Services, IIS Backup, Troubleshooting IIS, Virtual hosting, Types of virtual hosting **Active Directory:** Introduction to Active Directory, Understanding Active Directory Concepts and Administration Tasks, Planning the Active Directory Infrastructure Design. Administering Active Directory**,** Installing and Managing Domains, Trees, and Forests:, Creating Multiple

Domains, Trees, and Forests, Renaming and Restructuring Domains, and Renaming Domain Controllers **Farming and Clustering:** Understanding redundancy and clustering of machines, working with clustering tools like pacemaker and vrrp, load balancing Containers, Working with Kubernette, Planning and configuration of Clustering Planning a Microsoft Exchange Server Infrastructure, Configuring an Exchange Server Infrastructure, Introduction and Installation of Squid Server, Advance Network Equipment Configurations

Recommended Books:

1. The Practice of System and Network Administration, Second Edition by Thomas Limoncelli, Christina Hogan and Strata Chalup, Addison-Wesley Professional; 2nd Edition (2007). ISBN-10:0321492668
2. Red Hat Enterprise Linux 6 Bible: Administering Enterprise Linux Systems by William vonHagen,2011
3. Study guide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10:1428851755
4. Networking Systems Design and Development by Lee Chao, CRC Press; 1st Edition (December 21, 2009). ISBN-10: 142009159X(TB2)
5. The Complete Reference Red Hat Enterprise Linux and Fedora Edition by Richard Peterson and Ibrahim Haddad, McGraw Hill Osborne Media; 1st Edition, 2004.

Course Title: **FUNDAMENTALS OF WEB ENGINEERING**

Course Code: **ITEC4142**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduce the methods and techniques used in Web-based applications development.
- Understand the concepts, principles, strategies, methodologies and processes involve in web applications development.
- Utilize PHP or .Net Technologies particularly ASP.Net and C# to create effective, scalable, maintainable, and adaptable distributed applications to solve an extremely wide range of problems
- Students can expect to gain experience in PHP or in various .Net technologies such as ASP.Net, C#, Ado.Net, LINQ etc
- The students will be involved in various industry oriented assignments and will learn to explore the power of PHP or .Net technologies in solving various enterprise problems

Course Outline:

Introduction, Overview of Protocol: Course Overview, Define terms associated with basic Web page development, development of the World Wide Web (WWW). Differences between Web servers and Web browsers. Overview of Protocol, TCP/IP, HTTP, Introduction to Web and its various technologies.

Three tire Architecture: Overview of three tire Architecture, Web Base Application Architecture

HTML: Hypertext Markup Language (HTML) , tools to create HTML documents, general syntax of an HTML tag, techniques to display HTML files. Use of various tags in an HTML document.CSS (Cascading Style Sheets) :Embedded CSS, Linked, Inline, ID, Class, HTML5 HTML Forms and Input Post, Get Method.

Java Script: JS statement , commenting concept ,usage of variables ,External JS and its usage ,JS Operators, JS Comparison , JS Conditions , JS Popup, JS Functions ,JS For loop, JS do while loop, JS while loop, Events in JS, Form validation with J S

JS FORMS: JS Forms, JS Forms API, JS HTML DOM, JS HTML DOM, Working on PHP

Recommended Books:

1. Web Engineering, Rajiv Chopra, Prentice-Hall of India,2016
2. Web Engineering, Emilia Mendes and Nile Mosley, Springer Verlag,2010.
3. Web Engineering: A Practitioners' Approach, Roger S. Pressman, McGraw Hill, 2008.
4. Dynamic HTML: The Definitive Reference: A Comprehensive Resource for XHTML, CSS, DOM, JavaScript 3rd Edition, And O'ReillyMedia2007.
5. JavaScript: The Definitive Guide, 8th Edition, David Flanagan. O'Reilly Media.2014.
6. Marty Hall, Larry Brown. Core Servlets and Java server Pages: CoreTech.
7. Perl, Web enabled Commercial Application Development using…HTML, DHTML, JavaScript, CGI. BPB Publications.
8. Guy W. Lecky-Thompson, Just Enough Web Programming with XHTML, PHP, and MySQL, Course Technology PTR; 1st edition,2008.
9. Dana Moore, Raymond Budd, Edward Benson, Professional Rich. Internet Applications: AJAX and Beyond.
10. Wrox, Chris Bates, Web Programming: Building Internet Applications, Wiley,3rd edition.
11. Professional Asp.Net 4 in C#-and VB, WROX Series

COURSE OUTLINES (SEMESTER – II)

Course Title: **IT PROJECT MANAGEMENT**

Course Code: **ITEC3118**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Define and highlight importance of software project management.
- Describe the software project management activities.
- Train software project managers and other individuals involved in software project, planning and tracking and oversight in the implementation of the software project management process.

Course Outline:

Introduction to Project Management: Management, Project?, Project attributes, Project vs. operations, Project management, Project stakeholders, Project management office, Project management software, Project management certification, Ethics in project management.

Project Management in IT Context:, System approach, system analysis, system philosophy, 3-Sphere Model, Globalization, key issues in Globalization, Outsourcing, virtual team, Advantages and disadvantages of virtual team.

Different phases or Steps in the Planning of a Project: Project life cycle, Seven core software, Project Phases, Project Phase deliverable, Key project stakeholders, PMO. **Project Management Group of Processes:** Project Processes, Project management process group, Creating feasibility study report, Identify the business needs, Creating project charter, Analyzing stakeholders.

Project Integration Management: Project charter, Purpose of project charter, Skills required, Project charter sample, Statement of work, Strategic Planning and Project Selection (SWOT analysis), Considering enterprise environmental factor, Benefit measurement methods, Adopting project plan methodology, Project Management information system, Financial analysis of projects (NPV, ROI, payback analysis), Preliminary project scope statement, Project management plans.

Project Scope Management: Scope, deliverable, Project Scope management processes, WBS, Approaches for developing WBS, WBS Dictionary, defining and verifying scope and controlling scope.

Project Time Management: Schedules, Activity definition, activity sequencing, Project network diagrams, CPM, PERT, ADM and PDM, Task dependency.

Project Cost Management: Cost, Cost management, Direct cost, Indirect cost, Fixed cost, Variable cost, EV, PV, AC, CV, SV, EAC, BAC, CPI, SPI, Basic principles of cost Management, Cost estimation, Cost estimation tools and techniques, Cost budgeting and cost control.

Project Quality Management: The importance of Project Quality Management, Quality Management Processes (Quality planning, Quality assurance, Quality control).

Project Procurement Management: What is procurement? Why we outsource? Contracts, Project procurement management process.

Project Human Resource Management: Human resource management? Extrinsic and intrinsic motivation, Maslow hierarchy of need, Power and its type, Resource assignments, Resource loading and resource leveling, Coveys 7 Habits, Human resource planning, Acquiring the project team, Developing the project team, Managing the project team.

Project Risk Management: Risk, Risk management process, Risk management cycle, Why IT Project fail?

Project Management Body of Knowledge: Overview and basic understanding. **Introduction to MS Project 2010:**WBS creation tools, Calendaring features,Scheduling abilities, Work authorization tools, Quality control charts (PERT charts, Gantt charts, and other calendaring features), Calculations for the critical path, EVM, target dates based on the project schedule, resource tracking and leveling, reporting functionality.

Recommended Books:

1. Information Technology Project Management by Kathy Schwalbe, Course Technology; 6th Edition (July 22, 2010). ISBN-10:1111221758
2. A Guide to the Project Management Body of Knowledge, 3rd Edition(PMBOK Guides), ISBN-13:978-1930699458
3. IT Project Management: On Track from Start to Finish by Joseph Phillips, McGraw- Hill Osborne Media; 3rd Edition (February 25, 2010).ISBN-0071700439

4. Information Technology Project Management by Jack T. Marche, Wiley; 3rdEdition (January 6, 2009). ISBN-10: 0470371935
5. Effective Project Management: Traditional, Agile, Extreme by Robert K.Wysocki, Wiley; 6th Edition (2011). ISBN-10:111801619X

Course Title: **COMPUTER NETWORKS**

Course Code: **COMP4119**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Gain general understanding of the principles and concepts of data Communication Network.
- Help students to acquaint the analog and digital communication, TCP/IP layer and OSI reference model.
- Develop understanding about transmission media, types of networks, multiplexing techniques and error detection as well error correction techniques.
- Develop understanding about IP addressing, circuit and packet switching.

Course Outline:

Data Communication: Data Communication System**,** Networks (LAN, WAN, MAN), Data Representation, Direction of flow (Simplex, Half-duplex, full- duplex).

Protocols& Standards: Protocols, Key elements of protocols, Standards, Standard creation committees.

Networks: Networks, Network criteria, Network topologies, Physical topologies (Bus, Ring, Star, Hybrid or tree and Mesh), Advantages and disadvantages, Logical topology, Internet.

Computer Network Model: Layered tasks, OSI Model, Internet model (TCP / IP Suite) **Physical Layer Introduction:** Signals, Transmission impairment, Transmission media, Channel capacity, Multiplexing, Switching.

Digital Transmission: Digital-to-digital conversion, line coding, Unipolar encoding,Polar encoding, Bipolar encoding, block coding, Analog- to -digital conversion (PAM, PCM), Sampling, Quantization, Encoding, Transmission modes.

Analog Transmission: Digital –to- analog conversion (ASK, PSK, FSK, QAM), analog- to-analog conversion.

Transmission Media: Guided and unguided media.

Multiplexing: FDM, TDM, and WDM.

Switching: Circuit switching, Message switching and packet switching.

Data Link Layer Introduction: Functionality of data link layer.

Error Detection and Correction: Types of errors, Error detection, Error correction.

Data Link Control and Protocol: Flow control, Error control.

Network Layer and Network Addressing: TCP/IP Overview, Network Layer (IP), Addressing, Sub-Netting TCP and UDP.

Network Layer Protocols: ARP, ICMP, IPv4, IPv6.

Transport Layer Protocol: TCP &UDP, Client server model.

Application Layer Protocol: Simple Mail Transfer Protocol (SMTP); SNMP; HTTP; WWW; WLAN, Bootstrap Protocol (BOOPT) and Dynamic Host Configuration Protocol (DHCP); Domain Name System (DNS); Telnet; FTP; Trivial File Transfer Protocol(TFTP).

Recommended Books:

1. Computer Networking: A Top-Down Approach Featuring the Internet, 6th edition by James F. Kurose and Keith W.Ross
2. Computer Networks, 5th Edition by Andrew S.Tanenbaum
3. Data and Computer Communications, 10th Edition by William Stallings
4. Data Communication and Computer Networks, 5th Edition by Behrouz A.Forouzan
5. Gilbert Held (2000), Understanding Data Communications: From Fundamentals to Networking, 3rd /ed.,Wiley.

COURSE OUTLINES (SEMESTER – III)

Course Title: **CYBER SECURITY**

Course Code: **ITEC3125**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Describe the role of computers and networks in a security context;
- Identify computer system threats and evaluate their impact;
- Discuss the effectiveness of various cryptographic techniques and their impact on security;
- Develop basic organizational security policies; and
- Demonstrate how defense in depth can be used to implement security.

Course Outline:

Introduction: Fundamental concepts of Security, Types of Attacks, Social Engineering Attacks Classification traits of malwares, Circulation, Infection, Concealment, Payload capabilities, Web Application Attacks: SQL injection, Cross Site Scripting

Security Management & Cryptography: Client Side Attacks: Cookies, Dos, Man in the Middle, Replay, Developing Security Policy, Deploy and manage Security settings., Security Through Design, Security Through Anti Malware, Fundamentals of Cryptography

OSI Reference Model: OSI Reference Model, AES. Standard Network Devises. Network Security Hardware, Firewalls, Types of Firewalls, Spam Filters, Virtual Private Networks Intrusion Detection and Prevention Study, DNS

Network Security: Network Address Translation (NAT): Network Access Control (NAC), Network Protocols, TCP/IP. Wireless Network Security: Wireless Network Attacks, Types of Attacks

Mobile Devices Security: Mobile Devices Security, Cloud Security Challenges and Solution, IOT security Challenges

Recommended Books:

1. Security+ Guide to Network Security Fundamentals by Mark Ciampa, 4th Edition
2. Corporate Computer Society by Randall J.Boyle, 3rdEdition

Course Title: **PROFESSIONAL PRACTICES IN IT**

Course Code: **ITEC4141**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Determine and identify ethical procedures and behaviors in the organization.
- Get the information about computer and internet crimes.
- Understand the issues related to intellectual freedom, intellectual property, and copyright law.
- Understand the ethical issues associated with gathering, storing and accessing information in databases.

Course Outline:

Introduction: Historical, Social, and economic context of computing (Software engineering, Computer science, Information Technology), Definitions of computing, subject areas and professional activities, Professional societies; Professional competency and life-long learning; uses, misuses, Risks of software.

Overview of Ethics: Overview of Ethics, Ethics for IT professionals and IT Users Association for Computing Machinery (ACM) code of Ethics and professional conduct, PMI member ethical standards and member Code of Ethics. Ethics and social networking. **Computer and Internet Crime:** What is cybercrime? Computer misuse and criminal law, Computing fraud, Unauthorized access to computer, Unauthorized removal of information from computer, Data protection and privacy, Freedom of expression.

Intellectual Property and Software Law: Intellectual Property, The nature of intellectual property. The law relating to different types of intellectual property (confidential information, copyright, trademarks, and patents) and the relevance of each type to the software industry, Social responsibilities, Software related contracts, Software house organization.

Recommended Books:

1. Professional Issues in Software Engineering by Frank Bott, Allison Coleman, Jack Eaton and Diane Rowland, CRC Press; 3rd Edition (2000). ISBN-10:0748409513

2. Computer Ethics by Deborah G. Johnson, Pearson; 4th Edition (January 3,2009). ISBN-10:0131112414
3. A Gift of Fire: Social, Legal, and Ethical Issues for Computing and the Internet (3rd Edition) by Sara Baase, Prentice Hall; 3rd Edition (2008). ISBN-10:0136008488
4. Applied Professional Ethics by Gregory R. Beabout, University Press of America (1993). ISBN-10:0819193747.
5. M.F. Bott et al. (2000). Professional Issues in Software Engineering. CRCPress.
6. Todd G. Shipley. Investigating Internet Crimes.

COURSE OUTLINES (SEMESTER – IV)

Course Title: **VIRTUAL SYSTEMS AND SERVICES**

Course code: **ITEC3124**

Credit Hour: **4(3+1)**

Objectives: The main objectives of this course are to:

- Manage VMware and Microsoft Virtual Machine (VM) technologies
- Leverage VMs to build testing, support, and training environments
- Partition physical servers to decrease operating costs
- Migrate from physical to virtual machines

Course Outline:

Understanding Virtualization: Describing Virtualization, Microsoft Windows Drives Server Growth, Explaining Moore‟s Law, Understanding the Importance of Virtualization, Examining Today‟s Trends, Virtualization and Cloud Computing, Virtualizing Servers, Virtualizing Desktops. Virtualizing Applications, Exploring the History of Hypervisors: Understanding Type 1 Hypervisors Understanding Type 2 Hypervisors, Understanding the Role of a Hypervisor: Holodecks and Traffic Cops, Resource Allocation

Comparing Today's Hypervisors: VMware ESX, Citrix Xen, Microsoft Hyper-V, Other Solutions, Understanding Virtual Machines: Describing a Virtual Machine. Examining CPUs in a Virtual Machine., Examining Memory in a Virtual Machine, Examining Network Resourcesin a Virtual Machine, Examining Storage in a Virtual Machine, Understanding How a Virtual Machine Works, Working with Virtual Machines , Understanding Virtual Machine Clones., Understanding Templates, Understanding Snapshots, Understanding OVF, Understanding Containers

Building a New Virtual Machine: Thinking about VM Configuration, Creating a First VM Installing Windows on a Virtual Machine, Loading Windows into a Virtual Machine, Understanding Configuration Options. Optimizing a New Virtual Machine , Installing Linux on a Virtual Machine , Understanding Configuration Options, Optimizing a New Linux Virtual Machine , Managing CPUs for a Virtual Machine , Understanding CPU Virtualization, Configuring VM CPU Options , Tuning Practices for VM CPUs Choosing Multiple CPUs vs. a Single CPU Hyper-Threading :Working with Intel and AMD Servers, Managing Memory for a Virtual Machine, Understanding Memory Virtualization, Configuring VM Memory Options, Tuning Practices for VM Memory, Calculating Memory Overhead

Managing Storage for a Virtual Machine: Managing Storage for a Virtual Machine: Understanding Storage Virtualization, Configuring VM Storage Options, Tuning Practices for VM Storage Managing Networking for a Virtual Machine, Understanding Network Virtualization, Internal Virtualization, External Virtualization Configuring VM Network Options, Network Address Translation (NAT), Bridged networking, Internal networking

Host-only networking, NAT with Port-forwarding Enabling, Disabling, Adding, and Removing Host Virtual Adapters Tuning Practices for Virtual Networks

Copying a Virtual Machine: Copying a Virtual Machine: Cloning a Virtual Machine, Working with Templates, Saving a Virtual Machine State, Creating a Snapshot, Merging Snapshots Managing Additional Devices in Virtual Machines, Using Virtual Machine Tools Understanding Virtual Devices, Understanding Availability, Increasing Availability. Protecting a Virtual Machine, Understanding Applications in a Virtual Machine, Examining Virtual Infrastructure Performance Capabilities, Understanding Virtual Appliances, Open Stack and Containers. Types of Virtualization, The future of virtualization, Hosted/Virtual/Cloud Desktops, Network Virtualization (SDN and Storage Virtualization, User Virtualization Hybrid hypervisor / containers where containers are used for high performance network tasks

Recommended Books:

1. Handbook of Virtual Environments: Design, Implementation, and Applications (Human Factors and Ergonomics), Edited by Kay M Stanney, Lawrence Erlbaum Associates Virtual Reality Technology by GRIGORE
2. Matthew Portnoy -Virtualization Essentials-Sybex (2016)

Course Title: **NETWORK SECURITY**

Course Code: **ITEC4111**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduce computer and network security concepts.
- Understand basic cryptography concepts.
- Get the knowledge about VPNs, Firewalls,Viruses.

Course Outline:

Introduction: Computer Security, Network security, Information security, Security Trends, OSI Security architecture.

Security Basics: Security attacks, Services, Mechanisms, Model.

Classical Cryptography: Symmetric cipher model, Substitution and transposition Technique, Cryptography and cryptanalysis, Modular arithmetic. Caesar cipher, Vigenere cipher. Mono-alphabetic and polyalphabetic ciphers, Playfair cipher, Hill cipher

Stream Ciphers and Block Ciphers: Data Encryption Standard (DES), General depiction of DES algorithm.

Firewalls: What is firewall, Access control policy, Firewall functions, Firewall types, Windows based firewalls, Linux based firewalls.

Virtual Private Network: VPN basics and theory, How VPN works. VPN configuration and testing on windows operating system.

IP Security: IP Security, Applications of IPSec, Benefits of IP Sec, IP Security architecture. IP security services, Transport and tunnel modes.

Advance Encryption Standard (AES): How AES works, Placement of encryption functions, link versus End-to-End encryption. Traffic confidentiality

Key Distribution: Key distribution, Different key distribution approaches.

Message Authentication: Authentication requirements, Authentication functions, MAC and hash functions.

Public Key Cryptography: Public key cryptosystems, RSA Algorithm, Key management in Cryptographic systems, Diffie-Hellman Key Exchange,

Digital Signatures: Digital Signature requirements, Direct and arbitrated digital Signatures, Mutual and One-way authentication, Digital Signature Standard (DSS). **Authentication Applications:** Kerberos, How Kerberos works?

PKI, Authentication Service: X.509 Certificates, Public key infrastructure.

Email Security: PGP, S/MIME.

Web Security: SSL, TLS, SET.

Operating System Checklists: Operating system security checklists, Disaster prevention and recovery.

Security Threats: Viruses, Trojans and worms, Types of viruses, Antivirus approaches.

Recommended Books:

1. W. Stallings, Cryptography and Network Security, Prentice Hall PTR, Upper Saddle River, NJ,2003.
2. Kaufman, R. Perlman, M. Speciner, Network Security: Private Communication in a Public World Prentice Hall PTR, Upper Saddle River, NJ,2002.
3. M. Bishop, Computer Security: Art and Science Addison-Wesley,2003
4. Stinson, Cryptography: Theory and Practice, CRC Press, Boca Raton, FL.1995.
5. Richard A. Mollin, an Introduction to Cryptography, Chapman and Hall/CRC, 2001.
6. B. Schneier, Applied Cryptography, John Wiley and Sons, NY,1996.
7. Menezes, P. Oorshcot, and S. Vanstone, Handbook of Applied Cryptography, CRC Press, Boca Raton, FL,1997.

Course Title: **IT CAPSTONE PROJECT**

Course Code: **COMP4111**

Credit Hours: **6(6+0)**

Objectives: The main objectives of this course are to:

- The main objectives of this course are to:
- Plan and develop a real and substantial project related to computer science.
- Provide an opportunity to the students to crystallize their acquired professional competence in the form of a demonstrable software product.

Course Outline:

The final project report should generally contain the following deliverables:

Deliverable 1: Project Proposal.

Deliverable 2: Software Requirements Specification

Deliverable 3: Methodology and Work Plan

Deliverable 4: Design Document1 **Deliverable 5:**

Design Document2 **Deliverable 6:** Final Project

Report

The above organization is a general guideline. With approval of the faculty supervisor, the student may alter this structure to best meet the Capstone Project goals.

Textbooks, Software, Resources, and Required Materials: Reading materials and resourceswillbedeterminedbythestudent'scapstonesupervisor.Materialsmay include selected textbooks or their chapters, periodicals, government reports, company reports, online databases, Web resources, and other reading and case studies. In consultation with the instructor, the student will design a reading and research program.

Recommended Books:

1. Jalote, Pankaj, (2002).Software Project Management in Practice, Addison-Wesley Professional.
2. Andrew Stellman and Jennifer Greene,(2005).Applied Software Project Management, O'Reilly Media,Inc.
3. Richard Bechtold, (2007).Essentials of Software Project Management,2nd edition.

DOMAIN IT ELECTIVE

(Any five from the list of elective courses depending upon the availability of the experts. Coverage of relevant prerequisites must be ensured while offering any of the following courses form the category.)

Course Title: **INTERNET ARCHITECTURE AND PROTOCOLS**

Course Code: **ITEC3117**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Provide students basic concepts of Internet architecture, Internet technologies, ISP architecture, TCP/IP protocol suit, QoS techniques, multimedia concepts, real time interactive application, bridging and switching and wireless LAN.

Course Outline:

Internet: Introduction about Internet architecture, Basics, History, Internet service providers, Internet backbones.

Internet Technologies: Frame relay, ATM, ISDN, DSL, Cable modem, SONET, Point to point protocols

Internet Service Provider: ISP, Architecture and components.

Protocols: Detail discussion including headers of protocols, IPv4, IPv6, ARP, RARP, TCP, UDP.

Quality of Service: Techniques, Integrated Services, Differentiated Services, Multimedia, Concepts, Real time interactive applications.

Bridging and Switching: VLANs and spanning Tree. Multiple access techniques, CSMA, CSMA/CD, CSMA/CA, Framing, MAC layer protocols, Ethernet, Token ring, Wireless LANs.

Recommended Books:

1. Internet Architecture: An Introduction to IP Protocols by Uyless D. Black, Prentice Hall PTR; 1st Edition (2000). ISBN-10: 0130199060
2. Internet Routing Architectures by Sam Halabi, Cisco Press; 2nd Edition (2000). ISBN-10: 157870233X
3. TCP/IP Protocol Suite by Behrouz A. Forouzan, McGraw-Hill Science/Engineering/Math; 4th Edition (2009). ISBN-10: 0073376043
4. Next-Generation Internet: Architectures and Protocols by Andrei Gurtov, Cambridge University Press (2011). ISBN-10: 0521113687
5. Uyless D. Black, Uyless Black. Internet Architecture: An Introduction to IP Protocols.

Course Title: **DATA MINING**

Course Code: **ITEC4124**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand Data Mining(DM) principles and techniques
- Introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying new trends and behaviors.

Course Outline:

Data-Mining Concepts: What is data mining and knowledge discovery process? Data mining and the business intelligence, Data mining functions.

Preparing the Data: Data objects and attribute types; nominal, ordinal, binary etc, Data cleaning, Data integration and handling redundancy by binning and co relational analysis, Data transformation by normalization.

Basic Statistical Descriptions of Data: Mean, Median, Mode, Variance, Standard Deviation, Quartile, Preparing the five number Summery.

Visualization Methods: Box Plot, Histograms, Scattered plots, Pixel oriented visualization techniques, Geometric visualization projection.

Data Reduction: What are the methods of data reduction? Cube reduction, Dimensionality reduction, etc.

Decision Trees: Decision trees, Building a decision tree

Association Rules: Building association rules, multilevel association rules, Apriority algorithm, FP-tree growth.

Clustering: Supervised vs. Unsupervised learning, What is clustering? Types of clustering, K mean algorithm, Visualization of clustering

Classification: Classification process, Bayesian classification, Decision tree induction, Visualization of classification.

Other Related Terms and Technologies: Artificial neural networks, Ensemble learning, Web mining and text mining, Genetic algorithms, Fuzzy sets and fuzzy logic,

Data Mining Tools: Weka, CBA and Yale, etc.

Recommended Books:

1. Kantardzic, M.(2011),Data Mining: Concepts, Models, Methods, and Algorithms, Wiley-IEEE Press; 2nd Edition. ISBN-10:0470890452

2. Han,J,Kamberand,M., Pei, J., &Kaufmann, M. (2011), Data Mining: Concepts and Techniques, Third Edition (The Morgan Kaufmann Series in Data Management Systems), 3rdEdition. ISBN-10: 0123814790

3. Hand, D., Mannila, H. &Smyth,P., (2001), Principles of Data Mining (Adaptive Computation and Machine Learning) A Bradford Book. ISBN-10: 026208290X165.

Course Name: **ARTIFICIAL INTELLIGENCE**

Course Code: **ITEC4119**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.
- Have an appreciation for the engineering issues underlying the design of AI systems.
- Have an understanding of the basic issues of knowledge representation and blind and heuristic search.

Course Outline:

Introduction: Introduction to AI, Turing Test, Strong AI vs. Weak AI, Heuristics, Applications and Methods, History of AI.

Intelligent Agents: Agents and environments, Structure of agents.

Problem Solving by Searching: Problem solving agents, searching for solutions.

Uninformed Search Strategies: Search in IS, Blind Search Algorithm, Breadth-first search, Depth-first search, Depth-limited search, Iterative deepening depth-first Search, Comparison of uninformed search strategies.

Informed (Heuristic) Search Strategies: Greedy best-first Search, A* search, Heuristic functions, Local search algorithms and Optimization problems.

Logic in AI: Logic and Representation, Propositional Logic, Predicate Logic, Other Logics, propositional logic, First order logic, Semantic nets, Other knowledge representation schemes. **Knowledge Representation:** Search Tree, Production System, Objects, Frames, Scripts & the Conceptual Dependency System, Semantic Networks, Recent Approaches, Agents. Prolog Programming.

Production Systems: Strong Methods vs. Weak Methods, Production System and Inference Methods, Stochastic Processes and Markov Chain

Uncertainty in AI: Fuzzy Sets, Fuzzy Logic, Fuzzy Inference, Probability Theory and Uncertainty.

Expert Systems: Characteristics of ES, Knowledge Engineering, Knowledge Acquisition, Classical ES, Case-Based Reasoning.

Neural Networks: Introduction, The Perceptron Learning Rule, Back propagation, Discrete Hopfield Networks, Application Areas, Introduction to Artificial Neural Networks (ANN), ANN Applications, Topologies of ANN

Evolutionary Computation: Simulated Annealing, Genetic Algorithms, Genetics, Genetic Programming

Natural Language Processing: History of NLP, Syntax and Formal Grammars, Syntax and Formal Grammar, Statistical Parsing, Hidden Markov Model, Word net, Question Answering System

Machine Learning, Introduction to Computer Vision: Machine Learning: Introduction to Learning, Supervised Machine Learning: Unsupervised Learning, K-means Clustering Algorithm, Introduction to Computer Vision (CV), Pattern Recognition etc.

Recommended Books:

1. Russell and Norvig, Artificial Intelligence: A Modern Approach, 2nd edition, Prentice Hall.
2. Robert Wilensky, LISP Craft, W.W. Norton.
3. Jones & Bartlett Learning, 2004.
4. Jones & Bartlett Learning, (2004), Ben Coppin, Artificial Intelligence Illuminated, 1st edition.
5. Stuart Russell and Peter Norvig, (2009), Artificial Intelligence: A Modern Approach, 3rd edition, Prentice Hall.
6. George F. Luger, (2008), Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th edition, Addison-Wesley.
7. Nils Nilsson, Morgan Kaufmann, (1998), Artificial Intelligence: A New Synthesis.
8. Patrick Henry Winston, (1992), Artificial Intelligence, 3rd edition, Addison-Wesley.

Course Title: **SOFTWARE QUALITY ASSURANCE**

Course Code: **ITEC4122**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand quality assurance.
- Assure and verify quality using different techniques.

Course Outline:

Introduction to Software Quality Assurance: What is quality, quality assurance, Quality in the project manager's triangle, The Quality challenge, Quality control v/s Quality assurance, Testing concepts and issues?

Quality Assurance in Software Projects: Software phases, Principles and practices, Quality management, Quality assurance and standards, Quality planning and quality control.

Verification and Validation: Formal Verification, Planning verification and validation, Critical system Validation, Reliability validation, Principles of software validation, Software verification.

Software Quality Assurance: Planning for Software Quality Assurance, Software Quality Assurance (SQA) Plans, SQA-Organizational level initiatives, SQA planning (Observations, Numbers, Results),

Software Testing: Specification based test construction techniques, Black box, White-box and grey-box testing etc.

Tools and Framework for software testing: Jtest, JUnit, J Walk, Power Mock, Test NG etc.

Comprehensive Software Testing Techniques for SDLC: Control flow oriented test construction techniques, Data flow oriented test construction techniques, Clean-room approach to quality assurance.

Product Quality and Process Quality: Standards for process quality and standards for product quality.

Testing Documents: Walkthroughs and Inspections, Structure, Checklist, Audits, Roles and responsibilities (Reviews, Inspections, etc), How to make reviews and inspections most effective.

Quality Assurance beyond Testing: Defect Prevention and Process Improvement, Software Inspection, Fault Tolerance and Failure Containment, Comparing Quality Assurance Techniques and Activities.

Quantifiable Quality Improvement: Feedback Loop and Activities for Quantifiable Quality Improvement.

Recommended Books:

1. Nina S. Godbole, (2004),Software Quality Assurance: Principles and Practice (Hardcover), published by Alpha Science.
2. Jeff Tian, (2005), Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, published by John Wiley & sons.
3. Kit, Edward, (1998), Software Testing in the Real World: Improving the Process, Addison & Wesley.

Course Title: **HUMAN COMPUTER INTERACTION**

Course Code: **COMP3113**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduces the human issues of usability and its importance.
- Consider the implications of human understanding on the usability of computer systems and the importance of understanding the context of use.
- Describe guidelines for use of different media and interface styles.

Course Outline:

The Human: Input-output channels, Human memory, Thinking, Reasoning, Problem solving, Emotions, Individual differences, Psychology and design of interacting systems.

The Computer: Introduction, Text entry devices, Positioning, Pointing, and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, Sensors and special devices, Paper printing and scanning, Memory, Processing and networks.

The Interaction: Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interfaces, Interactivity, Context of interaction, Experience.

Usability Paradigm and Principles: Introduction, Paradigms for interaction. **Interaction Design Basics:** Introduction, What is design, Process of design, User focus, Navigation design, Screen design and layout, Iteration and prototyping.

HCI in Software Process: Introduction, Software life cycle, Usability engineering, Iterative design and prototyping, Design rationale.

Design rules, Prototyping, Evaluation techniques, Task analysis, Universal design and User support and Computer Supported Cooperative Work: Guidelines, Golden rules and heuristics, HCI patterns, Choosing an evaluation method, Requirements of user support, Applications, Design user support systems.

Introduction to Groupware, Pervasive and Ubiquitous Applications: Introduction, Groupware systems, Implementation of synchronous groupware, Ubiquitous computing.

Recommended Books:

1. Janet E. Finlay, Leeds Metropolitan. (2000). Human-Computer Interaction, Alan Dix, Computing Dept, Lancaster University, Birmingham Publisher: Prentice Hall.
2. Ben Shneiderman, University of Maryland Catherine Plaisant. (2010). Designing the User Interface: Strategies for Effective Human-Computer Interaction, 4/E, University Maryland. Publisher: Addison-Wesley.

Course Title: **OBJECT ORIENTED ANALYSIS AND DESIGN**

Course Code: **ITEC3115**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Teach Unified Modeling Language (UML), software development methodologies, requirements gathering and analysis, system architecture and design, implementation, testing, and deployment.
- Expose students with other proven OOAD practices.

Course Outline:

Introduction: Principles of Object Technology. OOP Review. Principles of Modeling. OOA&D Overview. Of Development Process, Review of Object-Oriented concepts, Unified process. UML **Requirements Engineering:** Analysis, and Specification: Requirements Engineering, Use Cases, Prototyping, Class Models. Interaction Diagrams. Verification and Validation.

Capturing System Behavior: Domain object model, Refining classes and associations, Achieving reusability, Generating the behavioral model use case realization.

Software Architectural design: Why the architectural design of software is important? Architectural design decisions Architectural views, Architectural patterns (ways of organizing system architectures, which can be reused in system designs, Application architecture. GRASP Principles (Creator, Low Coupling, High Cohesion, Controller, Polymorphism, Fabrication, Indirections, Protected Variations).

Design Patterns: Introduction to design patterns using design patterns; builder, hierarchy, abstract-occurrence, player-role, prototype, Delegator, Façade, Immutable, Read-only interface, proxy, GOF Patterns: (Adapter, Factory, Singleton, Strategy, Composite, Facade, Observer, Publish-Subscribe). Assignments and project.

Recommended Books:

1. Craig Larman (2001), Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process, 2nd /ed., Prentice Hall PTR, ISBN: 0130925691.
2. Wendy Boggs, Michael Boggs (2002), Mastering UML with Rational Rose 2002, Sybex, and ISBN: 0782140173.
3. Timothy Lethbridge, Robert Laganiere (2002), Object-Oriented Software Engineering: Practical Software Development using UML and Java, McGraw-Hill, ISBN: 0072834951.

Course Title: **TECHNOLOGY MANAGEMENT**

Course Code: **ITEC2111**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduce basic management functions with focusing on technology management issues.
- Get knowledge of business change and technology challenges, technology strategy, technology goals and objectives.
- Get understanding about hurdles to deploy technology and technology transfer issues.
- Understand IT as a change enabling technology, technology assessment, change management issues and case study to appraise student's real problems.

Course Outline:

Introduction: Introduction to issues in technology management. TM activities and tools, The TM framework, TM activities behind technological capabilities.

TM Activities: Identification, Selection, Acquisition, Exploitation, Protection, Learning

Basic Management Functions: Planning, Control, Decision making, organizing etc. **TM Tools.** TM Tools-Patent Analysis. TM Tools-Portfolio Management. TM Tools Road mapping. TM Tools-Value Analysis/Value Innovation

Risk Analysis: Business change and technology challenges and issues; Technology strategy, Goals and objectives, Common hurdles.

TM-Functions: Planning and Forecasting, Decision Making, Organizing, And Leading Technical People. Changer management, Knowledge management, Security management, Business strategy management, IT infrastructure management, Business process management

Technology Transfer Issues: Related to hardware, Software, Communications, Human resources. etc., IT as change enabling technology, Assessment and selection of technology, Training planning, Equipment and systems acquisition processes, Implementation processes, Common challenges in change management, Small case study.

Recommended Books:

1. Gerard H. Gaynor, Handbook of Technology Management, 1st Edition.
2. R. Ray Gehani, Management of Technology and Operations.
3. Richard C. Dorf, The Technology Management Handbook.
4. Robert Burgelman, Clayton Christensen, Steven Wheelwright, (2009).
5. Strategic Management of Technology and Innovation.

Course Name: **NETWORK DESIGN AND MANAGEMENT**

Course Code: **ITEC4117**

Credit Hours: **3(2+1)**

Objectives: The main objectives of this course are to:

- Focus on the technological aspects of existing business needs, routing protocols concepts, and technology and device selection.
- Understand LAN and WLAN designing strategies, Network monitoring, traffic metrics, performance Management, fault Management, network security management, Network management protocols and broadband network management.

Course Outline:

Network Design: Business goals and needs , Characterizing QoS, Selection of bridging, switching and routing protocols, Physical layer network design, Network design methodology, Network structure models, Enterprise LAN design, Designing basic campus and data centre networks, Designing remote connectivity, VLSM, Designing IP addressing.

Network Management: Need for monitoring and management in an IP network design, Understanding through router delay and packet congestion, Traffic matrices, inferences, modeling and estimation using SNMP link counts, Network performance, Fault, Security accounting, Management, RMON services estimating traffic caused by network management, Introduction to routers, Routing basics, Network management Protocols (ICMP, SNMP, RIP, IGRP, NDP, GDP, EIGRP), Broadband network Management. Access control lists: MPLS, Network management tools: MRTG, PRTG, Wireshark, Port Scanner.

Recommended Books:

1. Anthony Bruno, CCIE; Steve Jordan, CCIE, CCDA 640-864 Official Cert Guide, Premium Edition eBook and Practice Test, 4thEdition.
2. P. Oppenheimer, (2011), Top-down Network Design, CISCO Press, 3rded.
3. J.D. McCabe, (2003) Network Analysis, Architecture, and Design, Morgan- Kaufmann,2nded.

Course Title: **DISTRIBUTED DATABASE SYSTEMS**

Course Code: **ITEC4118**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand concepts and technical issues of distributed database systems.
- Understand the principles of distributed database systems within the framework of distributed data processing.

Course Outline:

Introduction: Concepts of RDBMS, What is DDBS and distributed data processing, Advantages &disadvantages of DDBS, Problem areas &network concepts, Transparencies in a DDBMS, Alternative design strategies.

Distributed Database Design: Distributed design issues fragmentation, Data allocation in distributed DBMS, Semantic data control, and semantic data control.

Database Integration: Bottom-up design methodology, Schema matching, Schema integration, Schema mapping, Data cleaning

Data and Access Control: View management, Data security, Semantic integrity control, **Query Processing:** Layers of query Processing, Query decomposition, Localization of distributed data, Factors governing query optimization, Centralized query optimization, Ordering of fragment queries, Distributed query optimization

Transaction Management: The Transaction concept; Transaction properties, Goals of transaction management.

Distributed Concurrency Control: Concurrency control in centralize database system, Distributed concurrency control, Dead lock management.

Distributed DBMS Reliability: Reliability concepts, Failure and faults of DDBMS, Reliability protocols, Network partitioning, parallel architecture.

Data Replication: Consistency of related databases, Update management strategies, Replication protocols, Replication failures.

Web Data Management: Web graph, Web search, Web querying.

Current Issues: Streaming Data and Cloud Computing: Data stream management, Cloud data management.

Recommended Books:

1. M. Tamer Özsu, Patrick Valduriez (2011), Principles of Distributed Database Systems, Third Edition, Prentice Hall, ISBN978-1-4419-8833-1.
2. Angelo R. Bobak (1996), Distributed and Multi-Database Systems, Artech House. ISBN:0890066140.

Course Title: **ELECTRONIC COMMERCE**

Course Code: **ITEC4120**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Discuss the e-commerce process.
- Describe an example of system architecture for an e-Business.
- List the seven major elements of web design.
- Identify the major electronic payment issues and options

Course Outline:

Introduction to Electronic Commerce: Define electronic commerce, Identify the four stages of e-commerce, Examine revenue models, Identify revenue models, Identify value chains, Evaluate SWOT techniques.

Technology Infrastructure: Internet, World Wide Web, Networks, ISPs, Markup languages.

Selling On the Web: Revenue models, Revenue strategies.

Marketing On The Web: Identify the major marketing strategies used in e-commerce, Discuss marketing issues related to e-commerce, Examine the differences between product-based and customer-based marketing strategies, Discuss effective communication methods used in e-commerce, Define market segments, Examine methods for reaching differentiating market segments, Examine customer relationship life cycle as it relates to e-commerce, Compare advertising methods used in traditional commerce and e-commerce**,** Name the advertising options.

Business-To-Business Online Strategies: Define business-to-business marketing, Examine strategies used by businesses use to improve purchasing, logistics, and other support activities, Discuss electronic data interchange, Compare electronic datainterchange techniques and internet techniques used in e-ecommerce, Define supply chain management, Examine why businesses are moving to database driven, Supply chain management systems, Examine the effective use of electronic portals and marketplaces **Online Auctions, Virtual Communities, and Web Portals:** Define auctions, Web portals and virtual communities, Examine auction techniques, Discuss the differences between the seven (7) major auction types, Discuss the advantages of electronic auctions,Discuss the disadvantages of electronic auctions, Identify the major obstacles of

consumer acceptance of electronic auctions, Discuss the significance of virtual communities

Environment of Electronic Commerce: Legal, Ethical, and Tax Issues: Examine laws that govern Electronic Commerce activities, Examine laws that govern the use of intellectual property by online businesses, Discuss online crime, terrorism, and warfare, Discuss ethics issues that arise for companies conducting electronic commerce, Examine the conflicts between companies desire to collect and use data about their customers and the privacy rights of those customers, Discuss issues concerning the taxes that are levied on electronic commerce activities, Discuss the increasing pressure by States to regulate and issue taxes based one-commerce

Web Server Hardware and Software: Examine the equipment used with web servers, Examine and discuss software packages for web servers, Discuss email options, Discuss spam and methods for controlling spam, Discuss internet and web site software packages **Electronic Commerce Software:** Web-hosting services**,** Electronic commerce software. **Electronic Commerce Security:** Define and discuss security issues surrounding online activities**,** Examine security techniques for securing client computers, Examine security techniques used for securing communication channels between computers, Examine security techniques for securing server computers, Evaluate organizations that promote security for computer, network, and Internet.

Payment Systems for Electronic Commerce: Discuss electronic payment issues, Contrast the different e-payment options, Identify on-line payment services, Explain activities performed by a transaction-processing service.

Planning for Electronic Commerce: List some international issues that must be addressed for on-line international sales, List at least three pros and cons regarding electronic signatures.

Recommended Books:

1. Janice Reynolds, (2004), The Complete E-Commerce Book, (Second Edition).
2. Kenneth Laudon &Carol Guercio Traver, (2012), E-commerce (9thEdition)
3. Ian Daniel, (2011), E-commerce: Get It Right.

Course Title: **DATA WAREHOUSING**

Course Code: **ITEC4121**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Manage large database systems.
- Monitor the processing of database system.

Course Outline:

Introduction: Introduction to data warehousing and decision support systems. Data warehouse constructs and components, Differences between TPS and DSS environments. **Data Warehouse Architecture:** Exploring data sources, Exploring and ETL process, Exploring a data warehouse, Popular ETL tools, Informatics, DGT studio, Oracle data warehouse builder, Microsoft SQL integration, etc.

Data Marts: Differentiate data marts and data warehouse, Evaluation of data warehouse, Data warehouse design methodology, Enterprise data warehouse **Dimensional Modeling of Data Warehouse:** Data warehouse design overview, Designing dimension tables, Designing fact tables, Physical design for a data Warehouse, Star schema, Snowflake schema, Time dimension

Online Transaction Processing: OLAP in data warehousing and different types of OLAP such as MOLAP, ROLAP and HOLAP.

Indexing Techniques Used in Data Warehousing: B-Tree Index, Pure bit map index, Encoded bitmap index, Projection index. Hardware and software systems consideration for data warehousing.

Recommended Books:

1. Paulraj Ponniah, Data Warehousing Fundamentals, John Wiley & Sons Inc.,NY.
2. W.H. Inmon, Building the Data Warehouse,(Second Edition), John Wiley & Sons Inc.,NY.
3. Ralph Kimball &Margy Ross, The Data Warehouse Toolkit,(Second Edition), John Wiley & Sons Inc.,NY.

Course Title: **GEOGRAPHICAL INFORMATION SYSTEM**

Course Code: **ITEC4123**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand the fundamental concepts of Geographical Information System(GIS)
- Understand data formats, structures, functions, importance and applications of GISs in various fields like environmental monitoring, vehicle navigation.

Course Outline:

Introduction: Introduction to GIS, History of GIS.

Architecture of GIS: Coordinate systems, Geographic information, Maps; Scales and projections, Topology.

Formats for GIS Data: Exchanging data; Analog-to-digital maps, Extracting and reading map data, digitizing and scanning, Field and image data, Data entry, Editing and validation, Spatial data modeling, Attribute data management, Data input and editing, Data analysis. **Analytical Modeling in GIS:** Output from new maps to enhanced decisions basic database management, Searches by attribute, Searches by geography, Query interface, Describing attributes, Statistical analysis, Spatial description, Spatial analysis, Searching for spatial relationships, GIS and spatial analysis. **Making Maps with GIS:** Evolution of GIS software, GIS and operating system, GIS software capabilities, GIS software and data Structures, Development of computer methods for spatial data, Data quality issues, Future data; Future hardware, Future software, Some future issues and problems.

Recommended Books:

1. Keith C. Clarke (2000), Getting Started with Geographic Information Systems, 3rdedition, Prentice Hall.
2. D. Ian Heywood, Ian Heywood, Sarah Cornelius, Steve Carver (1999), An Introduction to Geographical Information Systems, Prentice Hall. ISBN: 0130162388.

Course Title: **DESIGN PATTERNS**

Course Code: **ITEC4125**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Demonstrate a thorough knowledge of the different design patterns.
- Draw a high level class diagram in UML for each Pattern.

Course Outline:

Introduction: Overview of object-oriented design, Overview of UML &OCL. Introduction to design patterns. Coupling and cohesion. Why design patterns?

Creational Patterns: Singleton, Abstract factory, Builder, Prototype.

Structural Patterns: Facade, Composite, Bridge, Proxy, Adapter, Decorator. **Behavioral Patterns**: Chain of responsibility, Visitor, Observer, Iterator, Command, mediator, Strategy, Interpreter, Memento.

Patterns for Concurrent and Distributed Systems: Event handling patterns, Synchronization and concurrency patterns. Concurrency controller pattern.

Antipater's: Common pitfalls and antimatters examples, Recovering from bad designs, Refactoring to patterns, Introduction to aspect-oriented design: Aspects, Themes, Concerns.

Recommended Books:

1. E. Gamma, R. Helm, R. Johnson, and J. Vlissides, (1995), Design Patterns: Elements of Reusable Object Oriented Software,Addison -Wesley Professional.
2. Tony Bevis,(2012),Java Design Pattern Essentials, Ability First Limited; 2nd Edition ISBN-10:0956575846175
3. Mark Grand, (2002), Patterns in Java: A Catalog of Reusable Design Patterns Illustrated with UML, 2nd Edition, Volume 1, Wiley. ISBN-10:0471227293
4. B.Bruegge and A. H. Dutoit, (2003), Object-Oriented Software Engineering: Using UML, Patterns, and Java, 2nd Edition, Prentice Hall.ISBN-10:0136061257.
5. J. Kerievsky, (2004),Refactoring to Patterns, Addison-Wesley. ISBN- 10:0321213351.

Course Title: **BUSINESS PROCESS MANAGEMENT**

Course Code: **ITEC4126**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand BPM, Business process lifecycle, flow between different processes.

Course Outline:

Introduction: BPM, Motivation and definitions, Business process lifecycle,Classification of business processes, Goals, Structure and organization.

Evolution of Enterprise Systems Architectures: Traditional application development, Enterprise applications and their integration, Enterprise modeling and process Orientation, Workflow management, Enterprise services computing

Business Process Modeling Foundation: Conceptual model and terminology, Abstraction concepts, From Business functions to Business Processes, Activity models and activity instances, Process models and process instances, Process interactions, Modeling process data , Modeling organization, Modeling operation, Business process, Architecture of process execution environments.

Process Orchestrations: Control flow patterns, Petri nets, Event-driven Process Chains, Workflow nets, Graph-based workflow language, Business process model and notation. **Process Choreographies:** Motivation and terminology, Development phases, Process choreography design, Process choreography implementation, Service interaction Patterns, Choreography modeling in BPMN.

Properties of Business Processes: Data dependencies, Object lifecycle conformance, Structural soundness, Soundness, Relaxed soundness, Weak soundness, Lazy soundness, Soundness criteria overview.

Business Process Management Architectures: Workflow management architectures, Flexible workflow management, Web services and their composition, Advanced service composition.

Business Process Management Methodology: Dependencies between processes, Methodology overview, Phases.

Recommended Books:

1. Dumas, Marlon, et al. Fundamentals of business process management. 2nd Edition. 2018 : Springer, ISBN-13:978-3662565087
2. Mathias,W., (2012), Business Process Management: Concepts, Languages, Architectures, Springer; 2nd Edition .ISBN-10:3642286151.
3. Jörg, B., Martin,K.& Michael .R.,(2011), Process Management: A Guide for the Design of Business Processes, Springer; 2nd Edition. ISBN-10:3642151892168.

Course Title: **SOFTWARE CASE TOOLS AND APPLICATIONS**

Course Code: **ITEC4127**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand CASE tools.
- Explain three different perspectives for CASE tools classification.
- Evaluate existing CASE tools.
- Compare and contrast the fitness of existing CASE tools to the needs of specific software development context.

Course Outline:

Introduction: CASE, Types of CASE Tools, Case environment, Expectations about CASE and the need for tool integration, Example of CASE tool integration. Approaches CASE tool integration, Conceptual model of integration, Evolution of integrated CASE environment architectures, Integration as a design activity.

Service Based Model of a CASE Environment: Overview of PSE reference Model, Description of reference model services, Uses of reference model.

Properties and Types of Integration Mechanism: The Relationship between data and control model, Presentation integration.

The Role of Process in Integrated CASE Environments: Nature of process integration, Process integration and CASE Tools and environments, Examples of process and CASE tool interactions

Replacing the Message Service in a CASE Integration Framework: Background, Adding the tool talk interface, Running the experiment scenario, Replacing the tool talk in the emulation framework.

Integration of CASE Tools with CM Systems: Key concepts related to CM and CASE Tools integration, CASE tool integration scenarios involving CM.

CASE Environments in Practice: Background and studies, Observations, An example of transitional CASE environment, CASE environment progress over thepast decade.

Object-Oriented Analysis & Design Modeling: Business process models, Design reuse, E-Commerce, ISO, Comparison of popular CASE tools, Practice real life problem for development through CASE tools.

Recommended Books:

1. Alan W. Brown (1994), Principles of CASE Tool Integration, Oxford University Press, USA; 1st Edition.ISBN-10:0195094786.
2. Hausi A. Muller, Ronald J. Norman and Jacob Slonim, Computer,(2011),Aided Software Engineering, Springer; Soft cover reprint of the original 1st Edition. ISBN- 10:1461286263.
3. Most popular software CASE tools documentation.

Course Title: **COMPUTER GRAPHICS**

Course Code: **ITEC4128**

Credit Hours: **3(2+1)**

Objectives: The main objectives of this course are to:

- Have a basic understanding of the core concepts of computer graphics.
- Be capable of using OpenGL to create interactive computer graphics.
- Understand a typical graphics pipeline.
- Understand the core concepts of computer graphics.
- Create interactive computer graphics.

Course Outline:

Introduction: History of computer Graphics, Graphics architectures and software, Imaging, Pinhole camera, Human vision, Synthetic camera, Modeling vs. rendering.

OpenGL: Architecture, Displaying simple two-dimensional geometric objects, Positioning systems, Working in a windowed environment.

Color: Color perception, color models (RGB, CMY, HLS), color transformations. Color in OpenGL. RGB and indexed color.

Input: Working in a network environment, client-server computing; input measure,event, sample and request input, using callbacks, picking.

Geometric transformations: Affine transformations (translation, rotation, scaling, shear), homogeneous coordinates, concatenation, current transformation and matrix stacks. Three Dimensional Graphics: Classical three dimensional viewing, Specifying views, Affine transformation in 3D, Projective transformations. Ray tracing.

Shading: Illumination and surface modeling, Phong shading model, Polygon shading.

Rasterization: Line drawing via Bresenham's algorithm, clipping, polygonal fill, BitBlt. Introduction to hidden surface removal (z buffer).

Discrete Techniques: Buffers, reading and writing bitmaps and pixel maps, texture mapping, compositing.

Recommended Books:

1. Hughes, Van Dam, et al.(2014).Computer Graphics Principles and Practice(3rd.ed), Pearson.
2. OpenGL Programming Guide, Addison-Wesley,2004.
3. OpenGL Reference Manual, Addison-Wesley,2004.
4. E. Angel, (2004) OpenGL: A Primer Addison-Wesley.
5. P Shirley,(2005) Fundamentals of Computer Graphics,(2nded).
6. Hearn & Baker (2004) *Computer Graphics with OpenGL*, 3e, Prentice Hall.

Course Title: **SOFTWARE DESIGN AND ARCHITECTURE**

Course Code: **ITEC4129**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Design and motivate software architecture for large-scale software systems.
- Recognize major software architectural styles, design patterns, and frameworks.
- Identify and assess the quality attributes of a system at the architectural level.

Course Outline:

Introduction to Software Design: Introduction to software architecture, Introduction to software design, Design Vs architecture.

Software Architecture Core Concepts: Define software architecture, Architecture address NFR, Architectures and technologies.

Software Architecture Business Cycle: Where do architecture comes from, Software process and architecture business cycle, What makes a good architecture?

Software Architecture Business Cycle: Activities in software process and architecture business cycle, Architectural structures and views.

Quality Attributes in Software Architecture: Motivation, What are the different Quantity attributes, Performance, Scalability, Modifiability, Security, Availability, Robustness, How to achieve quality attributes at architectural level.

Software Architecture Process: Process outline, Architecture Design, Validation. Architecture patterns, Structural view, Behavioral view, Implementation issues.

Documenting Software Architecture: Architecture requirements, Solution, Architecture analysis.

Introduction to Design: Introduction to Unified Modeling Language (UML), Structural and behavioral diagrams.

Introduction to Software Product Line engineering: Overview, What makes SPL works? Architectures for product lines.

Aspect Oriented Architecture: Introduction to aspect-oriented programming (basic concepts), Aspect oriented architecture, Aspect oriented modeling using UML, Aspect oriented modeling tools.

Model-Driven Architecture: What is MDA? Why MDA? State of the art practices and tools.

Recommended Books:

1. Kai Qian, Xiang Fu, LixinTao, Chong-Wei Xu, Jorge L. Diaz-Herrera, Jones & Bartlett, (2009), Software Architecture and Design Illuminated(1stEdition).
2. Christopher.F, (2006), Introduction to Software Engineering Design: Processes, Principles and Patterns with UML2,Addison-Wesley.
3. Carlos, O., (2012), Software Engineering Design: Theory and Practice, CRCPress.
4. Sacha .K., (2006),Software Engineering Techniques: Design for Quality, Springer.

Course Title: **DISTRIBUTED COMPUTING**

Course Code: **ITEC4131**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Get the knowledge of the principles and practice underlying the design of distributed systems.

Course Outline:

Overview: Goals, architectures, middleware, heterogeneity.

Communication: Synchronous/ Asynchronous communication and computation, Remote Procedure Calls, Message- oriented communication.

Synchronization: Clock Synchronization, logical clocks.

Consistency & replication: Data and client centric models, consistency protocols. **Scalable multi computers & multi processors:** Distributed CC- NUMA and cluster scalability, machine virtualization for distributed computing: CPU, Memory, I/O and system virtualization.

Physical & Virtual Clusters: Server clusters, high availability

Grids & Applications: P2P Systems overlay networked, national or global computing, grids and applications.

Fault Tolerance: Failure models, disaster recovery, security

Recommended Books:

1. K. Hwang & Z. Xu (1998).Scalable Parallel Computing. McGraw-Hill.
2. F. Berman, G. Fox, & T. Hey.(2003).Grid Computing. Wiley.
3. Tanenbaum, A.S. & Steen, .M.V. (2002)Distributed Systems: Principles and Paradigms. Prentice-Hall.
4. Michael P & Papazoglou. (2007). Web Services: Principles and Technology. Pearson Prentice Hall.

Course Name: **COMPUTER ARCHITECTURE**

Course Code: **ITEC4132**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Get a deeper understanding of how computers work.
- Understand working knowledge of various subsystems and the general principles that affect their performance.

Course Outline:

Digital Hardware Design: Transistors, Digital logic, Hardware description languages (Verilog).

Instruction Set Architecture: Instruction types and mixes, Addressing, RISC vs. CISC, Exceptions.

Scalar Pipelines: Data dependencies, Static scheduling, Performance.

VLIW Pipelines: Local scheduling, Loop unrolling, Software pipelining, Trace scheduling, Deferred exceptions, Predicated execution, IA64.

Dynamic Pipelines: Dynamical scheduling, Register renaming, Speculative execution, Trace cache.

Thread-Level Parallelism: Cache coherency, Sequential consistency, Multithreading, Symmetric multiprocessing, Transactional memory.

Data-Level Parallelism: GPGPU programming.

Recommended Books:

1. Dubois et al. (2012). Parallel Computer Organization and Design, Cambridge University Press.
2. Shen,J.P.& Lipasti.H.M. (2005). Modern Processor Design: Fundamentals of Superscalar Processors.(1st edition).McGraw-Hill.
3. Hennessy, Patterson, Morgan & Kauffman (2006) Computer Architecture: A Quantitative Approach by Series.(4th.Edition).
4. Patterson & Hennessy, Morgan & Kauffman Series (2008).Computer Organization &Design. (4th.Edition).

Course Title: **iOS APPLICATIONS DEVELOPMENT**

Course Code: **ITEC4133**

Credit Hours: **3(2+1)**

Objectives: The main objectives of this course are to:

- Build iOS native applications for iPhone and iPad using different frame works.

Course Outline:

Creating an iOS App: Understanding Xcode, Using the Xcode interface builder, Using the Xcode objects library, Understanding view hierarchy, Creating a custom app icon, Creating a custom splash screen.

Outlets, Actions, and Views: Understanding outlets and Actions, Using text fields, Buttons, Labels, Web Views, and page controllers, Using Views along with sub Views, Creating Views using code.

Using View Controllers: Working with the single View template, Exploring the app delegate, Adding new View Controllers, and Transitioning between multiple View, Controllers, and Using animations.

Application Templates: Working with the tab bar application, Template, Understanding the master detail, Application template.

The iOS Keyboard: Customizing the iOS keyboard for different inputs, Adjusting text field behaviors, Methods for dismissing the keyboard, Detect keyboard activities with the notification center, Using the scroll view, Responding to keyboard activities programmatically using scrolling views.

Working with Different Ios Devices; iPhone & iPad: Programmatically detecting device hardware, Dynamically adjusting graphical layouts, Working with multiple devices, Creating apps that work universally.

Using Table Views: Understanding the UI Table View, Using UI Table View Cell Classes, Working with UI Table View data source and delegate, Using Table View and Table View Cell, The master detail template, Creating drill-down menus, Navigation to other views, Using Property lists for data persistence, Creating multi section tables.

Supporting Screen Rotations: Portrait &landscape modes, Handling device rotation setting preferred device orientation, forcing specific orientation using no Rotations, Dynamically adjusting graphical layouts based upon rotation.

Working with Databases: Importing the sqlite3 library. Creating a database, writing tables and inserting records into tables, Bundling a database with your app. Checking for database existence. Reading and displaying database data.

Using Animations & Video: Using the NSTimer Class. Animating objects on the screen using transformation, Rotation, Scaling and Translation, Animating image arrays Playing video within an app.

Accessing integrated iOS Apps: Using the email app accessing Safari. Sending SMS text messages, Working with the camera, Using with the Photo Library.

Using Web Services within an iOS app: Consuming a Web Service, Parsing XML consuming and parsing JSON, Web Services, Integrating common Twitter and Facebook with iOS apps.

Working with iOS Maps and Location Services: Using the MapKit and UI Map View getting and displaying user location, Getting directional information, Displaying map annotations. Displaying disclosure buttons on annotations performing reverse Geo coding.

Working with iCloud: Storing documents in iCloud, Setting project entitlements, Managing iCloud documents, Using the UIDocument Class, Storing KeyValue files in iCloud.

Working with the Accelerometer:

Using the Gyroscope, Using the Accelerometer, Outputting Sensor Data, Using the ShakeAPI.

Recommended Books:

1. Keur, C. & Hilllegass, A., iOS Programming: The Big Nerd Ranch,(5th ed.)
2. Nahavandi poor, V.,iOS 7 Programming Cookbook,(1st, ed.),Vandad.
3. Ray, J. iOS 7 Application Development in 24 Hours Sams Teach Yourself,(5th ed.).

Course Title: **MULTIMEDIA SYSTEMS AND DESIGN**

Course Code: **ITEC3113**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduce students to the complete process of multimedia system specification, design, testing, and prototyping, including the tools and techniques for integrating multimedia content (text, graphics, images, sound, animation, motion video and virtual reality) into a product.
- Present design principles and techniques to maximize the effectiveness of such products, and to give the students practice in the production using a variety of media and tools.

Course Outline:

Multimedia: What is Multimedia? Multimedia authoring tools, Multimedia authoring, Multimedia production, Multimedia presentation, Automatic authoring.

Editing and Authoring Tools: (Proprietary/open Source), VRML.

Making Multimedia: Handling images, Sound, Animation and video, Planning & costing, Designing and producing. Multimedia skills and talent.

Internet and Multimedia: Designing for the World Wide Web. Delivering multimedia product.

Recommended Books:

1. Tay Vaughan (2010). Multimedia: Making it Work, 8thEdition. ISBN- 10:7170048466.
2. Z. M. Li and M. S. Drew, (2004). Fundamentals of Multimedia Prentice Hall. ISBN: 0-13-127256-X.
3. Shuman, James,(2002).Multimedia Concepts, Cengage Learning.
4. Lake, Susan and Karen Bean, (2007). Digital Multimedia: The Business of Technology, Cengage Learning.
5. Z. M. Li, M. S. Drew (2004).Fundamentals of Multimedia. Prentice Hall. ISBN: 0-13- 127256-X
6. N. Chapman; J. Chapman (2004).Digital Multimedia. (2nd ed.), Wiley, ISBN: 0-470- 85890-7
7. Villalobos, Ray, (2007).Exploring Multimedia for Designers, Cengage Learning.

Course Title: **ADVANCE WEB APPLICATION DEVELOPMENT**

Course Code: **ITEC4116**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Describe the Microsoft web technologies stack and select an appropriate technology to use to develop any given application.
- Describe how to develop and deploy an ASP.NET MVC web applications

Course Outline:

Exploring ASP.NET MVC: Overview of Microsoft Web Technologies, Overview of ASP.NET, Introduction to ASP.NET MVC.

Designing ASP.NET MVC: Web Applications planning in the project design phase designing models, Controllers, and views module, Developing ASP.NET MVC models, Creating MVC, Models working with data.

Developing ASP.NET MVC Controllers: Writing controllers and actions, Writing action filters.

Developing ASP.NET MVC Views: Creating views with Razor Syntax, Using HTML helpers, Reusing code in views.

Testing and Debugging ASP.NET MVC Web Applications: Unit testing MVC components, implementing an exception handling strategy

Structuring ASP.NET MVC Web Applications: Analyzing information architecture, Configuring routes, Creating a navigation structure.

Applying Styles to ASP.NET MVC Web Applications: Using template views, Applying CSS to an MVC application, Creating an adaptive user interface.

Building Responsive Pages in ASP.NET MVC Web Applications: Using AJAX and partial page updates, implementing a caching strategy.

Using JavaScript and jQuery for Responsive MVC Web Applications: Rendering and executing JavaScript code, Using jQuery.

Controlling Access to ASP.NET MVC Web Applications: Implementing authentication and authorization, Assigning roles and membership.

Building a Resilient ASP.NET MVC Web Application: Developing secure sites, State management.

Using Windows Azure Web Services in ASP.NET MVC Web Applications: Introducing windows Azure, Designing and writing windows Azure Services, Consuming windows Azure Services in a web application.

Implementing Web APIs in ASP.NET MVC Web Applications: Developing a web API, Calling a web API from mobile and web Applications.

Handling Requests in ASP.NET MVC Web Applications: Using HTTP modules and HTTP handlers, Using Web sockets.

Deploying ASP.NET MVC Web Applications: Deploying a Web Application, Deploying an MVC 4 Application.

Recommended Books:

1. Matthew MacDonald, ASP.Net: The Complete Reference.
2. George Shepherd, Microsoft® ASP.NET 4 Step Publisher: Microsoft Press.

Course Title: **CLOUD COMPUTING**

Course Code: **ITEC4113**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand cloud computing.
- Evaluate various cloud delivery models.
- Specify security threat exposure within a cloud computing infrastructure.

Course Outline:

Cloud Computing Basics: Emergence and evolution of cloud computing, overview of cloud computing, global nature of cloud, cloud- based service offerings, characteristics, benefits of cloud model, challenges.

Cloud Computing Services Model: Web services delivered from the cloud, Communication-as-a-Service (CaaS), Monitoring as-a-Service (MaaS), Platform-as-a- Service (PaaS), Software-as-a-Service (SaaS), Infrastructure as a Service (IaaS).

Cloud Computing Deployment Model: Private, Public, Community and Hybrid deployment models.

Cloud Infrastructure: Cloud computing at Amazon, Google, and Windows Azure, open source software platforms for private cloud, legal issues, and service level agreements **Virtualization:** Building Cloud networks, Virtualization, Federation, Layering, VMs, Virtual machine monitors.

Security: Common standards in cloud computing, cloud security alliance, SAS 70, ISO270001.

Recommended Books:

1. John .W. R., James F & Ransome,(2010),Cloud Computing Implementation, Management, and Security, by Taylor & Francis Group:ISBN978-1-4398-0680-7.
2. J.Rhoton.(2009).Cloud Computing Explained: Implementation Handbook for Enterprises. Recursive Press. ISBN-10:0956355609.
3. Winkler,(2011),Securing the Cloud: Cloud Computer Security Techniques and Tactics, 1st Edition (2011). ISBN-10:1597495921.

Course Title: **MOBILE APPLICATION DEVELOPMENT**

Course Code: **ITEC4130**

Credit Hours: **3(2+1)**

Objectives: The main objectives of this course are to:

- Develop mobile applications on a popular mobile platform.
- Evaluate development with another mobile platform.
- Explain mobile devices, including their capabilities and limitations.
- Use current mobile platforms and their architectures.

Course Outline:

Android development platform: Development platform architecture, Installing the Android ADT (Android Development Tools), Installing the Android SDK (Software Development Kit), Creating AVDs (Android Virtual Devices),Using ADT tools from the command line.

Activities, Intents, Fragments: Using styles and themes, Displaying dialog windows, Displaying progress bars, Using intents and intent filters, Fragment life cycle.

Android User Interface: Creating views and view groups, Making layouts, Linear, Absolute, Table, Relative, Frame, Scroll view, Changing screen orientation, Using action bars, Creating UI controls with Java.

Android Views: Basic views, text view, button, edit, checkbox, radio, List views, List fragments, Image views, Using menus with views.

Database and Data Persistence: Saving and loading user preferences, Persisting data to files, Creating and using a database.

Content Providers: Creating and using content providers.

Messaging: Creating and using SMS messages.

Google Maps API: Getting location data, Displaying maps.

Networking: Working with web services using HTTP, Socket programming

Apache Cordova (Phonegap): Cordova architecture, Creating UI with HTML and CSS, Controlling the UI with JavaScript.

Publishing Android Apps: Deploying Android packages (APKs)

Recommended Books:

1. Lee,W.M., (2012), Beginning Android 4 Application Development. JohnWiley& Sons.
2. Allen,G., (2011),Beginning Android 4,Apress. ISBN:1430239840.
3. Zechner.M. Beginning Android game.(2011). Apress,ISBN:1430230428.
4. Satya, Maclean.D, (2012).Pro Android 4, Apress, ISBN:1430239301.
5. Meier.R&Reto. (2012) Professional Android 4 Application Development, Wiley, ISBN:1118237226.

Course Title: **MOBILE AND PERVASIVE COMPUTING**

Course Code: **ITEC4135**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Demonstrate an advanced understanding of the technologies used in mobile and ubiquitous systems and the constraints that they impose.
- Demonstrate an advanced understanding of the range of novel applications based upon mobile systems as well as their particular requirements.
- Demonstrate an understanding of the models and technologies for developing mobile applications including future technologies.
- Demonstrate practical skills in developing mobile applications
- Demonstrate an understanding of recent research issues in the field of Mobile and Ubiquitous Computing.

Course Outline:

Introduction: Overview**,** Evolution of Pervasive Computing, Pervasive Computing Projects, Modern Directions

Context-aware computing: Basic concept, Context sensing, Sensors and sensor networks

Smart objects and space: Smart objects, Communication, Smart space

Ubiquitous computing: embedded devices, m-commerce, location-aware applications, mobile games and multimedia, the Internet of Things

Infrastructure and middleware of pervasive computing: Middleware, Mobility and adaptation, Composition of Pervasive Computing

Wearable Computing, Example Scenarios: Composition of Pervasive Computing, Distributed Systems

Programming mobile devices: The basic building blocks, Creating UI's, Locating and Sensing, Storing Data

Heterogeneity of Device Platforms, Dynamics of Application Environments, Approaches for Developing Pervasive Applications

Case studies will be selected among the following:

- Mobile systems for computational science
- Mobile sensing systems
- Mobile technologies for smart cities
- Pervasive computing at a scale

Recommended Books:

1. S. Poslad, “Ubiquitous Computing: Smart Devices, Environments and Interactions,” Wiley, 2009, 502 pp., hardcover, ISBN: 978-0-470-03560-3
2. “Cognitive Networks: Towards Self-Aware Networks,” Q. Mahmoud (Ed.), Wiley, 2007, 368 pp., hardcover, ISBN: 978-0-470-06196-1

Course Title: **KNOWLEDGE BASED SYSTEMS**

Course Code: **ITEC4136**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- To enable students to search for knowledge (acquisition) and to specify it clearly(validation).
- The concepts of expert systems will be introduced.
- To enable students to design a knowledge structure integrated with production planning, quality control and other subsystems of an industrial organization.
- To introduce the features of a feasible expert system.
- To enable students, use various knowledge representation methods and different expert system structures from the industrial engineering point of view.

Course Outline:

Introduction: Knowledge-Based Systems (KBS), Expert Systems (ES), Data/Information/Knowledge

Knowledge Representation: Semantic Nets, Rules, Frames, Scripts, Logic, RDF, Semantic Web Technologies

Reasoning and Inference: Predicate Logic, Description Logics, Inference Methods, Resolution, Inference Methods, Resolution

Programming: ECLiPSe-specific Language features, Structure, Iteration, Loops, I/O

Reasoning with Uncertainty: Probability, Bayesian Decision Making, Dempster-Shafer Theory

Approximate Reasoning: Fuzzy Logic

Recommended Books:

1. Engineering of Knowledge-Based Systems. Avelino J. Gonzalez, Douglas D. Dankel, Prentice Hall (2000), ISBN-10: 0130189731.
2. Expert Systems: Principles and Programming, Fourth Edition. Joseph C. Giarratano, Gary D. Riley, 2004, ISBN-10: 0534384471
3. Knowledge-Based Systems. Rajendra Akerkar , Priti Sajja, 2009 ,ISBN10: 0763776475.

Course Title: **ADVANCED PROGRAMMING TECHNIQUES**

Course Code: **ITEC4137**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- This course introduces core programming basic including data types, control structures, algorithm development, and program design with functions—via the Python programming language.
- The course discusses the fundamental principles of Object-Oriented Programming, as well as in-depth data and information processing techniques.
- Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.
- Students will also deal with data manipulation for knowledge discovery

Course Outline:

Conceptual introduction: topics in computer science, algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system; installing Python; basic syntax, interactive shell, editing, saving, and running a script.

The concept of data types: variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; **Conditions:** boolean logic, logical operators; ranges, Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation

Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated).

String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers **Lists, tuples, and dictionaries;** basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

Simple Graphics and Image Processing: "turtle" module; simple 2d drawing, colors, shapes; digital images, image file formats, image processing Simple image manipulations with 'image' module (convert to bw, greyscale, blur, etc).

Classes and OOP: classes, objects, attributes and methods; defining classes; design withclasses, data modeling; persistent storage of objects, inheritance, polymorphism, operator overloading (_eq_,_str_, etc); abstract classes; exception handling, try block

Graphical user interfaces: event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

Data Manipulation: Preparing Data, Feature extraction and selection for machine learning, evaluation and resampling, supervised learning algorithms: SVM, decision tree, neural network, linear and logistic regression, Large-scale machine learning using TensorFlow, Keras andscikit- learn

Recommended Books:

1. *Fundamentals of Python: First Programs* Author: Kenneth Lambert Publisher: Course Technology, Cengage Learning, 2012 ISBN-13: 978-1-111-82270-5

DOMAIN IT SUPPORTING

(Any three **from the list of IT Supporting courses depending upon the availability of the experts. Coverage of relevant prerequisites must be ensured while offering any of the following courses form the category.)**

Course Name: **ENTERPRISE RESOURCE PLANNING SYSTEMS**

Course Code: **ITEC4114**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Prepare students to understand this vastly important technology.
- Examine enterprise software in general and learn how ERP software can improve the functions of a company, how it can streamline operations, and how the functional areas of any package relate to each other.

Course Outline:

Introduction: The evolution of software systems for planning and control in manufacturing companies, Material requirements planning, Manufacturing resource planning,

Enterprise Resource Planning (ERP) Systems: Basic methods and common features of ERP Systems, The market for ERP Systems, Systems Diagramming and the Process Map. ERP Life Cycle: Planning and Package Selection. Implementation and Operation and Maintenance

ERP Modules:

a- Customer Relationship Management (CRM) systems: Basic methods and common features of CRM systems, The market for CRM systems, Selected functions of the my SAP CRM system, Information warehouses Architectures, interfaces, and integration issues, Present state of ERP, SCM, and CRM applications and possible developments in the near future case studies.

b- Supply Chain Management (SCM) systems: Basic methods and common features of SCM systems, The market for SCM systems selected procedures of the mySAP SCM system APO.

c- ERP Financials

types of finance, introduction to financial reports, inputs and outputs financial systems, A/c payables, A/c Receivables, general ledger, basic introduction with mySAP financial module

d- Business Intelligence and Performance Management

Corporate performance management (CPM), CPM pyramid, Components of BI, How Data Analysis is important for decision making?

Recommended Books:

1. Modern ERP: Select, Implement & Use Today's Advanced Business Systems by Marianne Bradford, lulu.com (October 19, 2009). ISBN-10:0557012910.
2. Managerial Issues of Enterprise Resource Planning Systems by David Olson, McGraw-Hill/Irwin; 1st Edition (September 10, 2003). ISBN-10:0072861126.
3. Enterprise Resource Planning by Bret Wagner by Ellen Monk, Course Technology; 3rd Edition (February 4, 2008). ISBN-10:1423901797
4. ERP Systems by Dimpi Srivastava and AartiBatra, I K International Publishing House (February 15, 2010). ISBN-10:9380578148

Course Name: **SIMULATION AND MODELING**

Course Code: **ITEC4138**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- This course touches on some very interesting and relevant applications that differ quite a bit with, But then the fundamental similarities existing between the different approaches will be highlighted. The simulation pipeline, beginning with the derivation of the model up to its validation. This is about a first encounter with models and simulations, about gaining an impression of the diversity of tools employed from mathematics and computer science, and about the diversity of problem settings. We will discuss fluid dynamics, computational fluid dynamics.

Course Outline:

Introduction to Simulation Modeling: Simulation Modeling and Analysis, Other Types of Simulation Models, Purposes of Simulation, Advantages to Simulation, Disadvantages to Simulation, Other Considerations, Famous Simulation Quotes, Basic Simulation Concepts, Additional Basic Simulation Issues, Formal Problem Statement, Orientation, Project Objectives, Project Management Concepts, Simulation Project Manager Functions, Developing the Simulation Project Plan, Compressing Projects, Example Gantt Chart,

Advanced Project Management Concepts: Advanced Project Management Concepts, Project Management Software Packages, System Classifications, High-Level Flow Chart Basics, Components and Events to Model, Data to Be Included in the Model, Output Data, Sources for Input Data, Collecting Input Data, Deterministic versus Probabilistic Data, Discrete versus Continuous Data, Common Input Data Distributions Less Common Distributions, Offset Combination Distributions, Analyzing Input Data, How Much Data Needs to Be collected, What Happens if I Cannot Fit the Input Data

Simulation Program Selection: Software Implementations for Data Fitting, Simulation Program Selection, Model Translation Section Content, Program Organization, Divide-and- Conquer Approach, Animation, Advancing the Simulation Clock by Event by Event, Writing to an Output File, Assumptions, Simplifications, Oversights, Limitations, Need for Validation, Two Types of Validation, Face Validity, Statistical Validity, Validation Data Analysis Process, When a Model Cannot Be Statistically Validated and What to Do About It, Factors and Levels.

Experimental Designs: Two Alternative Experimental Designs, One-Factor Experimental Designs, Experimental Designs, Experimental Alternative Factor Interactions, Refining the Experimental Alternatives, Terminating System Analysis, Non-Terminating System Analysis, Written Report Guidelines, Equations, Importing Screen Captures, Presentation Guidelines, **MODEL TRANSLATION:** Presentation Media, Electronic Presentation Software Issues, Actual Presentation, Problem Formulation, Project Planning, System Definition, Input Data Collection, Model Translation, Verification, Validation, Implementation

Recommended Books:

1. Modeling and Simulation, Bungartz, H.-J., Zimmer, S., Buchholz, M., Pflüger, D., Springer-Verlag,2014.
2. Simulation Modeling Handbook, A Practical Approach, Christopher A. Chung, CRC Press,2004.
3. System design, modeling and simulation using Ptolemy II, Claudius Ptolemaeus, ,Ver 2.0, Creative Commons Attribution-ShareAlike 3.0 Unported, 2014
4. Applied Simulation Modeling, Andrew F. Seila, Vlatko Ceric, Pandu Tadikamalla, Thomson Learning Inc.,2003.

Course Title: **FORMAL METHODS IN SOFTWARE ENGINEERING**

Course Code: **ITEC4115**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Introduce formal methods in software engineering.
- Get knowledge about formal mechanisms for specifying and verifying the correctness, reliability and efficiency of software systems.
- Introduce the concepts related to finite state machines, regular expression, assertions, algebraic and model based specification techniques including case studies.

Course Outline:

Introduction to formal methods: Developing and acquiring formal methods, Using and applying formal methods, Brief introduction to logic and set theory,

Introduction to Hoare's Logic: Logic and theorem proving, Modeling software systems, Sequential, Concurrent and reactive systems, States, State spaces, Transition systems, Combining state spaces, Fairness, Partial order view.

Modeling formalism: Formal specifications linear temporal logic, Automata on infinite words, Specifications using Buchi-automata, completeness of specification;

Types of verification: State space verification, Representing states, Automata framework, Combining buchi-automata, Checking emptiness, Translating LTL into automata,

Model checking: Checking examples, checking complexity of model checking, safety properties, state space explosion problem. Z-Specification, Structure and schema

Recommended Books:

1. Doron A. Peled , (2001), Software Reliability Methods, Springer-Verlag.
2. Michael Huth, (2004), Logic in Computer Science Modeling and Reasoning about Systems 2ndEdition, Imperial College of Science, Technology and Medicine, London Mark Ryan, University of Birmingham.
3. Christel Baier and Joost-Pieter Katoen, (2008), Principles of Model Checking, MIT Press.

Course Name: **OPERATIONAL RESEARCH**

Course Code: **ITEC4139**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- This course will provide the characteristics of different types of decision-making environments, appropriate decision making approaches and tools to be used in each type. Solve the Transportation Models and Assignment Models. Understand the basic methodology for the solution of linear programs and integer programs.

Course Outline:

Introduction to operations research: Introduction to operations research, History of operations research, Applications, Modeling the linear programming, Linear programming, Geometry, Solving the linear programming,

Theory of the simplex method: the Simplex method, Shadow price, Theory of the simplex method, Duality, Dual theory, Sensitivity analysis, Other algorithms for linear programming, The dual simple method, Big – M method,

The transportation problem: The tow phase method, The transportation and assignment problems, The transportation problem, A streamlined simplex method for transportation problem, The assignment problem, A special algorithm for the assignment problem,

Dynamic programming: Dynamic programming, Characteristic of dynamic programming, Deterministic dynamic programming, Integer programming, Prototype examples,

BIP applications and formulation: BIP applications and formulation examples, Some perspectives on solving integer programming problems, The branch-and-cut approach to solve BIP problems, The incorporation of constraint programming

Recommended Books:

1. Frederick S. Hiller, Gerald J. Lieberman, Introduction to Operations Research, 9th Edition, English, McGraw-Hill,2010.
2. W. Winston, Operations Research, Duxbury Press.
3. Operations Research: Applications and Algorithms, Wayne L Winston, Indian University, 4th edition, 2004

Course Name: **SOFTWARE REQUIREMENTS ENGINEERING**

Course Code: **ITEC4140**

Credit Hours: **3(3+0)**

Objectives: The main objectives of this course are to:

- Understand the basics of requirements engineering.
- Understand the social, cultural, political, and technical issues in requirements engineering.
- Understand activities in requirements engineering (requirements elicitation, analysis and negotiation, validation, and management).
- Understand requirements traceability.
- Understand requirements documentation.
- Understand use-case modeling, object-oriented static modeling, functional modeling, and dynamic modeling techniques applicable in requirements engineering.
- Understanding the need for research in selected topics in requirements engineering.
- To know how to apply the learnt concepts, knowledge and techniques to solve real world problems

Course Outline:

Introduction: Introduction to Requirements Engineering, Software Requirements, classification of requirements, Requirements process, Levels/layers of requirements, Requirement characteristics

Process-to- Process Communication And Circuit Switching: Analyzing quality requirements, Software requirements in the context of systems engineering, Requirement evolution, requirement traceability, requirement prioritization, trade-off analysis, risk analysis and impact analysis,

Requirements Management: Requirement management, interaction between requirement and architecture, Requirement elicitation, elicitation sources and techniques, Requirement specification and documentation, specification sources and techniques

Requirements validation and techniques: Requirements validation and techniques, Management of Requirements, Introduction to Management, Requirements Management Problems

Requirements engineering for agile methods: Managing Requirements in an Acquisition Organization, Supplier Organizations, Product Organizations, Requirements engineering for agile methods.

Recommended Books:

1. Software Requirements, Wiegers K. &Beatty J., 3rd Ed. Microsoft Press,2013
2. Requirements Engineering, Elizabeth Hull, Ken Jackson and Jeremy Dick. 3rd Ed, Springer-Verlag London Limited,2011.
3. Requirements Engineering and Management for Software Development Projects, Chemuturi M., Springer New York,2013.

DEFICIENCY COURSES

Deficiency Course Pool for Annual System students only

(Any four from the list of deficiency courses depending upon the availability of the experts for Annual System students only to fulfil the Credit Hours for awarding degree)

Course Title: **PROGRAMMING FUNDAMENTALS**

Course Code: **COMP1112**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Introduce students with the concepts of programming using the industry standard language.
- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Have the ability to write a computer program to solve specified problems.
- Use the selected programming language to create, debug and run programs.

Course Outline:

Introduction to Programming: Problem solving, Introduction to programming and programs, Types of languages, Compiler vs. Interpreter.

Overview of Programming: Structure of Program, indentation and coding conventions, Program output, Syntax rules, Common errors, Language keywords.

Data Types: Identifiers, Constants, Types of variables, Type conversion and casting, Type promotion rules.

Operators: Arithmetic operators and punctuations, Precedence, Associations, Equality and relational operators.

Control Statements: Selection structure (if/, if/else), Multiple selection structure (switch and break), break and continue, Loops.

Arrays: Declaring arrays; Initialization, Multidimensional arrays, Two dimensional array, Example (Matrix manipulation), Assignments, Mini Project.

Methods/Functions: Library functions, Modular Approach, Functions, and Function definitions. Function prototypes.

Class Fundamentals: Class syntax, General form of class, Object declaration.

Recommended Books:

1. D.E. Stevenson. (2006). Programming Language Fundamentals by Example, Auerbach Publications; 1stedition.
2. Herbert Scheldt. (2010).The java 2 Complete Reference. JBD Press.
Donald E. Knuth, (1997). Art of Computer Programming, -Wesley Professional; 3rd edition.

Course Title: **OBJECT ORIENTED PROGRAMMING**

Course Code: **COMP2111**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Develop student's knowledge and programming skills about object-oriented paradigm for developing error free reliable programs.
- Understand fundamentals of object-oriented programming in Java, including defining, classes, invoking methods, using class libraries, etc.
- Write and enhance classes, arrays, inheritance and polymorphism, abstract classes and interfaces, I/O streams, exceptions.
- Use the Java SDK environment to create, debug and run simple Java programs.

Course Outline:

Basic of Object Oriented Programming: Evolution of object oriented Paradigm, Object oriented concepts and principles, problem solving in object oriented paradigm, Object oriented program design process.

Class Fundamentals; Classes, methods, objects and encapsulation; constructors and destructors, operator and function overloading, virtual functions.

Inheritance: Derived classes, Member access, Super, Types of inheritance.

Polymorphism: Method overriding, Dynamic method dispatch, Abstract classes and variables, Final keywords.

Interfaces: Define interface, Implements and apply interfaces**, V**ariable in interfaces and extent interface.

Exception Handling: Exception fundamental, Exception types, Built-in and User defined exception.

File Handling: I/O and file processing, Practical, Assignments and mini project.

Recommended Books:

1. Cay S. Horstmann & Gary Cornell, (2007) Core Java(TM), Volume I-Fundamentals, Prentice Hall PTR; 8edition.
2. IraPohl(1997),"Object-OrientedProgrammingUsingC++",2nd edition.Addison Wesley, ISBN: 0-201-89550-1.
3. Sunil K. Pandey (2007), .THINKING IN C++, S.K Kataria & Sons.
4. Herbert Schildt. (2010).The java 2 Complete Reference, JBD Press.
5. Stanley B.Lippman (2000);"Essential C++",AddisonWesley,ISBN:0-201-48518-4.
6. Budd, Addison Wesley. Understanding Object Oriented Programming. Addison Wesley,Deitel and Deitel, (2009). Java: How to Program, 5/e, Prentice Hall, International Edition.

7. Deitel and Deitel. C++: How to Program, 4/e,Pearson.

Course Title: **DATABASE SYSTEMS**

Course Code: **COMP2114**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Equip the student with the knowledge related to a variety of design, implementation of relational databases.

Course Outline:

Introduction to Databases: Introduction, Application &history of database systems, Traditional file system, The database, Database environment, Database management System (DBMS), User roles in database environment, Advantages &disadvantages of DBMS.

Database Environment: Three level ANSI-SPARC Architecture, Schemas, Mappings and instances, Data independence, Database languages, Data models & Conceptual modeling, Functions of DBMS, Multi-user DBMS architecture.

The Relational Model: History of Relational Model, Basic terminologies, Entity, Attribute, Relationship, Relational data Structure, Mathematical relations, Database relations, Relations properties, Relational keys, Integrity constraints, Nulls, Entity Integrity, Referential integrity, General constraints, Views.

Relational Algebra: Unary operations, Set operations, Join operations, Division operations, Aggregation & grouping operations.

Entity Relationship (ER) Modeling: Entity types, Relationship types, Attributes &type of attributes, Strong &weak entities, Structural constraints, One to One (1:1) relationship, One to many (1:N) Relationship, many to many (M:N) relationship, Cardinality & multiplicity constraints, ER Notations, UML notation, Chen notation, Crow's Feet notation.

Enhanced Entity Relationship (EER) Model: Specialization, Generalization, Superclass, Subclass, Attribute inheritance, Aggregation, Composition.

Mapping of Entity Relationship to Relational Model: Relational database designUsing ER-to-Relational mapping, Mapping of regular entity types, Mapping of weak entity types, Mapping of binary 1:1 relationship types, Mapping of binary 1: N relationship types, Mapping of binary M:N relationship types, Mapping of multivalued attributes, Mapping of n-ary relationship types.

Normalization: Purpose of normalization, Data redundancy and update anomalies, Insertion anomaly, Deletion anomaly, Modification anomaly, Functional dependency, Inference rules for functional dependencies, Identifying the primary key for a relation using functional, dependencies, Process of Normalization, First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce Codd Normal Form (BCNF).

Introduction to SQL: Introduction to SQL, History &Objectives of SQL, Simple queries, Sorting, Grouping, Aggregate functions, Sub-queries, Join, Inner Join, Left join, Right, Full join, Set operations, Union, Intersection, Except, Database update queries, INSERT, DELETE, UPDATE.

SQL Data Definition: Table creation, Data types, Views.

Introduction to Commercial DBMS: Microsoft SQL Server 2012 Express Edition/ MY SQL/ Microsoft Access 2012

Security Concepts: Security Threats, Authentication &authorization, Users &roles

Transaction Management: Basic concept of transaction, Transaction properties.

Distributed Database Management System (DDBMS): Introduction, Concepts of DDBMS, Advantages & disadvantages of DDBMS.

Object Oriented Database Management Systems (OODBMS): Introduction, concepts of OODBMS, Advantages &disadvantages of DDBMS.

Recommended Books:

1. Connolly & Begg (2001), Database Systems: A Practical Approach to Design,Implementation, and Management, Pearson Education ISBN:0-201-70857-4.
2. Elmasri & Navathe (2010), Fundamentals of Database Systems, sixth edition,Pearson Education ISBN-13:978-0-136-08620-8.
3. J Hughes (1991), Object-Oriented Databases, Prentice-Hall.
4. Ceri and Pelagatti, Distributed Databases, Mc GrawHill.

Course Title: OPERATING SYSTEMS
Course Code: COMP3142
Credit Hours: 4(3+1)

Objectives: The main objectives of this course are to:

- Gain general understanding of the principles and concepts governing the functions of operating systems.
- Help students to acquaint the layered approach that makes design, implementation and operation of the complex OS possible.

Course Outline:

History and Goals: Introduction about computer system structure, Introduction about process management and memory management activities.

Evolution of multi-user systems: Introduction about OS activities, System call, OS design and its implementation, Introduction about VM architecture.

Process Management: Process states, Process scheduling, Process control block.

CPU Management: Process scheduling techniques, Introduction about CPU scheduler and dispatchers.

Multithreading: Multithreaded server architecture, Multithreading models, Process synchronization, Introduction to critical section problem and its solution.

Kernel and User Modes: Protection, OS services, User OS interfaces.

Problems of Cooperative Processes: System program and communication in client service architecture.

Synchronization: Introduction about sockets and socket communication.

Deadlocks: Introduction about deadlock problem, Introduction about deadlock Characterization, Deadlock presentation and deadlock avoidance techniques.

Memory Management: Virtual memory, Address binding, Swapping, logical and Physical memory.

Relocation: External fragmentation metabolism, Virtual address space.

Paging: Demand Paging, Page replacement algorithms.

Secondary Storage: Security and protection, Security plan and security violation methods, Program threats, Introduction about cryptography.

File systems: File attributes, File operations, I/O systems, Interrupts, Direct Memory Access, Blocking and non-blocking I/O, I/O protection.

Introduction to distributed operating systems: Scheduling and dispatch, Introduction to concurrency.

Security and Linux System: The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Firewalling to Protect Systems and Networks, Computer-Security Classifications, An Example: Windows 8/8.1/10, Introducing Linux, Installing Troubleshooting and Configuring Linux

Recommended Books:

1. Operating Systems Concepts, 9th edition by Abraham Silberschatz
2. Modern Operating Systems, 4th edition by Andrew S.Tanenbaum
3. Operating Systems, Internals and Design Principles, 9th edition by William Stallings

Course Title: **Data Structures**

Course Code: **COMP2117**

Credit Hours: **4(3+1)**

Objectives: The main objectives of this course are to:

- Develop student's knowledge & skills about different data structures that help them to write programs to efficiently manipulate, store, and retrieve data.
- Learn about the concepts of time and space complexity of computer programs.
- Familiar with basic techniques of algorithm analysis.
- Familiar with writing recursive methods, linked data structures, advanced data structures.
- Familiar with several sorting algorithms. Graph algorithms such as shortest path and minimum spanning tree.

Course Outline:

Introduction, Array & Stacks: Data structure, Types of data structure, Algorithm, Properties, Specification. Abstract Data Type, Revision of arrays, Polynomial as ADT, Stack, The Stack ADT, Expressions, Postfix & Prefix Notation Infix to postfix and prefix conversion Postfix and prefix evaluation

Analysis of Algorithms: Performance analysis and measurement, Mathematical Analysis of Algorithms, types of functions, Order of Growth and Asymptotic Notations.

Queue, Recursion and Link List : Queue (array implementation) Variation of Queue ADT i.e. Circular and Double Ended Queue. Applications of Queues, Recursive Definition and Processes, Direct and Indirect Recursion, Binary Search and Towers of Hanoi as example, Writing Recursive Programs, conversion of recursive algorithms into iterative algorithms, Linear Single Link List, and Linked Stacks and Queues, Containers and Iterators, Linear Linked list Iterator, Linear Doubly Link List, Circular Lists: Singly and Doubly and Its Iterator. **Sorting and Searching:** Linear search, Binary search, Bubble sort, Selection sort,
Heap sort, Bucket Sort, Radix Sort, Insertion sort, Merge sort, etc.

Dynamic Data Structures: Trees, and Graphs. Hashing table, Storage and retrieval properties and techniques for the various data structures.

Classes of Efficient Algorithms: Polynomial and intractable algorithms divide and conquer technique, Optimization, Dynamic programming, Greedy approach

Recommended Books:

2. Frank M. Carrano, (2006). Data Abstraction & Problem Solving with C++, Addison Wesley; 5thedition.
3. Ellis Horowitz, Sartaj Sahni and D.Mehta(1995),"Fundamentals of Data

Structuresin C++",2nd/ed.,ComputerSciencePress,ISBN:0716782928.

4. Adam Drozdek (2008), Data Structures and Algorithms in Java, Cengage Learning Asia; 3rdedition.
5. Tenenbaum,M.Augenstein,andY.Langsam(1999),"DataStructuresusingCand C++",2nd/ed.,PrenticeHall,ISBN:0130369977.
6. D.Samanta.(2001)"ClassicDataStructures",2nd/ed.,Prentice Hall.
7. H.Deitel, P.Deitel(1999)"C++HowtoProgram",3rd/ed.,Prentice Hall.
8. Lafore, Sams (1999). Data Structures and Algorithms (SAMS teach yourself, Publishing).Standish, (2000), Data Structures in JAVA, Addison Wesley.

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March 27, 2025

NOTIFICATION

No.UE/Syn/R/2025/1165 The Syndicate, in its 74th meeting held on 20.02.2025, on the recommendations of the Academic Council made in its 48th meeting held on 07.01.2025, has approved the new Scheme of Studies of following Degree Programs:

SN	Nomenclature of the Degree Program	Abbreviation of the Degree Program	Duration	Year	Applicable w.e.f.	Annex
1.	Associate Degree Program in Special Education	ADP Special Education	2 Years	2024	Fall 2024	'A'
2.	Associate Degree Program in Physical Education and Sports Sciences	ADP Physical Education and Sports Sciences	2 Years	2024	Fall 2024	'B'
3.	Associate Degree Program in Fine Arts (Graphic Design)	ADP Fine Arts (Graphic Design)	2 Years	2024	Fall 2024	'C'
4.	Associate Degree in Information Technology	ADP Information Technology	2 Years	2024	Fall 2024	'D'
5.	Bachelor of Science in Public Administration	BS Public Administration	4 Years	2025	Fall 2025	'E'
6.	Associate Degree in Economics	ADP Economics	2 Years	2024	Fall 2024	'F'
7.	Associate Degree in Economics and Finance	ADP Economics and Finance	2 Years	2024	Fall 2024	'G'
8.	Bachelor of Science in Business Analytics	BS Business Analytics	4 Years	2025	Fall 2025	'H'
9.	Bachelor of Science in Mathematics	BS Mathematics	4 Years	2024	Fall 2024	'I'
10.	Associate Degree in Mathematics	ADP Mathematics	2 Years	2024	Fall 2024	'J'
11.	Associate Degree in Botany	ADP Botany	2 Years	2024	Fall 2024	'K'
12.	Bachelor of Science in Physics	BS Physics	2 Years	2025	Fall 2025	'L'
13.	Bachelor of Science in Information Technology	BS Information Technology	2 Years	2025	Fall 2025	'M'

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SN	Nomenclature of the Degree Program	Abbreviation of the Degree Program	Duration	Year	Applicable w.e.f.	Annex
14.	Bachelor of Science in Zoology	BS Zoology	2 Years	2025	Fall 2025	'N'

Note:

The Syndicate on the recommendations of the Academic Council approved to omit the word "POST ADP" from all the scheme of studies.

Muhammad Nasir Ahmad
Registrar

No. & Date Even

Copy is forwarded for information and necessary action to the: -

1. PS to Vice Chancellor
2. PA to Registrar
3. All Directors / Principals / Chairpersons
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6. Treasurer
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8. Director, Quality Enhancement Cell
9. Director, Information Technology
10. Deputy Directors (M&A / Registration)
11. Incharge, In-House UMS
12. Assistant Directors (Establishment I/II)
13. Office file

Muhammad Nasir Ahmad
Registrar