Curriculum

for

Bachelor of Information Security Engineering Technology Degree

(2023)

Higher Education Commission
Islamabad
Curriculum Division

Acronyms, Abbreviations & Definitions

Acronym/Abbreviation	Definition
NTC	National Technology Council
NCRC	National Curriculum Review Committee
IDEE	Integration of Data in Engineering Environment.
MATLAB	Matrix Laboratory
HEI	Higher Education Institution
URL	Uniform Resource Locator
HTML	Hypertext Markup Language
Wi-Fi	Wireless Fidelity
LAN	Local Area Network
MAN	Metropolitan Area Network
WAN	Wide Area Network
UTP	Unshielded Twisted Pair
STP	Shielded Twisted pair
DHCP	Dynamic Host Configuration Protocol
SNMP	Simple Network Management Protocol
Th	Theory
Lab	Laboratory
Cr. Hrs.	Credit Hours

Contents

1. Introduction

Curriculum is the total learning experience of a student that occurs in the educational process. The term refers specifically to a planned sequence of instruction, and to the student's experiences in terms of the educator's or institutions instructional goals. Curriculum is a systematic and intended packaging of competencies (i.e., knowledge, skills, and attitudes, underpinned by values) that learners should acquire through organized learning experiences.

Curriculum forges in learners' life-long learning competencies, as well as social attitudes and skills, such as tolerance and respect, constructive handling of diversity, peaceful conflict management, promotion and respect of Human Rights, gender equality, justice, and inclusiveness. At the same time, curriculum must be singularly aligned to national development goals, and produce human resources that become an effective factor of production in the economy.

Curriculum is thus the foundation on which rests the edifice of academic programs designed for focused outcomes that equip graduates with desired skill sets. Engineering technology curriculum aims to produce proficient engineering technology graduates who meet demands of both national and international job markets. The curriculum conforms substantially to the Sydney Accord – the international accreditation body regulating local accrediting institutions of partnering countries -- and is in consonance with the essence of Graduates Attributes and Professional Competence defined by International Engineering Alliance (IEA). [See Appendix A through C]

Curriculum is developed and reviewed by HEC's National Curriculum and Review Committee (NCRC).

2. Curriculum Development Methodology

2.1 Benchmarking

Curriculum for Bachelor of Engineering Technology (Information Security) is benchmarked to HEC's Undergraduate Policy and in accordance with NTC Curriculum Framework. It conforms substantially to the standards laid out by the Sydney Accord and the International Engineering Alliance pertaining to engineering technology programs [See Appendix A through C].

The course of studies clearly defines and differentiates the program from Information Security Engineering by contact hours spent in classrooms, laboratories, and industry.

Ideally an engineering program is designed with classroom to practical training ratio of 70:30 contact hours with emphasis on design aspects. Whereas for engineering technology programs, the ratio of contact hours is reversed to 30:70, providing more opportunity for hands on and psychomotor training.

The course learning outcomes and its mapping with program learning outcomes mentioned in this document may be used as guideline for HEI's.

2.2 Curriculum Development Cycle

Curriculum development is a rigorous process and entails the following steps:

- Nominations are requested from academic circles and relevant industry forums to constitute a National Curriculum Review Committee (NCRC) comprising of leading national experts.
- From the nominations received, NCRC is finalized and notified by NTC (HEC).
- NCRC Members elect a Convenor, a co-Convenor, and a Secretary amongst themselves for the proceedings of NCRC, after mutual consultations.
- Preliminary Meeting of NCRC spanning three days is held to establish framework and benchmarking issues and assign different facets of curriculum development to smaller teams within the NCRC.
- A draft of program curriculum is prepared by NCRC at the end of the Preliminary Meeting and sent to relevant foreign experts for review and feedback.
- After foreign expert's review, a Final NCRC Meeting lasting up to three days is held to finalize the recommendations and prepare final curriculum document.
- The entire cycle of curriculum development is completed in two months.

2.3 Historical Timeline of Meetings

Historical Timeline of meetings carried out in this context are enlisted below:

- Preliminary Meeting of NCRC [See Appendix D]
- Final Meeting of NCRC [See Appendix E]

3. Curriculum Details

Bachelor of Information Security Engineering Technology Program			
Parameter	**HEC Framework**	**Framework - A (SIT in Semester 7 & 8)**	**Framework - B (SIT in Semester 8 Only)**
Program Type	Semester System	Semester System	Semester System
Program Duration	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years	8 Semesters Min: 4 Years Max: 7 Years
Semester Duration	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams	16 weeks of Teaching 2 weeks for Exams
Total Number of Courses	41	39	41**
Engineering Technology Domain Courses	28	26	26**
Non-Engineering Technology Domain Courses	13	13	15**
Total Credit Hours	124 – 136	129	130
Engineering Technology Domain Credit Hours	85	96	94
Percentage of Engineering Technology Domain Courses	74.42%	74.42%	67.67%
Non-Engineering Technology Domain Credit Hours	39	33	35
Percentage of Non-Engineering Technology Domain Courses	31.45%	25.58 %	32.33%
No. of Credit Hours per Semester	15 – 18	15 – 17	15 – 17
** Optional Courses may be included for Framework B (SIT in Semester 08 only)			
1 credit hour: (1) 1 contact hour per week for a minimum 15 weeks for theory: (2) 3 contact hours per week for a minimum of 15 weeks for practical's			

Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework							
Knowledge Area	**Name of Course**	**Credit Hours** (Th+Lab)	**Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
				As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Computing	Information and Communication Technology	1+2=3	1+6=7	7	6	2	2-3
	Computer Programming	2+2=4	2+6=8				
Bachelor of Engineering Technology (Information Security) (Foundation)	Object Oriented Programming	2+2=4	2+6=8	23	20	7	10
	Digital Electronics	2+1=3	2+3 =5				
	Data Structures and Algorithms	2+1=3	2+3 =5				
	Computer Networks	2+2=4	2+6=8				
	Database systems	2+1=3	2+3 =5				
	Operating Systems	2+1=3	2+3 =5				
	Computer Architecture and Organization	2+1=3	2+3 =5				
Bachelor of Engineering Technology (Information Security) (Breadth)	Web Development Technologies	1+2=3	1+6=7	16	24	6	6
	Software Engineering	2+1=3	2+3 =5				
	Information Security	2+1=3	2+3 =5				
	Systems and Network Administration	1+1=2	1+3 =4				
	Artificial Intelligence	1+1=2	1+3 =4				
	Digital Forensics and Laws	2+1=3	2+3 =5				
Bachelor of Engineering Technology (Information Security)	IT Security Evaluation and Audit	2+1=3	2+3 =5	21	14	7	5
	Ethical Hacking and Penetration Testing	2+1=3	2+3=5				
	Depth Elective-I	1+2=3	1+6=7				
	Depth Elective-II	1+2=3	1+6=7				

(Depth)	Depth Elective-III	2+1=3	2+3=5				
	Depth Elective-IV	2+1=3	2+3=5				
	Depth Elective-V	1+2=3	1+6=7				
IDTE	IDTE-I	1+1=2	1+3=4	5	5	2	2
	IDTE-II	2+1=3	2+3=5				
Senior Design Project	Project Part-I	0+3=3	0+9=9	6	6	2	2
	Project Part-II	0+3=3	0+9=9				
Training	Supervised Industrial Training-(Opt.)	0+16=16	0+16=16	16**		0	
	Supervised Industrial Training	0+16=16	0+16=16	16		0	
Total Credit Hours and Courses (For Engineering Technology Domain Courses)		40 (Th)+54 (Lab) = 94	40+154 = 194	98 - 110		26	
** Optional Courses may be included for Framework B (SIT in Semester 08 only)							

Non-Engineering Technology Domain Courses in Recommended Schemes of Studies as per Framework								
Knowledge Area	**Sub Area**	**Name of Course**	**Credit Hours** (Th+Lab)	**Contact Hours** (Th+Lab)	**Total Credit Hours**		**Number of Courses**	
					As per Scheme of Studies	**As per Framework**	**As per Scheme of Studies**	**As per Framework**
Humanities and Social Sciences	English (Expository Writing)	Communication Skills	3+0=3	3+0=3	7	6	3	2
		Functional English	2+0=2	2+0=2				
		Technical Report Writing	2+0=2	2+0=2				
	Culture	Islamic Studies / Ethics	2+0=2	2+0=2	4	6	2	2
		Pakistan Studies and Global Perspective	2+0=2	2+0=2				
	Social Sciences Electives	Professional Practices	2+0=2	2+0=2	3	9	2	3
		Health, Safety and the Environment	1+0=1	1+0=1				
Management Sciences	Management Sciences	Organizational Behavior / Management Elective - I	3+0=3	3+0=3	5	6	2	3
		Technopreneurship / Management Elective - II	2+0=2	2+0=2				
Natural Sciences	Math (Quantitative Reasoning)	Calculus and Analytical Geometry	3+0=3	3+0=3	8	6	3	2
		Linear Algebra	2+0=2	2+0=2				
		Probability and Statistics	3+0=3	3+0=3				
	Physics	Applied Physics	2+1=3	2+3=5	3	4	1	1
University Electives		University Elective - I	3+0=3	3+0=3	6	4	2	1

		University Elective - II	3+0=3	3+0=3				
Total Credit Hours and Courses ** Optional Courses may be included for Framework B (SIT in Semester 08 only)					Cr. Hrs. **34 + 1 = 35**		Courses **15**	

List of Elective Subjects	
Social Sciences	**Management Sciences**
• Critical Thinking • Logic and Methodology • International Relations • Professional Psychology • Sociology • Criminology • Elective Courses by HEI*	• Technopreneurship • Leadership • Financial Accounting • Organizational Behavior • Project Management • Marketing Management • Elective Courses by HEI*
Interdisciplinary Technology Electives*	**Depth Electives***
• Agricultural Technologies • Bioinformatics • Renewable Energy • Biotechnology • Elective Courses by HEI*	• Malware Analysis • GPS Security • Secure Software Design and Development • Embedded Systems Security • Blockchain Technology and Security • Software Defined Networking • Smart Surveillance Systems • Error Correction and Coding Techniques • Cryptography • Cryptanalysis • Wireless Networks Security • Web Application Security • Machine Learning • Operating System Security • Cloud Computing and IoT • Security in Ad Hoc Sensor Networks • Security in Cloud Environment • Vulnerability Assessment and Reverse Engineering • Elective Courses by HEI*
*Any related course can be included with approval of the HEI's Statutory Bodies (maximum: 3 courses per elective knowledge area)	

4. Admission Criteria

Criteria for admission in Bachelor of Information Security Engineering Technology program is defined in NTC's Accreditation Manual, Clause 3.2.4.1. The salient features for eligibility for admission are:

(1) At least 50% marks in DAE/FSc (Pre-engineering)
or other equivalent qualifications such as A-level/ICS/B.Sc. (sports and Hafiz-e-Quran marks are not included) and

(2) Entrance Test

(3) Weightage:

- 70% for academics (DAE/FSc etc.)
- 30% for Entrance Test

5. Semester-wise Scheme of Studies

Semester-wise scheme of studies for the Bachelor of Information Security Engineering Technology program spanning 4 years, spread over 8 semesters, and totaling 131 credit hours is presented below:

SEMESTER-I				
Course Codes	**Course Title**	**Knowledge Area/Domain**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ISH-111/ ISH-112	Islamic Studies / Ethics	Humanities and Social Sciences-I	2+0	2+0
ISC-111	Computer Programming	Computing-I	2+2	2+6
ISQ-111	Calculus & Analytical Geometry	Natural Sciences-I	3+0	3+0
ISN-111	Applied Physics	Natural Sciences-II	2+1	2+3
ISC-112	Information and Communication Technologies	Computing-II	1+2	1+6
ISE-111	Functional English	Humanities and Social Sciences-II	2+0	2+0
	Subtotal		**12+5 =17**	**12+15 =27**
SEMESTER-II				
ISH-121	Pakistan Studies and Global Perspective	Humanities and Social Sciences-III	2+0	2+0
IST-121	Object Oriented Programming	Engineering Technology (Information Security) Foundation-I	2+2	2+6
ISQ-121	Linear Algebra	Natural Sciences-III	2+0	2+0
IST-122	Digital Electronics	Engineering Technology (Information Security) Foundation-II	2+1	2+3
ISE-121	Communication Skills	Humanities and Social Sciences-IV	3+0	3+0
IST-123	Web Development Technologies	Engineering Technology (Information Security) Breadth-I	1+2	1+6
	Subtotal		**12+5 =17**	**12+15 =27**
SEMESTER-III				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
IST-231	Data Structures and Algorithms	Engineering Technology (Information Security) Foundation-III	2+1	2+3
ISE-231	Technical Writing	Humanities and Social Sciences-V	2+0	2+0
IST-232	Computer Networks	Engineering Technology (Information Security) Foundation-IV	2+2	2+6

IST-233	Software Engineering	Engineering Technology (Information Security) Breadth-II	2+1	2+3
IST-234	Database systems	Engineering Technology (Information Security) Foundation-V	2+1	2+3
ISQ-231	Probability and Statistics	Natural Sciences-IV	3+0	3+0
	Subtotal		**13+5 =18**	**13+15 =28**
SEMESTER-IV				
IST-241	Operating Systems	Engineering Technology (Information Security) Foundation-VI	2+1	2+3
IST-242	Information Security	Engineering Technology (Information Security) Breadth -III	2+1	2+3
IST-243	Computer Architecture and Organization	Engineering Technology (Information Security) Foundation-VII	2+1	2+3
IST-244	Systems and Network Administration	Engineering Technology (Information Security) Breadth -IV	1+2	1+6
IST-245	Artificial Intelligence	Engineering Technology (Information Security) Breadth -V	1+1	1+3
ISU-241	University Elective -I	General Elective - I	3+0	3+0
	Subtotal		**11+6 =17**	**11+18 =29**
SEMESTER-V				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ISU-351	University Elective - II	General Elective - II	3+0	3+0
IST-351	Depth Elective - I	Engineering Technology (Information Security) Depth –I	1+2	1+6
IST-352	Depth Elective - II	Engineering Technology (Information Security) Depth –II	2+2	2+6
ISH-351	Professional Practices	Humanities and Social Sciences-VI	2+0	2+0
ISM-351	Organizational Behavior / Management Elective - I	Management Sciences-I	3+0	2+0
	Subtotal		**11+4 =15**	**11+12 =23**
SEMESTER-VI				
ISM-361	Management Elective-II	Management Sciences-II	2+0	2+0
IST-361	Depth Elective-III	Engineering Technology (Information Security) Depth-III	1+1	1+3
IST-362	Digital Forensics and Laws	Engineering Technology (Information Security) Breadth -VI	2+1	2+3
IST-363	IT Security Audit and Evaluation	Engineering Technology (Information Security) Depth –IV	2+1	2+3
ISI-361	IDTE-I	Inter Disciplinary Technology Elective-I	1+1	1+3

IST-364	Project Part-I	Senior Design Project	0+3	0+9
	Subtotal		**8+7 =15**	**8+21 =29**
SEMESTER-VII				
Course Codes	**Course Title**	**Knowledge Area**	**Credit Hrs. (Th+Lab)**	**Contact Hrs. (Th+Lab)**
ISH-471	Health, Safety and the Environment	Humanities and Social Sciences-VII	1+0	1+0
IST-471	Depth Elective-IV	Engineering Technology (Information Security) Depth-V	2+1	2+3
IST-472	Depth Elective-V	Engineering Technology (Information Security) Depth-VI	2+1	2+3
IST-473	Ethical Hacking and Penetration Testing	Engineering Technology (Information Security) Depth – VII	2+1	2+3
ISI-471	IDTE-II	Inter Disciplinary Technology Elective-II	2+1	2+3
IST-474	Project Part-II	Senior Design Project	0+3	0+9
	Subtotal		**9+7=16**	**9+21 =30**
SEMESTER-VIII				
IST-481	**Supervised Industrial Training (Compulsory)**	Engineering Technology (Information Security) Domain Industrial Training	**16**	**40 (per Week)**
	Subtotal		**0+16= 16**	**0+48= 48**
Total Credit Hours & Contact Hours in Four Years			**76+55 = 131**	**76+157 =233**
Theory vs Practical with respect to Contact Hours			Theory Practical	76 (32.18%) 157 (67.38%)

6. Course Codes

Details pertinent to course code are presented below:

- Each course has a unique three letter prefix, followed by three-digit code
- Letters are acronyms for course description, and numbers define the chronological position in the academic year and sequence number in the program.
- Program will span over 4 years, with 2 semesters per year, Spring and Fall (with possible inclusion of Summer Semester).

Digits in course-code are defined in table below:

1st Digit	2nd Digit	3rd Digit
Denotes Year (1,2,3,4)	Denotes Semester (1,2,3)	Denotes Sequence (1, 2, 3…)

Letters in course-code prefix are defined below:

- First two letters pertain to the program (e.g., IS for Information Security)
- Third letter pertains to specifics of the course (e.g., T for technology, E for expository writing etc.)

Sr.	Course Code Prefix	Description
1	IS**T**	Engineering Technology (Information Security) Foundation/ Breadth/ Depth
2	IS**E**	Expository Writing
3	IS**H**	Art & Humanities
4	IS**S**	Social Sciences
5	IS**Q**	Quantitative Reasoning
6	IS**N**	Natural Sciences
7	IS**C**	Computing
8	IS**M**	Management Sciences
9	IS**I**	Inter Disciplinary Technology Elective

7. Elective Courses

The list of **depth elective** courses are presented below.

Course Code	Title	Credit Hrs.	Contact Hrs.
IST-351	Cryptography	1+2	1+6
IST-352	Malware Analysis	2+2	2+6
IST-361	Wireless Networks Security	1+1	1+3
IST-371	Machine Learning	2+1	2+3
IST-372	Vulnerability Assessment and Reverse Engineering	2+1	2+3
IST-362	GPS Security	1+1	1+3
IST-353	Secure Software Design and Development	2+2	2+6
IST-354	Embedded Systems Security	1+2	1+6
IST-373	Blockchain Technology and Security	2+1	2+3
IST-374	Software Defined Networks	2+1	2+3
IST-363	Smart Surveillance Systems	1+1	1+3
IST-364	Error Correction and Coding Techniques	1+1	1+3
IST-355	Cryptanalysis	1+2	1+6
IST-375	Web Application Security	2+1	2+3
IST-376	Operating System Security	2+1	2+3
IST-377	Cloud Computing and IoT	2+1	2+3
IST-378	Security in AdHoc Sensor Networks	2+1	2+3
IST-379	Security in Cloud Environment	2+1	2+3

8. Course Contents

Primary goal of this curriculum is to be substantially in compliance with international standards set by relevant agencies such as the International Engineering Alliance (IEA) and the Sydney Accord.

Program Learning Objectives (PLO's), Course Learning Objectives (CLO's) and Bloom's Taxonomy Levels are expected learning outcomes and are aligned to standards set by the Sydney Accord and the IEA.

Course Content

8.1 Islamic Studies

CODE & TITLE (ISH-111) **Islamic Studies**		CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab Sessions**	KNOWLEDGE AREA/ DOMAIN **Humanities and Social Sciences-I**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the Holy Quran, Hadith, and the life of the Holy Prophet (Peace be upon Him).	C-2	PLO-1
CLO-2	**Apply** Islamic ethical principles and values to analyze and evaluate contemporary social issues and challenges, demonstrating the ability to make informed decisions guided by Islamic teachings.	C-3	PLO-6
CLO-3	**Present** Islam as a complete code of life.	A-3	PLO-6

Course Outline

History of Islam: Compilation of the Holy Quran and Hadith, Fundamental doctrines of Islam i.e., Tawheed, oneness of Allah, Prophet hood, the day of Judgment, Revealed books, Ibadaat (worship) Philosophy of Ibadaat, Namaz, Zakat, Hajj & Sawm, Importance of preaching of Islam, its needs and effects, Difficulties in the ways of preaching of Islam, sectarianism, its causes and effects in Muslim society, definition of Right, classification of Right, importance of Rights, Khutba Hajjatul Wida (last address of the Holy Prophet, peace be upon him), Seeratun-Nabi (Peace be upon him).

Life of Holy Prophet (Peace be upon him): The life of the Holy Prophet before and after prophet hood. The Hijra (Migration to Madina), Treaty of Al Madina, Makki and Madani life of Holy Prophet Muhammad (Peace be upon him), importance of peace and causes of terrorism.

Islam and Civilization: Definition of civilization, Impacts of Islamic civilization on the Sub-continents, international impacts of Islamic civilization, Impacts of Human thoughts, social and humanistic effects, Importance of Ethics, Human rights (Hoqooq Ul Ibad) with detail.

Knowledge and Islam: Definition of Knowledge, Classification of knowledge, Importance of technology in the light of Holy Quran and Sunnah, relevant verses of the Holy Quran about Technology (Baqara 28,30,33,201, Nahal:76, Jasia: 13, Araf: 32, Noor: 55 etc), Islamic and scientific knowledge.

Recommended Books

1. A Guidebook for Muslims, by Syed. Abul Hasan Ali Nadvi. (Latest Edition)
2. An Introduction to Islam, by Dr. Muhammad Hamidullah. (Latest Edition)
3. What is Islam? by Maulana Manzoor Nomani. (Latest Edition)
4. Islamiat (A standard book for CSS), Prof. Dr. Arif Naseem. (Latest Edition)
5. Islamiat for Students O levels, Farkhanda Noor Muhammad (Latest Edition)

Course Content

8.2 Ethics

CODE & TITLE (ISH-112) Ethics		CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Humanities and Social Sciences-I
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Create** stable and healthy civilized society.	C-2	PLO-6
CLO-2	**Develop** uniformity of moral beliefs and behaviour.	C-2	PLO-8

Course Outline

Islam: role of beliefs and arkans of Islam in character building, ethical values including brotherhood, equality, liberty, tolerance, social justice, rights of non-muslim, effects of corruption and respect of law. **Hinduism:** doctrines, religious books, concept of re-birth, celebration days, cast systems, trimurti, ethical teaching. **Budhism:** doctrines, eight nobel paths of buddha, critical study of renunciation of material and wordly life. **Christianity:** doctrines, religious books, human honor, self-reforms, celebration days and ethical teaching. **Judaism:** doctrines, religious books, ethical values, ten commandments of prophet Moses.

Recommended Books

1. A Comparative Study of the Religions of Today - Mohammed Ali Muhiyaddin (Latest Edition)
2. Comparative Study of Religions - A. Rasheed (Latest Edition, 2001)
3. Ikhlaqiyat Mazahib-e-Aalam ki Nazar Main - Aadil Faraz (Latest Edition, 2002)
4. Mazahib-e-Aalam jo Taqabili Jaezo - M. Hashim Channa (Latest Edition, 1988)

Course Content

8.3 Computer Programming

CODE & TITLE (ISC-111) Computer Programming		CREDIT & CONTACT HOURS (2+2) 32 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Computing-I
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the concepts of programming, the characteristics of programming tools and their applications.	C-2	PLO-1
CLO-2	**Analyze** basic programming constructs, data-types of programming language (python or C/C++) and common errors in the programs.	C-4	PLO-2
CLO-3	**Design** and implement algorithms to solve real-world problems.	C-3	PLO-3
Lab CLOs and its Mapping to PLOs			
CLO-4	**Use** proficiently the programming platform, like python/C++ for programming and debugging tasks.	P-4	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Produce** effectively the results about experiments or projects in the form of a report.	P-4	PLO-10

Course Outline for Theory

Background: Basics of computer hardware and software, how computers store data and manipulate, how a computer program works, Why programs are written in high-level languages, Concept of compiler and interpreter, Building and running computer program, python through interactive / script mode.
Fundamentals: Program development cycle, pseudocode and flow chart, Design / write / compile simple programs (input, processing, output), Variables, comments, reading input from keyboard, Data types and assignment statements, mathematical operation and performing calculation, named constants, Introduction to Turtle Graphics, basic programs through turtle graphics library. **Decision Structures:** if and if-else structures, comparing strings, if-elif-else nested structures, Logical operators (AND, OR, and NOT), boolean variables, apply decision structures using Turtle Graphics. **Repetition Structures:** While loops, For loops, Counters, accumulators, running totals, Sentinels, techniques for writing input validation loops, Nested loops, Utilize loops to draw designs with Turtle Graphics. **Functions:** Function definition, benefits of using functions, identify situations where functions can be used effectively, Defining and calling a Void function, designing a program to use functions, local variables and scope, passing arguments to functions, Global variables and global constants, Value-returning functions, examples of value-returning functions, Standard library functions and modules, importing modules (math, random), Writing your own value-returning functions, Modularize the code with functions using Turtle Graphics. **Files and Exceptions:** Basic File Input and Output, Type of files, file access methods, filenames and file objects, File processing (opening a file, specifying the location of a file, writing data to a file, reading data from a file, appending data to an existing file, writing and reading numeric

data), Using loops to process files and records, Handling exceptions. **Lists and Tuples:** Python sequences, Basics of lists (repetition operator, iterating over a list with the for loop, indexing, concatenating lists), List slicing and List processing, Two-dimensional lists, Tuples, plotting list data with the matplotlib package as well as learn how to interpret and analyze it, Dictionaries and Sets

Lab Outlines

1. Python Environment
    a. Python and its features, Installation and setting up Python environment
    b. Python in Interactive / Script mode
    c. Python IDEs (Visual Studio Code / PyCharm Community Edition / Spyder)
    d. Package management and virtual environment setup
2. Fundamentals
    a. Demonstration of data types, variables, operators, assignment statements, mathematical operation and performing calculation, named constants, comments
3. Decision Structures
    a. Apply if, if-else, structures to code efficient and concise programs
    b. Apply decision structures to handle errors and unexpected inputs
    c. Apply logical operators and boolean variables to demonstrate wide range of scenarios and conditions
    d. Develop a project that uses decision structures to make decisions based on user input
4. Repetition Structures
    a. Demonstration of definite and indefinite loops
    b. Demonstration of loop control statements and nested loops
    c. Demonstration of how to raise exceptions in loops to handle unexpected situations
    d. Develop a project that uses repetition structures to iterate over data and perform operations, as well as apply error handling techniques to handle unexpected situations
5. Functions
    a. Demonstration of how to use built-in functions in python
    b. Demonstration of how to write reusable code by defining and calling custom functions as well as learn to pass arguments in python
    c. Demonstration of how to import and use built-in as well as external modules in python
    d. Develop a project that uses functions and modules to organize and reuse code, as well as apply good coding practices such as code readability and documentation
6. Files and Exceptions
    a. Demonstration of file input and output operations in Python
    b. Demonstration of different file types and access methods
    c. Demonstration of creating, opening, and closing file objects in Python
    d. Demonstration of reading from and writing data to files using Python's file I/O functions
    e. Demonstration of appending data to existing files in Python
    f. Demonstration of writing and reading numeric data to/from files using Python's file I/O
    g. Demonstration of processing files and records using loops in Python
    h. Demonstration of handling exceptions in Python's file I/O operations
    i. Develop a finance management program that uses files and exceptions to read/write financial data and handle errors caused by incorrect user input or file access issues
7. Lists and Tuples
    a. Demonstration of how to create, modify, and access elements of lists in Python
    b. Demonstration of the repetition operator and concatenation to manipulate lists
    c. Demonstrate of how to iterate over a list with a for loop and the use of indexing to access list elements
    d. Demonstration of how to slice a list and perform various operations on the sliced elements
    e. Demonstration of creating and manipulating two-dimensional lists
    f. Demonstration of how to create, modify, and access elements of tuples in Python
    g. Demonstration of using the matplotlib package to plot list data

h. Develop a project to analyze sales data using lists and tuples in Python, including reading and parsing data from CSV files, organizing data, performing data analysis, visualizing data using matplotlib package, and writing the analyzed data to a new CSV file

8. Dictionaries and Sets
    a. Demonstration of creating, modifying, and accessing dictionary and set data structures
    b. Demonstration of the ability to use dictionary and set methods to perform common operations such as adding, removing, and updating elements
    c. Demonstration of the ability to manipulate dictionary and set data structures using iteration and conditional statements
    d. Demonstration of the ability to apply dictionary and set data structures to real-world problem-solving scenarios
    e. Develop a project that utilizes dictionaries and sets in Python to efficiently store and retrieve data about a fictional bookstore's inventory, including features such as adding new books, updating information, searching by title or author, tracking sales and generating reports.

Recommended Books

1. Starting Out with Python - Tony Gaddis (Latest Edition "4th", ISBN-10: 0134444329 or ISBN-13: 978-0134444321)
2. Starting Out with Programming Logic and Design - Tony Gaddis (Latest Edition "4th", ISBN-10: 0133985075 or ISBN-13: 978-0133985078)
3. Introduction to Computation and Programming using Python: With Application to Understanding Data - John V. Guttag (Latest Edition "2nd", ISBN-10: 0262529629 or ISBN-13: 978-0262529624)
4. Python crash course: A hands-on, project-based introduction to programming, Matthes, Eric, No Starch Press (Latest Edition)
5. C++ How to Program, latest Edition, Deitel & Deitel, Prentice Hall. (Latest Edition)
6. Problem Solving with C++, latest Edition, Walter Savitch, Addison Wesley (Latest Edition)
7. Introduction to Computation and Programming Using Python: With Application to Understanding Data, latest Edition by Guttag, John. (Latest Edition)
8. "C++ programming in easy steps" by Mike McGrath (Latest Edition)
9. "Thinking in C++" by Bruce Eckel available at http://mindview.net/Books/TICPP/ThinkingInCPP2e.html#Contents
10. For the advanced programmer: "The C++ Programming Language" by Bjarne Stroustrup, published by Addison Wesley (Latest Edition)

Course Content

8.4 Calculus and Analytical Geometry

CODE & TITLE (ISQ-111) Calculus and Analytical Geometry	CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Natural Sciences-I Quantitative Reasoning-I	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** elementary knowledge of calculus to solve mathematical problems.	C-3	PLO-1
CLO-2	**Apply** the techniques of integration for solving and analyzing problems in integral calculus.	C-3	PLO-2
CLO-3	**Analyze** parametric functions, polar coordinates, conic sections, vector functions, tangent lines, integrals, arc length, and curvature.	C-4	PLO-2

Course Outline for Theory

Basic definition of derivative, differentiation of different functions, rule of differentiation, chain rule implicit differentiation, Applications: slope, equation of tangent and normal. maxima, minima and point of inflection. Indefinite integral, different technique or integration i.e. integration by parts, integration by substitution, by partial fraction, integration of different trigonometric identity. Define definite integral: Application of definite integral, i.e., Area under the curve. Area between the curve, mean value theorem, finding the volume by slicing, volume of solid revolution Disk and Washer method, moment and center of mass etc. Vector in space, vector calculus, Divergence, curl of vector field, Directional derivatives, multivariable function Partial derivatives, Spherical, polar, cylindrical coordinates. Vector in plane: Dot product and cross products, line and plane in space. Application: work, angle between two vectors, Area of triangle, Area of parallelogram etc.

Recommended Books

1. H. Anton, I. C. Bivens, S. Davis, "Calculus, Early Transcendental", 11th edition (or Latest Edition), John Wiley, New York, 2016.
2. Essential Calculus by James Stewart, 2nd Edition (or Latest Edition)
3. G. B. Thomas, A. R. Finney, "Calculus", 14th edition (or Latest Edition), Pearson, USA, 2017.
4. S.M Yousaf, "Calculus and Analytic Geometry" (or Latest Edition).
5. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. (or Latest Edition) Willey 2014.

Course Content

8.5 Applied Physics

CODE & TITLE (ISN-111) Applied Physics		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Natural Science-II
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental physical principles.	C-2	PLO-1
CLO-2	**Apply** these principles, together with logical and mathematical reasoning, to situations of the physical world.	C-3	PLO-2
CLO-3	**Analyze** different physical problems using the laws of physics.	C-4	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Practice** of operating various tools /equipment used during experimentation.	P-2	PLO-5
CLO-5	**Ability** to solve the mathematical expressions and numerical analysis related to the principles and techniques of experimental physics project.	P-4	PLO-11

Course Outline for Theory

Electric charge, Conductors and insulators, Coulomb's law, Electric field, Field due to a point-charge Electric dipole and line of charge, Flux of an electric field, Permittivity of a medium, Gauss's law, Application of Gauss's Law, Electric potential, calculating the potential from electric field, Potential due to a point-charge and a group of point-charges. Potential due to a dipole, Potential due to a continuous charge distribution. Capacitors, calculating capacitance, Capacitors in series and parallel, Factors affecting capacitance, Application of Capacitors. Current and Conductors, Electric current and current density, Resistance and resistivity, Ohm's law, The Steady Magnetic Field, Resistors in series and parallel, Temperature dependence of resistance and other factors affecting resistance, Application of resistors. The magnetic field, Magnetic force on a current carrying conductor, Torque on a current-loop. Magnetic field due to current, Force between two parallel current-carrying conductors, Biot Savart law and its applications, Ampere's law, Inductance and inductors, Factors affecting inductance Permeability Faraday's law of induction, Lenz's law, Energy stored in a magnetic field, Self-induction, Mutual Induction, Magnets and magnetic materials, Di-magnetic material, Para-magnetic material, Ferromagnetism.

Lab Outlines

1. Demonstration of the properties of series combination of Capacitors
2. Determination of the given resistance by leakage method using ballistic Galvanometer
3. Demonstration of variation of Photoelectric current with intensity of incident beam
4. Demonstration of temperature coefficient of resistance of coil by wheat stone bridge

5. Demonstration of Ohm's law 6. Demonstration of the properties of Series / Parallel Combination of Resistances 7. Demonstration of Ampere's and Faraday's Law 8. Demonstration of the function of transformer as Step Up and Step-Down Transformer
Recommended Books
1. Halliday, Resnick and Walker, "Fundamentals of Physics" (Latest Edition) 2. Hugh D. Young and R.A. Freedman, University Physics. (Latest Edition) 3. Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, (Latest Edition) 4. Fundamentals of Electromagnetic Phenomenon by D. Corson & Lorrain. (Latest Edition)

Course Content

8.6 Information and Communication Technologies

CODE & TITLE (ISC-112) Information and Communication Technologies		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Computing-II	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Identify** types, building blocks (hardware components) and application software's of a computer and outline the basic concepts of computer networks, internet and world wide web.		C-3	PLO-1
CLO-2	**Explain** the basic computing technology and related terminologies.		C-2	PLO-1
CLO-3	**Demonstrate** the concepts of data communication and networks.		C-3	PLO-1
Lab : CLOs and its Mapping to PLOs				
CLO-4	**Demonstrate** the working of hardware components of computer and software applications		P-4	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments		A-3	PLO-9
CLO-6	**Produce** effectively the results about experiments or projects in the form of a report.		P-4	PLO-10
Course Outline for Theory				
Introducing Computer Systems: Basic Definitions, Computer and Communication Technology, the applications of ICT - particularly for engineering technology. Basic Operations and Components of a Generic Computer System: Basic operations: Input, Processing, output, storage Basic components: Hardware, Software, Data, Users, types of storage devices. Processing Data: Transforming data into information, how computers represent and process data, Processing Devices, CPU architectures. The Internet: The Internet and the World Wide Web- browsers, HTML, URLs/ How DNS works, Email and other programs. Introduction to Embedded Systems: What is an Embedded System, Applications, Components, Programming Languages, Popular Development Platforms. Networking Basics: Uses of networks, Common types of networks (LAN, WAN, MAN etc.), Introduction to OSI Model, Future of Networks. Database Management: Hierarchy of Data, Maintaining Data, Database Management Systems. Exposure to ICT Tools and Blogs (Student Assignment). Protecting your privacy, your computer and your data: Basic Security Concepts, threats to users, threats to hardware, threats to Data				

Lab Outlines
1. Recognize different components of computer as well as be able to assemble and disassemble it. a. System Unit, Processing, Memory, Storage, Input and Output. 2. Recognize and be able to use System as well as Application Software. a. Operating Systems (Installation and Basic Usage / Demonstration of Windows / Linux) b. System Tools: Windows Defender Firewall, Disk Cleanup, Disk Management, OS Recovery c. Basic DOS/Linux command line tools such as copy, move, dir, del, cd, format, ping, tracert, grep, pwd, cat, nano, gpart, chown, chmod etc. d. ISO Image Making and Deployment on Removable Media e. Desktop Application Software such as Microsoft (Word, Excel, PowerPoint, Access) / LibreOffice (Writer, Calc, Math, Impress, Draw), Compression Tools, Web Browsers, Image/Audio/Video Editing Tools etc. f. Web Server Installation / Deployment (XAMP, WAMP, Apache, PHP) g. Development of Simple Website using HTML and CSS basics. h. Mobile Application Software (Android OS Usage) 3. Recognize different transmission media and connectors used in computer networks. a. UTP/STP cable and RJ45 connectors, Straight-through / Crossover Ethernet cable, Crimping tool, Fiber optic cable and LC/ST/SC/FC connectors, Coaxial cable and BNC connectors. 4. Recognize and be able to use different electronic devices. a. Hub, Switch, Router, Servers, WiFi Access Point and USB WiFi Adaptors, PCI Express Gigabit Ethernet adaptor, Ethernet Cable Modem, USB 4G Modem, USB flash drives, Smart Phones and Tablets, Fitness Band and Smart Watches, CCTV System, Biometric Devices, LAN cable testers 5. Be able to Recognize and Deploy Ad-hoc as well as Infrastructure Network between PCs
Recommended Books
1. “Introduction to Computers”, Peter Norton, McGraw-Hill. (Latest Edition) 2. “Computing Essentials”, Timothy O’Leary and Linda O’Leary, McGraw-Hill. (Latest Edition) 3. Using Information Technology: A Practical Introduction to Computers & Communications”, Williams Sawyer, McGraw-Hill. (Latest Edition) 4. “Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning” Shelly GB, Vermaat ME, (Latest Edition) 5. Al Kelley and Ira Pohl, “A Book on C: Programming in C”. (4th Edition) 6. Understanding Computers: Today and Tomorrow: Comprehensive - Deborah Morley and Charles S. Parker (Latest Edition “16th”, ISBN-10: 1305656318 or ISBN-13: 978-1305656314)

Course Content

8.7 Functional English

CODE & TITLE (ISE-111) **Functional English**		CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Humanities and Social Sciences-II** **Expository Writing-I**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** accurately building blocks of English language in terms of various parts of speech, syntax and grammar rules.	C-1	PLO-10
CLO-2	**Strengthen** ability of students to write academic papers, essays and summaries using the process approach.	C-4	PLO-10
CLO-3	**Adopt** English language skills in their profession.	A-3	PLO-12

Course Outline

Basics of Grammar, Parts of speech and use of articles, Sentence structure, active and passive voice, Practice in unified sentence Analysis of phrase, clause and sentence structure, Transitive and intransitive verbs, Punctuation and spelling, Comprehension, Answers to questions on a given text, Discussion, General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students), Listening to be improved by showing documentaries/films carefully selected by subject teachers, Translation skills Urdu to English, Paragraph writing topics to be chosen at the discretion of the teacher, Presentation skills Introduction

Recommended Books

1. A.J. Thomson and A.V. Martinet, (1997), "Practical English Grammar. Exercises 1". Third edition. Oxford University Press. ISBN 0194313492.
2. A.J. Thomson and A.V. Martinet, (1997, "Practical English Grammar". Exercises 2 Third edition. Oxford University Press. ISBN 0194313506.
3. Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet, (1993),"Writing. Intermediate" Oxford Supplementary Skills. Fourth Impression. ISBN 0 19435405 7 Pages 20-27 and 35-41.
4. Brain Tomlinson and Rod Ellis, (1992) Reading. Upper Intermediate. Oxford Supplementary Skills. Third Impression ISBN 0194534022.
5. Graham Lock, (1995), "Functional English Grammar", (Cambridge Language Education), ISBN-13: 978-0521459228

Course Content

8.8 Pakistan Studies and Global Perspective

CODE & TITLE (ISH-121) Pakistan Studies and Global Perspective		CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Humanities and Social Sciences-II
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Describe** various stages of Pakistan Movement inspired by the need of an ideological state.	C-2	PLO-6
CLO-2	**Discuss** the geo, political and constitutional history of Pakistan.	C-2	PLO-7
CLO-3	**Analyze** amendments in the constitution of Pakistan made since 1973.	C-4	PLO-7
CLO-4	**Understand** the foreign policy and futuristic vision of Pakistan and the current issues of Pakistan, their causes and solution.	A-4	PLO-7

Course Outline for Theory

Pakistan ideology: Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah, Aims and objective of the creation of Pakistan. Indus Civilization, Location and Geo-Physical features, Reformist Movement in Subcontinent. Muslim League 1906, Lahore Resolution 1940, 3rd June plan and Independence 1947, Constitution and Law, Constitutional Assembly, Nature and Structure of Constitution, Features of 1956, 1973 Constitutions. Amendments in the Constitution (17th, 18th, 19th and 20th), Foreign Policy, Objectives, Contemporary Pakistan, Economic institutions and issues, Society and social structure, Ethnicity, Determinants of Pakistan Foreign Policy and challenges, Futuristic stance of Pakistan

Recommended Books

1. Amin, Tahir. Ethno – National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad. (Latest Edition)
2. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, (Latest Edition)
3. Struggle for Pakistan by Mr. Ishtiaq Hussain Qureshi (Latest Edition)

Course Content

8.9 Object Oriented Programming

CODE & TITLE (IST-121) Object Oriented Programming		CREDIT & CONTACT HOURS (2+2) 32 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-I
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Analyze** object-oriented C++ programs and flowcharts.	C-4	PLO-2
CLO-2	**Design** object-oriented solutions for small-to-medium scale computing problems involving multiple objects.	C-6	PLO-3
CLO-3	**Investigate** and fix a given object-oriented C++ program for all possible errors and finally conclude the correct output.	C-5	PLO-4
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Proficiently** use taught programming language for programming and debugging tasks.	P-4	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Produce** effectively the results about experiments or projects in the form of a report/manual.	P-4	PLO-10
CLO-7	**Develop** management skills to manage design projects for programming.	A4	PLO-11
CLO-8	**Acquire** knowledge about the technological developments in the field of programming.	A4	PLO-12
Course Outline			
Perspective: Overview of object-oriented programming (OOP) principles and concepts, Comparison of procedural and object-oriented approaches, Benefits and applications. **Fundamentals:** Overview of popular object-oriented programming languages (e.g., Java, C++, Python), Language-specific features and syntax, Object-oriented design patterns. **Classes and Objects:** Understanding classes, objects, and their relationships, Data encapsulation and information hiding, Constructors and destructors, Access modifiers and visibility levels. **Inheritance and Polymorphism:** Understanding class hierarchies and inheritance relationships, Single inheritance and multiple inheritance, Method overriding and dynamic polymorphism, Abstract classes and interfaces. **Function Overloading and Operator Overloading:** Overloading functions with different parameters, Operator overloading for custom behavior, Benefits and best practices of overloading. **Identification of Classes and Their Relationships:** Identifying classes and objects in a problem domain, Composition and aggregation relationships, Inheritance relationships and class hierarchies. **Generics and**			

Templates: Generic programming concepts, using templates to create reusable code, Benefits and limitations of generics/templates, **Exception Handling and Error Management:** Handling exceptions and error conditions, Try-catch blocks and exception propagation, Designing robust error-handling mechanisms. **Design Patterns:** Understanding common design patterns (e.g., Singleton, Factory, Observer), Applying design patterns to solve real-world problems, Design patterns for concurrency and parallelism. **Object-Oriented Analysis and Design (OOAD):** Overview of OOAD methodologies (e.g., UML, Agile), Requirements gathering and analysis, Design principles and best practices. **Advanced Topics in OOP: R**eflection and introspection, Metaprogramming and code generation, Aspects of OOP: Aspect-oriented programming (AOP), **Software Development Practices:** Testing and debugging techniques for OOP, Version control and collaborative development, Documentation and code documentation tools

Lab Outline

1. Object-Oriented Programming and Java Setup
    a. Setting up the development environment (Java IDE, compiler)
    b. Writing and running a simple Java program
2. Implementing Class Hierarchies and Inheritance
    a. Creating a class hierarchy with inheritance relationships
    b. Implementing overridden methods and dynamic polymorphism
    c. Testing and validating the class hierarchy through code execution
3. Encapsulation and Data Abstraction
    a. Implementing classes with encapsulation and information hiding
    b. Using access modifiers and visibility levels effectively
    c. Applying abstraction principles to design robust class interfaces
4. Working with Generics and Templates
    a. Implementing generic classes and methods in Java
    b. Utilizing templates in C++ for generic programming
    c. Comparing and contrasting generics/templates in different languages
5. Exception Handling and Error Management
    a. Handling exceptions in Java and C++
    b. Writing try-catch blocks and handling various exception scenarios
    c. Designing error-handling mechanisms for robust code
6. Applying Design Patterns
    a. Implementing common design patterns in code (e.g., Singleton, Factory)
    b. Analyzing and discussing the benefits and trade-offs of each pattern
    c. Applying design patterns to solve real-world programming problems
7. Object-Oriented Analysis and Design (OOAD) with UML
    a. Using UML diagrams for object-oriented analysis and design
    b. Creating class diagrams, sequence diagrams, and use case diagrams
    c. Applying OOAD principles to model and design a software system
8. Advanced OOP Concepts and Features
    a. Exploring advanced topics such as reflection and metaprogramming
    b. Applying aspects of OOP, such as aspect-oriented programming (AOP)
    c. Experimenting with advanced language-specific features (e.g., Python decorators)
9. Software Development Practices and Tools
    a. Implementing unit tests for object-oriented code

b. Using version control systems (e.g., Git) for collaborative development
c. Documenting code effectively using code documentation tools (e.g., Javadoc)

10. Project Work and Code Review
    a. Working on a larger-scale project to apply OOP principles and techniques
    b. Conducting code reviews and providing feedback to peers
    c. Presenting and showcasing the final project to the class

Recommended Books

1. Effective Java - Joshua Bloch (Latest Edition “2nd”, ISBN-10: 0321356683 or ISBN-13: 860-1300201986)
2. Java - How to Program - Paul Deitel, Harvey M. Deitel (Latest Edition “9th”, ISBN-10: 0132893517 or ISBN-13: 978-0132893510)
3. Python 3 Object-Oriented Programming - Dusty Phillips (Latest Edition “2nd”, ISBN-10: 1784398780 or ISBN-13: 978-1784398781)
4. Object-Oriented Programming in C++ - Robert Lafore (Latest Edition “4th”, ISBN-10: 0672323087 or ISBN-13: 978-0672323089)
5. Fundamentals of Data Structures in C++ - Ellis Horowitz, Sartaj Sahni, Dinesh Mehta (Latest Edition “2nd”, ISBN-10: 0929306376 or ISBN-13: 978-0929306377)
6. Object-Oriented Software Engineering: Practical Software Development using UML and Java - Timothy Lethbridge, Robert Laganiere (Latest Edition “2nd”, ISBN-10: 0077109082 or ISBN-13: 978-0077109080)

Course Content

8.10 Linear Algebra

CODE & TITLE (ISQ-121) **Linear Algebra**		CREDIT & CONTACT HOURS (2+0) **32 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN Natural Sciences-III **Quantitative Reasoning-II**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** the operations on matrices to solve systems of linear equations.	C-3	PLO-1
CLO-2	**Apply** linear transformations and applies matrix theory to model real-life situations.	C-3	PLO-1
CLO-3	**Analyze** matrix operations such as inverse, factorization, partitioning, the bases of system, column space, null space of given matrix and matrix system by crammer's rule.	C-4	PLO-2
CLO-4	**Use** simulation tools (Matlab, Mathematica) for visualization and calculation of linear algebra concepts.	P-4	PLO-5

Course Outline for Theory

System of linear equations, row reduction and echelon forms, vector equations, the matrix equation ax=b. Solution sets of linear systems, applications of linear systems. Concept of matrices, types of matrices, operation on matrices i.e., addition, subtraction, multiplication, properties of matrix operation, the elementary row operation, echelon form, solution of linear system of equation by gauss elimination method, concept of consistent and inconsistent solution, polynomial interpolation. inverse of matrix using Gauss-Jordon method. Determinant of matrix: definition and properties of determinants and their theorem, concept of singular and nonsingular matrix, solution of non-homogenous linear system of equation using Cramer's rule. Introduction to linear transformation, daily life application i.e., cryptography example coding and decoding the messages, computer graphic.

Recommended Books

1. Introductory Linear Algebra by Bernard Kolman (Latest Edition)
2. Advanced Engineering Mathematics by Erwin Kreyszig, 10th Ed. Willey 2014. (or Latest Edition)
3. D. C. Lay, S. R. Lay, J. J. McDonald, "Linear Algebra and Its Applications", 5th Edition, Pearson Education, 2015. (or Latest Edition)
4. Linear Algebra and its Applications by Gilbert Strang, 4th Edition, (or Latest Edition)

Course Content

8.11 Digital Electronics

CODE & TITLE (IST-122) Digital Electronics		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-II	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** basic concepts of digital and binary systems.		C-2	PLO-1
CLO-2	**Perform** number conversion, gate level minimization using Boolean algebra, k-map and tabulation method.		C-3	PLO-2
CLO-3	**Analyze** digital integrated circuits (RTL, DTL, TTL, ECL, MOS and CMOS).		C-4	PLO-2
CLO-4	**Design** combinational circuits ,sequential logics, Registers, Counters and memories.		C-4	PLO-3
Lab : CLOs and its Mapping to PLOs				
CLO-5	**Investigate** performance of a complex digital circuit.		C-5	PLO-4
CLO-6	**Use** software tools (electronic workbench, Multisim etc.) to design digital circuits.		P-5	PLO-5
CLO-7	**Work** effectively as an individual or in a group while performing laboratory experiments.		A-3	PLO-9
CLO-8	**Communicate** effectively both in oral description and written reports about each experiment.		P-4	PLO-10
CLO-9	**Organize** design and implementation of semester project using digital logic devices.		A-4	PLO-11
Course Outline				
Number Systems: Review of number systems, binary numbers, hexadecimal numbers, octal numbers, decimal to binary and binary to decimal number conversion, hexadecimal to binary and binary to hexadecimal conversion, binary coded decimal numbers, grey code, binary to grey and grey to binary number conversion, parity in codes. Boolean **Algebra and Boolean Operations:** Review of digital electronics, logic, events and binary variables, introduction to fundamental boolean operations, NOT, OR, AND operation and truth tables, other boolean operations as XOR, NOR, NAND, XNOR, truth tables, boolean algebra, boolean expressions, boolean rules, demorgan's theorems, two's complement of a binary number. **Logic Gates:** Introduction to digital logic gates, symbols of logic gates, positive logic, negative logic, implementing simple Boolean expressions with logic gates, concept of universal gate, NAND gate as a universal gate, NOR gate as a universal				

gate. **Expression Simplification:** Reducing an expression using boolean rules, introduction to Karnaugh map, reducing an expression using Karnaugh-map, implementing logic circuits using universal gate, deriving SOP and POS expressions directly from K-map, few examples with K-map, hazzard free design. **Combinational Logic Circuits:** Few examples of combinational logic circuits including half adder, full adder, parallel adder, parallel adder subtractor, deriving sum-of-products (SOP) and product-of-sums (POS) expressions from a truth table, logic comparators, encoders, decoders, multiplexers, de-multiplexers. **Introduction to Sequential Circuits:** Flip-flop (RS, JK, D, T, Master-Slave), registers, shift registers, counters. **Introduction to Sequential Machines:** Classification of sequential machines, concept of pulse and level digital signal, understanding word statement and its key words, state diagram, state table, flow table. **Transition Tables:** Assigning states to the state table of a pulse input machine, assigning states to the state table of a level input synchronous machine, assigning states to a level input asynchronous machine, races in an asynchronous level machine, introducing cycles to eliminate races, obtaining transition table for pulse input machine, synchronous level input machine.

Lab outline

1. Logic Gates and Boolean Operations
    a. Familiarization with logic gate symbols and truth tables
    b. Implementing basic boolean operations using logic gates
    c. Verifying boolean identities and De Morgan's theorems
2. Expression Simplification and Karnaugh Maps
    a. Simplifying boolean expressions using boolean rules
    b. Introduction to Karnaugh maps for expression simplification
    c. Using Karnaugh maps to derive simplified boolean expressions
    d. Implementing logic circuits using universal gates
3. Combinational Logic Circuits
    a. Designing and implementing combinational logic circuits
    b. Building circuits for adders, comparators, encoders, decoders, multiplexers, and demultiplexers
    c. Verifying the functionality of the circuits using truth tables
4. Flip-Flops and Sequential Circuits
    a. Understanding different types of flip-flops: RS, JK, D, T, Master-Slave
    b. Designing and building sequential circuits using flip-flops
    c. Constructing registers and shift registers
    d. Creating counters for various applications
5. Sequential Machines and State Diagrams
    a. Modeling sequential machines using state diagrams
    b. Building state tables and flow tables
    c. Implementing sequential machines using flip-flops and logic gates
    d. Analyzing the behavior of the machines based on input sequences
6. Transition Tables and Pulse Input Machines
    a. Assigning states to transition tables for pulse input machines
    b. Implementing pulse input machines using flip-flops and logic gates
    c. Verifying the operation of the machines using input signals and observing the state transitions
7. Level Input Synchronous Machines
    a. Assigning states to transition tables for level input synchronous machines
    b. Constructing level input synchronous machines using flip-flops and logic gates

c. Testing the functionality of the machines by applying different input levels and observing the state changes

8. Asynchronous Machines and Races
    a. Handling races in level input asynchronous machines
    b. Introducing cycles to eliminate races
    c. Modifying transition tables for asynchronous machines
    d. Verifying the race-free operation of the machines with appropriate input sequences

Recommended Books

1. Digital Electronics: Principles and Applications - Roger L. Tokheim (Latest Edition "7th", ISBN-10: 0073126349 or ISBN-13: 978-0073126340)
2. Digital Fundamentals - Thomas L. Floyd (Latest Edition "11th", ISBN-10: 0132737965 or ISBN-13: 978-0132737968)
3. Digital Systems: Principles and Applications - Ronald J. Tocci, Neal Widmer, Greg Moss (Latest Edition "11th", ISBN-10: 0135103827 or ISBN-13: 978-0135103821)
4. Digital Design - M. Morris R. Mano, Michael D. Ciletti (Latest Edition "4th", ISBN-10: 0131989243 or ISBN-13: 978-0131989245)
5. Logic and Computer Design Fundamentals - M. Morris R. Mano, Charles R. Kime, Tom Martin (Latest Edition "5th", ISBN-10: 0133760634 or ISBN-13: 978-0133760637)

Course Content

8.12 Communication Skills

CODE & TITLE (ISE-121) **Communication Skills**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Humanities and Social Sciences-IV** **Expository Writing-I**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understanding** of fundamentals of oral & interpersonal communication.	A-2	PLO-9
CLO-2	**Identify** common errors usually made by learners of English as a second language.	C-2	PLO-9
CLO-3	**Communicate** effectively through technical writing and presentations, using basic- to-intermediate level English, and develop understanding of communication skills essentials.	A-3	PLO-10

Course Outline

Vocabulary building, common writing errors, purposeful writing, business writing, critical reading, reading for understanding, introduction to communication process, seven Cs of communication, types of listening, listening skills, verbal and non-verbal communication, basic presentation skills, Presentation Strategies and public speaking skills, use of Audio-Visual Aids, basics of group communication, communicate effectively in job interviews.

Recommended Books

1. Practical English Grammar, by A. J. Thomson and A. V. Martinet. Fourth edition. Oxford University Press. (Latest Edition)
2. Practical English Grammar Exercises 1, by A. J. Thomson and A. V. Martinet, Oxford University Press. (Latest Edition)
3. A Practical Guide to Business Writing: Writing in English for Non-Native Speakers, by Khaled Mohamed Al Maskari. Wiley. (Latest Edition)
4. Communication Skills for Engineers, by Sunita Marshal and C. Muralikrishna (Latest Edition)
5. The Essentials of Technical Communication, by Elizabeth Tebeaux and Sam Dragga, Oxford University Press. (Latest Edition)
6. College Writing Skills, by John Langan,. 9th Edition (or Latest Edition)
7. Exploring the World of English, by Saadat Ali Shah, Ilmi Kitab Khana. (Latest Edition)

Course Content

8.13 Web Development Technologies

CODE & TITLE (IST-123) Web Development Technologies		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Breadth-I	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Gain** an understanding of the theories and concepts underlying web development and e-commerce.		C-2	PLO-1
CLO-2	**Apply** common web technologies and design patterns to connect them together.		C-3	PLO-2
CLO-3	**Design** interactive web interfaces Using front-end development framework.		C-5	PLO-3
Lab : CLOs and its Mapping to PLOs				
CLO-4	**Use** web development tools for designing a webpage.		P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.		A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.		P-4	PLO-10

Course Outline

Website Structure, Designing your own website using HTML, DHTML, JavaScript, and Bootstrap, HTML basic and advanced topics, JavaScript concepts, CSS and Bootstrap concepts, Website Structure and Hosting, Selecting a web host company, Naming a website, Name registration for websites, Website Control Panel, web development tools, Creating web applications, Client-side versus Server-side Application Development, Features in Web Applications, Front-end development using any latest framework such as React JS. The contents for front-end development include an introduction to React JS, Components in React JS, Properties and Events, Form Components, Accessing DOM, React Router, Flux, Reflux.

Backend Development using any latest framework such as Node JS. The contents include Introduction and Installation of Node JS. Creating Server using Express, Connect with NoSql (Mongo DB) Database, Routers, Models in Database, CRUD Operations with APIs, Testing on Postman, Hosting your application.

Lab Outline

Installation of XAMPP and WAMP servers. Using HTML to Create a table, Use tables to provide layout to HTML page, Use frames such that page is divided into frames, Embed Audio and Video into HTML web page, Create links on the words to link them to Wikipedia pages, Insert an image and create a link such that clicking on

image takes user to other page, Using CSS to write an HTML page, Using JavaScript to write java script programs, Develop and demonstrate the usage of inline, internal and external style sheet using CSS, Write XML Files, Develop and demonstrate PHP script, Implement web applications using (a) PHP (b) Servlets (c) JSP, design patterns to connect them together, Create boilerplate starter projects with React, Redux, Express, flutter, and VueJS
Recommended Books
1. Web Technology: Theory and Practice 1st Edition by Akshi Kumar (2018) ISBN-13 : 978-1138550438 or latest edition. 2. Web Programming with HTML, CSS, Bootstrap, JavaScript, jQuery, PHP, and MySQL by Larry Sanchez (2017) ISBN-13: 978-1542604758 or latest edition. 3. HTML 5, CSS 3 & Bootstrap 4 All-in-One: a complete introduction to front end web development by Mike Ludo (2019) ISBN-13: 978-1777026769 or latest edition. 4. Wieruch, R. (2017). The road to react: Your journey to master plain yet pragmatic react. js. Robin Wieruch. Tsonev, K. (2015). Node. js by example. Packt Publishing Ltd or latest edition. 5. Write Modern Web Apps With the Mean Stack: Mongo, Express, Angularjs, and Node.js (Develop and Design), Jeff Dickey, 2014, Peachpit Pr; ISBN 978-0133930153 6. Beginning MEAN Stack (MongoDB, Express, Angular, Node.js), Greg Jim, Daniel Correa, ISBN 979-8460912742

Course Content

8.14 Data Structures and Algorithms

CODE & TITLE (IST-231) Data Structures and Algorithms		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-III
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamentals of data structures such as lists, queues, trees, etc.	C-2	PLO-1
CLO-2	**Compare** tradeoffs in the design and implementations of the data structures.	C-4	PLO-2
CLO-3	**Apply** the concept of algorithm in solving real world problems.	C-4	PLO-1
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Use** Integrated Development Environment for Implementation and analysis of various sorting/searching algorithms.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Produce** effectively the results about experiments or projects in the form of a report/ manual.	P-4	PLO-10
Course Outline			
Fundamentals: Abstract data types and their importance, Complexity analysis and Big O notation, Overview of algorithmic analysis techniques. **Stacks:** Linked list implementation of stacks, Array implementation of stacks, Applications of stacks, Time and space complexity analysis. **Recursion and Recursive Algorithms:** Understanding recursion and its properties, analyzing recursive algorithms, Divide and conquer algorithms. **Sorting Algorithms:** Selection sort, Insertion sort, Merge sort, Quick sort, Bubble sort, Heap sort, Shell sort, Radix sort, Bucket sort, Time and space complexity of sorting algorithms, **Queues and Deques:** Queue data structure, Deque data structure, Priority queues, Linked list implementation of queues, Array implementation of queues, Time and space complexity analysis. **Linked Lists:** Singly linked lists, doubly linked lists, Circular linked lists, Sorted linked lists, Time and space complexity of linked list operations. **Searching and Hashing:** Searching an unsorted array, Binary search for sorted arrays, Hashing and indexing techniques, Open addressing and chaining methods, Time and space complexity analysis. **Trees and Tree Traversals:** Overview of tree data structure, Binary search trees, Heaps and heap operations, M-way trees, Balanced trees (e.g., AVL trees, Red-Black trees), Tree traversal techniques, Time and space complexity analysis. **Graphs:** Introduction to graphs and their representations, Breadth-first traversal, Depth-first traversal, Topological ordering of graphs, shortest path algorithms (e.g., Dijkstra's algorithm), Adjacency matrix and adjacency list implementations, Time and space complexity analysis. **Memory Management and Garbage Collection:**			

Overview of memory management in programming languages, Concepts of garbage collection, Different garbage collection algorithms and techniques.
Lab outline
1. Environment and Tools Setup a. Setting up the programming environment b. Familiarization with the programming language, IDE (Integrated Development Environment) and its features 2. Implementation of Stacks and Queues a. Implementing a stack using linked list and array b. Implementing a queue uing linked list and array c. Hands-on exercises and testing 3. Recursive Algorithms and Divide and Conquer a. Implementing recursive algorithms (e.g., factorial, Fibonacci series) b. Analyzing and understanding the recursive algorithms c. Implementing divide and conquer algorithms (e.g., merge sort) d. Practical exercises and performance analysis 4. Sorting Algorithms a. Implementing various sorting algorithms (e.g., selection sort, insertion sort) b. Analyzing the time and space complexity of sorting algorithms c. Comparing the performance of different sorting algorithms d. Hands-on sorting exercises and benchmarking 5. Linked Lists and Memory Management a. Implementing different types of linked lists (e.g., singly linked list, doubly linked list) b. Manipulating linked lists (e.g., insertion, deletion) c. Understanding memory management and pointers d. Hands-on exercises with linked lists and memory allocation 6. Searching and Hashing a. Implementing searching algorithms (e.g., linear search, binary search) b. Implementing hashing techniques (e.g., open addressing, chaining) c. Analyzing the performance of searching and hashing algorithms d. Practical exercises with searching and hashing operations 7. Trees and Tree Traversals a. Implementing binary search trees b. Implementing heap data structure and operations c. Implementing tree traversal algorithms (e.g., inorder, preorder, postorder) d. Hands-on exercises with trees and tree traversals 8. Graph Algorithms a. Implementing graph representations (e.g., adjacency matrix, adjacency list) b. Implementing breadth-first and depth-first traversal algorithms c. Implementing shortest path algorithms (e.g., Dijkstra's algorithm) d. Practical exercises with graph algorithms 9. Memory Management and Garbage Collection a. Understanding memory management techniques b. Implementing manual memory management in a programming language

c. Exploring garbage collection concepts and algorithms
d. Hands-on exercises with memory management and garbage collection

10. Comprehensive Project
    a. Working on a comprehensive programming project that involves multiple data structures and algorithms
    b. Implementing various operations and algorithms to solve a specific problem
    c. Testing, debugging, and optimizing the project
    d. Presentation and demonstration of the project

Recommended Books

1. Data Structures and Algorithms in C++ - Adam Drozdek (Latest Edition “4th”, ISBN-10: 8131521265 or ISBN-13: 978-8131521267)
2. Data Structures and Algorithm Analysis in C++ - Mark A. Weiss (Latest Edition “4th”, ISBN-10: 013284737X or ISBN-13: 978-0132847377)
3. Data Structures and Algorithm Analysis in Java - Mark A. Weiss (Latest Edition “3rd”, ISBN-10: 0132576279 or ISBN-13: 978-0132576277)
4. Data Structures and Abstractions with Java - Frank M. Carrano, Timothy M. Henry (Latest Edition “5th”, ISBN-10: 0134831691 or ISBN-13: 978-0134831695)
5. Java Software Structures: Designing and Using Data Structures - John Lewis, Joseph Chase (Latest Edition “4th”, ISBN-10: 0133250121 or ISBN-13: 978-0133250121)

Course Content

8.15 Technical Writing

CODE & TITLE (ISE-231) Technical Writing		CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Humanities and Social Sciences-V Expository Writing-II
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Describe** all the technicalities of formal writing to be used in professional workplace.	C-2	PLO-10
CLO-2	**Write** and construct technical documents such as CVs, cover letters, emails, resume, report/Thesis/Paper, proposal, etc. postulating in appropriate style for academic or scientific report.	C-5	PLO-10
CLO-3	**Demonstrate** the role of ethics in preparing professional communication.	C-3	PLO-7
CLO-4	**Use** a modern typesetting tool (LATEX) along with a referencing tool (EndNote or Mendeley) to create technical and business documents.	P-5	PLO-5

Course Outline for Theory

Introduction to Technical Report Writing (What is a report? Purpose of Technical Report Writing, Parts of Technical Report Writing). **Intended Audience Recognition of a Technical Report**. **7C's of Effective Communication** (Writing Clear Sentences, Writing Clear Paragraphs, Revising for Clarity, Organizing Clearly). **Types of Reports** (Informal Report, Formal Report, Informational & Analytical Report, Recommendation and Feasibility Reports). **Technical Writing Applications** (Memorandums, Cover Letters, Emails). **Technical Writing Process (**The Pre-writing Stage, The Writing Stage, The Post-writing Stage). **Essay Writing** (Parts of an Essay, Descriptive Essay, Narrative Essay, Discursive Essay, Argumentative Essay). **Writing Project Proposal** (Parts, Format). **Different Parts of a Technical Report** (Formatting) (Title Page, Table of Contents, List of Figures, List of Tables, Abbreviations, Symbols, Abstract/Summary, Introduction, Background, Discussion, Conclusion, Recommendations, Figures and Tables, Appendix, Acknowledgment, Bibliography, Biography). **Resume Writing** (The Functional Resume, The Chronological Resume, Hybrid Resume). **Plagiarism (**Definition, Types, how to avoid? HEC Penalties, IEEE Policy). **Writing Research/Term Paper** (Emphasis on **S**tyle and Content, Consistency and Clarity, Language and Form). **Typesetting Tools** (Introduction to Math-type equation editor, Word, Latex, EndNote, Mendeley for report writing). **Practical Activities of Technical Report Writing (**Each student should write and submit a report on including all components of a technical report for a project offered in any engineering course on IEEE format. Citations must be incorporated using standard referencing software. Assessment of the project would be carried out based on defined rubrics covering all aspects of the technical report).

Recommended Books
1. Heather Silyn Roberts, “Writing for science and Engineering papers, presentations and Reports”, 2nd Edition, Elsevier 2013 2. Ron White Writing, (1992) Advanced Oxford Supplementary Skills. Third Impression. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing). 3. John Langan (2004) College Writing Skills 9th Edition McGraw-Hill Higher Education. 4. Daniel Riordan, (2013), “Technical Report Writing Today”, Tenth Edition, ISBN-13: 978-1133607380 5. Technical Report Writing Today, by Daniel Riordan, 10th Edition (or Latest Edition) 6. Technical Writing and Professional Communication, Leslie Olsen and Thomas Huckin, 2nd Edition. (Or Latest Edition) 7. Communication for Engineering Students by J. W. Davies, (or Latest Edition) 8. Science Research Writing for Non-Native Speakers of English by Hilary Glassman-Deal, Imperial College Press. (Latest Edition)

Course Content

8.16 Computer Networks

CODE & TITLE (IST-232) **Computer Networks**		CREDIT & CONTACT HOURS (2+2) **32 Theory + 96 Lab**	KNOWLEDGE AREA/ DOMAIN **Foundation-IV**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** layered network architecture and associated protocols. Especially related to TCP/IP architecture.	C-3	PLO-1
CLO-2	**Analyze** TCP/IP architecture routing algorithms, error correction and detection techniques.	C-4	PLO-2
CLO-3	**Design** a data communication network and subnetworks using subnet masks.	C-4	PLO-3
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Use** software tools (Wireshark, Packet Tracer) for the analysis of messages exchange between communicating entities.	P-5	PLO-5
CLO-5	**Perform** the experiments effectively, as an individual and in a group.	A-3	PLO-9
CLO-6	**Communicate** effectively regarding Laboratory work in oral communication and written format.	P-5	PLO-10
Course Outline			

Introduction to Computer Networks: Overview of computer networks, Network topologies and architectures, OSI and TCP/IP network models, Network protocols and standards. **Network Devices and Media:** Network devices: routers, switches, hubs, and modems, Network media: copper, fiber-optic, and wireless, Ethernet and wireless LAN technologies, Introduction to network virtualization and software-defined networking (SDN). **Local Area Networks (LANs):** LAN design and implementation, Ethernet switching and VLANs, Spanning Tree Protocol (STP) and Rapid STP, LAN troubleshooting and performance optimization. **Wide Area Networks (WANs):** WAN technologies: leased lines, circuit-switched networks, and packet-switched networks, Introduction to MPLS and VPN technologies, WAN protocols: HDLC, PPP, and Frame Relay, WAN troubleshooting and optimization. **Network Addressing and Routing:** IPv4 and IPv6 addressing schemes, Subnetting and supernetting, Routing protocols: RIP, OSPF, and BGP, Introduction to IP multicast. **Network Services and Applications:** Domain Name System (DNS), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Network file services: FTP, NFS, and SMB, Network Security: Network threats and vulnerabilities, Firewalls and Intrusion Detection Systems (IDS), Virtual Private Networks (VPNs), Secure Sockets Layer (SSL) and Transport Layer Security (TLS). Network Management and Monitoring: Network management protocols: SNMP and NetFlow, Network monitoring tools and techniques, Quality of Service

(QoS) and traffic shaping, Network performance optimization. Wireless and Mobile Networks: Wireless LAN standards: Wi-Fi 802.11 family, Cellular networks: 3G, 4G, and 5G, Mobile IP and Mobile Ad hoc Networks (MANETs), Security considerations in wireless networks. Internet of Things (IoT) and Cloud Networking: Introduction to IoT and its networking requirements, Cloud computing and virtualization in networking, Software-Defined Networking (SDN) in the cloud, IoT security challenges and solutions. Network Design and Planning: Network design methodologies, Capacity planning and scalability, Redundancy and high availability, Network documentation and diagrams. Emerging Trends in Computer Networks: Software-Defined Networking (SDN), Network Function.

Lab Outline

1. Networking Tools and Network Configuration
    c. Familiarization with networking tools (e.g., Wireshark, Ping, Traceroute)
    d. Basic network configuration on different operating systems
    e. Verifying network connectivity and troubleshooting
2. Physical Layer and Transmission Media
    a. Hands-on experience with different types of transmission media (e.g., twisted-pair cables, fiber optics)
    b. Measurement and analysis of signal characteristics using oscilloscopes or network analyzers
    c. Practical exercises on error detection and correction techniques
3. Data Link Layer and LAN Technologies
    a. Configuration and testing of Ethernet networks
    b. Implementation of CSMA/CD or CSMA/CA protocols
    c. Packet capture and analysis of network traffic using Wireshark
4. Network Layer and Routing
    a. Configuration of routing protocols (e.g., RIP, OSPF)
    b. Setting up static and dynamic routing tables
    c. Simulation of different routing scenarios using network simulation tools (e.g., GNS3)
5. Transport Layer and Socket Programming
    a. Implementing TCP and UDP socket programming in a programming language (e.g., Python, Java)
    b. Developing client-server applications with connection establishment and data transfer
    c. Experimenting with flow control and congestion control algorithms
6. Application Layer Protocols and Services
    a. Configuring and testing common application layer protocols (e.g., HTTP, FTP, DNS)
    b. Capturing and analyzing application layer traffic to understand protocol behavior
    c. Implementing basic client-server interactions for different protocols
7. Network Security and Firewall Configuration
    a. Setting up firewall rules and access control policies
    b. Testing network security measures and intrusion detection systems
    c. Analyzing network traffic for security threats using specialized tools
8. Virtualization and Cloud Networking
    a. Building and configuring virtual networks using virtualization platforms (e.g., VMware, VirtualBox)
    b. Deploying virtual machines and connecting them in a network topology
    c. Experimenting with network functions virtualization (NFV) and software-defined networking (SDN) concepts

9. Network Monitoring and Troubleshooting
    a. Using network monitoring tools to capture and analyze network traffic
    b. Troubleshooting network connectivity issues and identifying bottlenecks
    c. Performing network performance tests and optimizing network configurations
10. Project and Case Study
    a. Undertaking a network-related project or case study
    b. Designing and implementing a network solution for a given scenario
    c. Presenting findings, analysis, and recommendations to the class

Recommended Books

1. Behrouz A. Forouzan “Data Communication and Networking”, McGraw-Hill, latest Edition
2. Computer Networking: A Top-Down Approach - James F. Kurose, Keith W. Ross (Latest Edition “6th”, ISBN-10: 0132856204 or ISBN-13: 978-0132856201)
3. Computer Networks - Andrew S. Tanenbaum, David J. Wetherall (Latest Edition “5th”, ISBN-10: 0132126958 or ISBN-13: 978-0132126953)
4. Data and Computer Communications - William Stallings (Latest Edition “10th”, ISBN-10: 1292014385 or ISBN-13: 978-1292014388)
5. Data Communications and Networking - Behrouz A. Forouzan (Latest Edition “5th”, ISBN-10: 0073376221 or ISBN-13: 978-0073376226)
6. Computer Networks and Internets - Douglas E. Comer (Latest Edition “6th”, ISBN-10: 0133587932 or ISBN-13: 978-0133587937)

Course Content

8.17 Software Engineering

CODE & TITLE (IST-233) Software Engineering		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Breadth-II
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** various software architectural styles.	C-2	PLO-1
CLO-2	**Use** software modeling techniques for requirements analysis and requirements presentation.	C-3	PLO-2
CLO-3	**Develop** user stories and use cases to represent software requirements.	C-4	PLO-3
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Use** modern tools and techniques for producing application software solutions from informal and semi-formal problem specifications.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10

Course Outline for Theory

Nature of Software, Overview of software engineering, Professional software development, Software engineering practice, Software process structure, Software process models, Agile software Development, Agile process models, Agile development techniques, Requirements engineering process, Functional and non-functional requirements, Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering, Fundamentals of Software design, Architectural design, Object-oriented representation, Structural decomposition, Design and implementation, UML diagrams and design patterns, Software testing and quality assurance, Software Evolution, Project management and project planning, Configuration management, Software process improvement

Lab outline

1. RECOGNIZE the concepts of Visual Paradigm software and implementing flow chart diagram for given process flow.
2. Implementation of UML Use-Case diagram.
3. PRACTICE how to develop Class diagram for the given scenarios.

4. UML Interactions diagram by implementing sequence diagram for given problems. 5. Develop collaboration diagrams for the given problems. 6. RECOGNIZE the perception of State diagrams and show its implementation. 7. Practice the UML Component diagram for the specified problems. 8. Practice the concept of UML Deployment Diagram and solve the given scenarios by implementing their deployment diagrams. 9. OBSERVE the concept of Data Flow Diagram 10. RECOGNIZE the concepts of MS Project Software and learn to develop a schedule of a project. 11. WBS Process and implementation of WBS Codes. 12. OBSERVE activity, Sequence activity, applying lead & leg time, setting predecessor & task linking in MS Project. 13. RECOGNIZE activity resources & setting work time & calendar of project given. 14. Course Management System (open ended) 15. Identify critical activities in a project. (Open ended)
Recommended Books
1. Software Engineering, Sommerville I., latest Edition, Pearson Inc., 2. Software Engineering, A Practitioner's Approach, Pressman R. S.& Maxim B. R., latest Edition, McGraw-Hill. 3. Software Modeling and Design: UML, Use Cases, Patterns, and Software Architectures, H. Gomaa, Cambridge University Press, 2011. 4. Software Architecture and Design Illuminated, K. Qian et al., 2010

Course Content

8.18 Database systems

CODE & TITLE (IST-234) Database systems		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-V
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** fundamental database concepts.	C-2	PLO-1
CLO-2	**Apply** conceptual, logical and physical database schemas using different data models.	C-3	PLO-2
CLO-3	**Investigate** functional dependencies and resolve database anomalies by normalizing database tables.	C-3	PLO-4
CLO-4	**Apply** Structured Query Language (SQL) for database definition and manipulation in any DBMS.	C-3	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-5	**Apply** Structured Query Language (SQL) for database definition and manipulation in any DBMS.	P-4	PLO-5
CLO-6	**Perform** the experiments effectively, as an individual and in a group.	P-4	PLO-9
CLO-7	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Contents			
Fundamentals: Basic database concepts, Database approach vs. file-based systems, Database architecture and components, Three-level schema architecture, Data independence. **Relational Data Model:** Overview of the relational data model, Attributes, domains, and tuples, Schemas and relation instances, Keys of relations and integrity constraints. **Relational Algebra:** Fundamental operations of relational algebra, Selection and projection operations, Cartesian product and join operations, Different types of joins. **Normalization and Data Modeling:** Introduction to normalization, Functional dependencies and normal forms, Entity-relationship (ER) model, Entity sets, attributes, and relationships, Entity-relationship diagrams (ERDs). **Structured Query Language (SQL):** Overview of SQL, Data definition language (DDL) statements, Data manipulation language (DML) statements, Joins and sub-queries in SQL, Grouping and aggregation in SQL. **Concurrency Control and Recovery:** Concurrency control in database systems, Managing concurrent transactions, Database backup and recovery mechanisms. **Indexing and Performance Optimization:** Indexes and their role in database performance, Types of indexes (e.g., B-trees, hash indexes), Query optimization and performance tuning			

techniques. **NoSQL Databases:** Introduction to NoSQL systems, Comparison of relational and NoSQL databases, Overview of different NoSQL database models.

Lab outline

1. Environment Setup and Tools
    f. Setting up the database environment
    g. Basic SQL queries for data retrieval and manipulation
    h. Creating tables and defining schemas
    i. Performing CRUD operations using SQL statements
2. Relational Data Modeling and Normalization
    a. Designing a relational database schema
    b. Applying normalization techniques to improve data integrity
    c. Implementing the designed schema in a relational database management system
3. Querying and Manipulating Data with SQL
    a. Advanced SQL queries with joins and sub-queries
    b. Performing data aggregation and grouping operations
    c. Modifying database records using DML statements
4. Database Administration and Security
    a. Managing user roles and access privileges
    b. Creating views for data abstraction and security
    c. Implementing integrity constraints and enforcing data consistency
5. Physical Database Design and Performance Tuning
    a. Analyzing query execution plans
    b. Indexing strategies for query optimization
    c. Monitoring and optimizing database performance
6. Distributed Database Systems
    a. Configuring and setting up a distributed database environment
    b. Implementing distributed transaction management
    c. Handling data replication and consistency in a distributed setting
7. NoSQL Databases (e.g., MongoDB)
    a. Setting up a NoSQL database system
    b. CRUD operations in a NoSQL environment
    c. Exploring features specific to NoSQL databases
8. Database Research Trends and Emerging Technologies
    a. Exploring recent research advancements in database systems
    b. Investigating emerging technologies and trends in the field
    c. Presenting and discussing research papers or case studies

Recommended Books

1. Database Systems: A Practical Approach to Design, Implementation, and Management - Thomas Connolly, Carolyn Begg (Latest Edition “6th”, ISBN-10: 0132943263 or ISBN-13: 978-0132943260)
2. Database Systems: The Complete Book - Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom (Latest Edition “2nd”, ISBN-10: 0131873253 or ISBN-13: 978-0131873254)
3. Database System Concepts - Abraham Silberschatz, Henry F. Korth, S. Sudarshan (Latest Edition “6th”, ISBN-10: 0071289593 or ISBN-13: 978-9339212124)

4. Database Management Systems - Raghu Ramakrishnan, Johannes Gehrke (Latest Edition “3rd”, ISBN-10: 0072465638 or ISBN-13: 978-0072465631)

Course Content

8.19 Probability and Statistics

CODE & TITLE (ISQ-231) Probability and Statistics		CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Natural Sciences-IV Quantitative Reasoning-III
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Identify** the basic concepts of probability and random variables/signals, illustrate the use of CDFs, PDFs and PMFs of continuous as well as discrete nature.	C-3	PLO-1
CLO-2	**Calculate** the PMFs, PDFs and CDFs and express probability of events from statistical data.	C-4	PLO-2
CLO-3	**Compare** and correlate multiple random variables/Processes and evaluate if they are independent, orthogonal or correlated to solve problems from the field of communications falling in both discrete and continuous domain.	C-3	PLO-4

Course Outline for Theory

Basic concept of probability, conditional probability, independent events, Baye's theorem, concept of random variables, discrete and continuous one- and two-dimensional random variables, probability distributions, marginal and joint distributions and density functions, important probability distributions (Binomial, Poisson, Uniform, Normal, Exponential and Hyper-geometric), mean, variance, moments and moments generating functions, central limit theorem, autocorrelation and cross-correlations.

Recommended Books

1. Fundamentals of Applied Probability and Random Processes Book by Oliver C Ibe 2nd Edition.
2. Peebles, Peyton Z., Jay Read, and Peter Read. Probability, random variables, and random signal principles. Vol. 3. New York, NY: McGraw-Hill, 2001.
3. Leon-Garcia, "Probability and Random Processes For Electrical Engineering", Third Edition, 2008, Pearson Education, ISBN-13: 978-0131471221.
4. A. Popoulis and U. Pillai, "Probability Random Variable and Stochastic Processes", Fourth Edition, 2002, McGraw-Hill, ISBN-13: 978-0071226615.
5. J. Devore, "Probability and Statistics", Eight Edition, 2011, John Wiley & Sons, ISBN-13: 978-0538733526.
6. Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", Fifth Edition, 2010, John Wiley, ISBN-13: 978-0470910610.

Course Content

8.20 Operating Systems

CODE & TITLE (IST-241) Operating Systems		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-VI
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the characteristics of different structures of the Operating Systems and identify the core functions of the Operating Systems.	C-2	PLO-1
CLO-2	**Demonstrate** the knowledge in applying system software and tools available in modern operating systems.	C-3	PLO-2
CLO-3	**Analyze** and evaluate the algorithms of the core functions of the Operating Systems and explain the major performance issues regarding the core functions.	C-4	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Demonstrate** the knowledge in applying system software and tools available in modern operating systems.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			
Fundamentals: Overview of operating systems and their role, Evolution and history of operating systems, Types of operating systems (e.g., batch, time-sharing, distributed), Operating system components and functionalities. **System Calls:** Understanding system calls and their purpose, Types of system calls (e.g., process control, file management, device management), System call interface and usage in programming. **Process Concept and Scheduling:** Introduction to processes and process management, Process states and state transitions, Process control blocks and process scheduling algorithms, Context switching and process synchronization. **Inter-Process Communication:** Mechanisms for inter-process communication (IPC), Shared memory, message passing, and synchronization primitives, IPC techniques and their applications, **Multithreaded Programming:** Introduction to multithreading and its benefits, Multithreading models (e.g., user-level threads, kernel-level threads), Thread creation, management, and synchronization, Thread scheduling algorithms. **Memory Management:** Basics of memory management in operating systems, Swapping and contiguous memory allocation, Segmentation and paging techniques, Virtual memory			

management and demand paging. **File Systems:** File concept and file operations, Directory structure and implementation, File allocation methods and free space management, Disk structure, scheduling, and I/O operations. **Synchronization and Deadlocks:** Principles of synchronization and mutual exclusion, Critical sections and synchronization mechanisms, Deadlock prevention, avoidance, and detection, Handling and recovering from deadlocks. **System Protection and Security:** Basics of system protection and security, Access control mechanisms and policies, Virtual machines and their role in system security, Operating system security measures and best practices

Lab outline

1. Operating Systems and Environment Setup
    a. Overview of operating systems and their components, Linux, macOS, and Windows
    b. Setting up development environments on Linux, macOS, and Windows
    c. Familiarization with command-line interfaces (CLI) on each platform
2. Process Management and System Calls
    a. Understanding process management in Linux, macOS, and Windows
    b. Exploring system calls related to process creation, termination, and management
    c. Writing and executing programs to demonstrate process management using system calls
3. Inter-Process Communication and Synchronization
    a. Implementing inter-process communication mechanisms using shared memory and message passing
    b. Synchronizing processes using semaphores, mutexes, and condition variables
    c. Developing programs to demonstrate inter-process communication and synchronization on all platforms
4. Multithreading and Thread Scheduling
    a. Creating and managing threads in Linux, macOS, and Windows environments
    b. Exploring thread synchronization and thread-safe programming techniques
    c. Analyzing and comparing thread scheduling algorithms on different platforms
5. Memory Management and Virtual Memory
    a. Experimenting with memory management techniques, such as swapping and paging
    b. Implementing demand paging and virtual memory concepts
    c. Analyzing memory usage and performance characteristics on Linux, macOS, and Windows systems
6. File Systems and Disk Management
    a. Working with file systems on Linux, macOS, and Windows
    b. Creating, reading, and modifying files and directories
    c. Examining disk structures, file allocation methods, and disk scheduling algorithms
7. Deadlocks and System Protection
    a. Implementing deadlock prevention, avoidance, and detection algorithms
    b. Exploring mechanisms for system protection and access control
    c. Analyzing security measures and best practices on Linux, macOS, and Windows
8. Virtualization and System Security
    a. Setting up virtual machines using tools like VirtualBox or VMware
    b. Exploring system security measures, such as firewalls and antivirus software
    c. Conducting security assessments and implementing security measures on Linux, macOS, and Windows

Recommended Books
1. Operating System Concepts - Avi Silberschatz, Peter Baer Galvin, Greg Gagne (Latest Edition “9th”, ISBN-10: 1118063333 or ISBN-13: 978-1118063330) 2. Modern Operating Systems - Andrew S. Tanenbaum (Latest Edition “4th”, ISBN-10: 9332575770 or ISBN-13: 978-9332575776) 3. Operating Systems: Internals and Design Principles - William Stallings (Latest Edition “9th”, ISBN-10: 0134670957 or ISBN-13: 978-0134670959)

Course Content

8.21 Information Security

CODE & TITLE (IST-242) Information Security		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Breadth-III
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the role of computers and networks in a security context.	C-2	PLO-1
CLO-2	**Analyze** the vulnerabilities in any computing system and hence be able to design a security solution.	C-3	PLO-2
CLO-3	**Implement** various cryptographic techniques and simulate attack scenarios.	C-3	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** Information Security knowledge to understand the Attacks and Vulnerabilities.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			
Introduction of Core Security Principles, Security System Development Life Cycle, Ethical, Legal and Professional issues in Cyber Security, The Ten Commandments of Computer Security, Cyber Crime Act 2006 (Pakistan), Threats and their types, Human Error and its solution, Forces of Nature, Delibrate Attacks and their types, Buffer Overflow, SQL Injection, Session Hijacking, CSRF, XSS, Social Engineering Attacks, Malware, DOS Attacks, Industrial Espionage in Cyberspace, Introduction to Ethical Hacking and Tools, Practical Implementation of SQL Injection and DOS Attack, Cryptography, Encryption Strategies, Mono Alphabetic Ciphers: Ceaser Cipher, Albash Cipher, Playfair Cipher, Poly Alphabetic Ciphers: Vigne're Cipher, Vernam Cipher, Hill Cipher, Transposition Ciphers: Rail Fence Cipher, Row Transposition, Column Trasposition, Block Ciphers, DES, AES, Implementation of Cryptographic Techniques using programming language, User Authentication, Access Control, Information Rights Management, Protecting Clients and Servers, Secure Programming Practices: Validations, Simplicity, Default Denial, Coding Standards, Least Privilege, Input Sanitization, Defense in Depth, Quality Assurance, Protecting Networks and Communication Mediums, Enforcing Confidentiality with Encryption, Certificates, PKI and Hash functions			

Lab Outline
Introduction of Core Security Principles, Introduction to Ethical Hacking and Tools, Malware, types of malware; Attacks using malware; Malware Attack Lifecycle: Stages of Attack; Social engineering attacks; types of payload; Industrial Espionage in Cyberspace, Encryption Strategies, Implementation of Symmetric, Asymmetric Algorithms, User Authentication, Audit Policies and Network Auditing, Protecting Clients and Servers, Practical Implementation of SQL Injection and DOS Attack, Best Programming Practices for Security, Protecting a Network, Wireless Security, Physical Security, Enforcing Confidentiality with Encryption, Certificates and PKI. Implementation using Kali Linux/Ubuntu
Recommended Books
1. Principles of Information Security by Michael E. Whitman, 6th Edition, 2017 2. Practical Cryptography in Python: Seth James Nielson and Christopher K Monson (Apress)

Course Content

8.22 Computer Architecture and Organization

CODE & TITLE (IST-243) Computer Architecture and Organization	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Foundation-VII	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** functionality of major components of a computer system like CPU, control unit, memory, I/O and storage.	C-2	PLO-1
CLO-2	**Apply** principles of instruction set design including RISC architectures and basic assembly programming.	C-3	PLO-2
CLO-3	**Analyze** pipelining and parallelism features applied in single processor, multiple processors and multicore architectures.	C-4	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** Information Security knowledge to understand the Attacks and Vulnerabilities.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			

Fundamentals: Information as bits + context, Translation of programs by other programs, understanding compilation systems, Processor instruction interpretation, Importance of caches in computer systems, Memory hierarchy and storage devices, Role of the operating system, Communication between systems using networks. **Representing and Manipulating Information:** Information storage in computer systems, Integer representations and arithmetic, Floating-point representations, Manipulating integers and floating-point numbers. **Machine-Level Representation of Programs:** Historical perspective on program encodings, Data formats in machine-level representation, Accessing information in memory, Arithmetic and logical operations, Control flow in machine-level programs, Procedures and subroutine calls, Array allocation and access, Working with heterogeneous data structures, Understanding pointers, Debugging with the gdb debugger, Handling out-of-bounds memory references and buffer overflow, Introduction to x86-64 architecture (64-bit extension of ia32), Machine-level representations of floating-point programs. **Processor Architecture:** Introduction to the Y86 instruction set architecture, Logic design and Hardware Control Language (HCL), Sequential implementations of Y86, General principles of pipelining, Pipelined implementations of Y86

Lab outline
I. Assembly Language ▪ Familiarizing with assembly language syntax and conventions ▪ Writing simple assembly programs to perform basic operations II. Manipulating Data in Assembly Language ▪ Implementing integer arithmetic operations using assembly language instructions ▪ Performing calculations with floating-point numbers in assembly language III. Debugging and Testing Assembly Programs ▪ Using assembly-level debugging tools to analyze and debug programs ▪ Writing test cases and conducting thorough testing of assembly programs IV. Memory Management and Pointers in Assembly ▪ Implementing memory allocation and deallocation routines in assembly language ▪ Working with pointers and their manipulation in assembly programming V. Control Flow and Procedures in Assembly ▪ Implementing control flow mechanisms such as conditionals and loops in assembly programs ▪ Writing and calling procedures/subroutines in assembly language VI. Array Manipulation and Data Structures in Assembly ▪ Implementing array allocation, access, and manipulation operations using assembly language ▪ Exploring data structures and their implementation in assembly programming VII. Error Handling and Exception Handling in Assembly ▪ Identifying and handling errors, such as out-of-bounds memory references, in assembly programs ▪ Implementing exception handling mechanisms in assembly language VIII. x86-64 Assembly ▪ Understanding the features and enhancements of the x86-64 architecture in assembly programming ▪ Porting and adapting existing assembly programs to the x86-64 instruction set IX. Pipelining and Optimization in Assembly ▪ Optimizing assembly programs for performance improvements, considering pipelining techniques ▪ Analyzing the impact of pipelining on the execution time of assembly programs X. Final Project in Assembly ▪ Integrating the knowledge and skills gained throughout the course to complete a comprehensive assembly programming project ▪ Demonstrating proficiency in understanding and manipulating computer systems at the machine level using assembly language
Recommended Books
1. Computer Systems: A Programmer's Perspective - Randal E. Bryant, David R. O'Hallaron (Latest Edition "3rd", ISBN-10: 9332573905 or ISBN-13: 978-9332573901) 2. Computer System Architecture - M. Morris Mano (Latest Edition "3rd", ISBN-10: 0131755633 or ISBN-13: 978-0131755635) 3. Assembly Language for Intel-Based Computers - Kip R. Irvine (Latest Edition "4th", ISBN-10: 0130910139 or ISBN-13: 978-0130910134) 4. MIPS Assembly Language Programming - Robert L. Britton (Latest Edition "1st", ISBN-10: 0131420445 or ISBN-13: 978-0131420441)

5. William Stallings, Computer Organization and Architecture Designing for performance, 8th Edition, Prentice Hall Inc. 2016
6. Walter A. Triebel, Avtar Singh, The 8088 and 8086 Microprocessors fourth edition Prentice Hall Inc.

Course Content

8.23 Systems and Network Administration

CODE & TITLE (IST-244) Systems and Network Administration		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Breadth-IV
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** an understanding of the principles and practices in systems and network administration, with an emphasis on small-scale computing environments.	C-2	PLO-1
CLO-2	**Practically** manage a local area network consisting of servers, clients, network devices, and associated software services and tools running on multiple platforms.	C-3	PLO-2
CLO-3	**Evaluate** and critique a design for systems and network solution.	C-4	PLO-3
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Use** different tools for analysis of Systems and Network Administration.	P-5	PLO-5
CLO-5	**Perform** the experiments effectively, as an individual and in a group.	A-3	PLO-9
CLO-6	**Communicate** effectively regarding Laboratory work in oral communication and written format.	P-5	PLO-10
Course Outline for Theory			
Introduction to network and system administration, server environment (Microsoft and Linux), Comparative analysis of most demanded OS, Linux installation and verification, Managing and administrating the users and groups, Services and management, software management in Linux, Managing network services and network establishment in VM, managing permissions in Linux, monitoring of network resources securing network traffic, logs handling and log management, Installation of Remote Desktop Server, Installation and Configuration of web server, Installation and Configuration of FTP server, Installation, managing and maintaining active directory, Access to Directory information through LDAP and access directory services through JNDI			

Lab Outline
Installation of operating system, Installation of office productivity software (MS Office/ Open Office), User Management, Directory management commands, Startup & Shutdown scripts, Process management commands and their execution, Firewall Configuration, Study of Important LINUX Services, Study and measure voltages of SMPS, Drawing the motherboard layout (any latest processor) and studying the chipset through data books or Internet, CMOS setup of any latest PC, Fault findings: (a) Problems related to CPU (b) Problems related to RAM, Disassembly and Assembling of PC and Installation of Operating System a) Windows b) Linux. Perform dual booting also, learn parallel port, serial port and USB port testing and Installation of Scanner, Printers and ADSL/DSL Modems, Crimping of RJ45: Straight and Cross. a) Punching Cat 6 cable to I/O Box. Use punching tool. b) Check connectivity using LAN tester, install a Switch and Wireless router, Study different IP classes (A, B, C) addressing. (Manual & Dynamic). Check connectivity for peer-to-peer and client-server, Windows Server & also install the following services a) Active directory b) DNS c) DHCP, Visit any industry / institutes (Engineering colleges, university campuses, etc.)
Recommended Books
1. Mastering Windows Server 2019: The complete guide for system administrators to install, manage, and deploy new capabilities with Windows Server 2019, 3rd Edition 3rd ed. Edition by Jordan Krause (2021) ISBN-13 : 978-1801078313 or latest edition. 2. Study guide for Practice of System and Network Administration by Thomas A. Limoncelli, Cram101; 2nd Edition (2011). ISBN-10: 1428851755 or latest edition. 3. Linux Administration: A Beginner's Guide, Seventh Edition 7th Edition by Wale Soyinka (2015) ISBN-13 : 978-0071845366 or latest edition. 4. Active Directory: Designing, Deploying, and Running Active Directory Fifth Edition by Barian Desmond (2013) ISBN-13 : 978-1449320027

Course Content

8.24 Artificial Intelligence

CODE & TITLE (IST-245) Artificial Intelligence	CREDIT & CONTACT HOURS (1 Th + 1 Lab) 16 Th + 48 Lab	KNOWLEDGE AREA/DOMAIN Breadth-V	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	C-3	PLO-1
CLO-2	**Solve** Artificial Intelligence problems and implement basic AI algorithms.	C-3	PLO-2
CLO-3	**Design** Artificial Intelligence based systems and applications.	C-3	PLO-3
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** AI algorithms using Matlab/Python	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10

Outline for Theory

Introduction: Basic component of AI, identifying AI systems, branches of AI, etc. Reasoning and Knowledge Representation: Introduction to Reasoning and knowledge representation, propositional logic, first order logic. Problem Solving by Searching: Informed searching, uninformed searching, local searching, constraint satisfaction problems, adversarial search, min-max algorithm, alpha beta pruning, game-playing. Learning: Unsupervised learning, supervised learning, reinforcement learning. Uncertainty Handling: Uncertainty in AI, fuzzy logic. Recent Trends in AI and Applications of AI Algorithms: Trends, case study of AI systems, analysis of AI systems

Outline for Laboratory Experiments

- Demonstration on Agents, Searching Algorithm, Hill Climbing Algorithm, MinMax Algorithm, Constraint Satisfaction Problems, Expert System, Genetic Algorithm, Machine Learning (classification and regression-based Algorithms), Computer Vision (Blurring and contrast stretch), Automated Feature Selection (SURF and LBP), Convolution Neural networks (CNN). Introduction to prolog, Facts and Variables

Recommended Books

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, 2009, Prentice Hall, ISBN-13: 978-0136042594.
2. Pattern Classification: Hart, P.E., Stork, D.G. and Duda, R.O., 2001... John Willey & Sons. (Latest edition)

3. AI algorithms, Data Structures, and Idioms in Prolog, Lisp, and Java: Luger, G.F. and Stubblefield, W.A., 2009...Pearson Addison-Wesley. (Or Latest edition)

Course Content

8.25 Depth Elective – I / Cryptography

CODE & TITLE (IST-351) Depth Elective – I		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Depth –I
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the applications of cryptography algorithms and protocols to real-life problems and many implementation issues in developing these solutions.	C-2	PLO-1
CLO-2	**Evaluate** functionality, security and performance properties of cryptography methods used as components of complex security solutions.	C-3	PLO-2
CLO-3	**Analyze** the impact of errors or different designs of cryptography algorithms and protocols.	C-4	PLO-2
CLO-4	**Describe** the applications of cryptography algorithms and protocols to real-life problems and many implementation issues in developing these solutions.	C-2	PLO-1
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** Cryptography knowledge to understand the encryption / decryption algorithms.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			
Security: Computer Security, Information Security, Network Security, **CIA Triad:** Confidentiality, Integrity, Availability, Cryptography, Cryptosystem, Cryptanalysis, Security Threats: **Attacks:** Passive (Release of message, Traffic analysis), Active (Replay, Denial of service) **Security Services:** Authentication, Access Control, Nonrepudiation Security Mechanisms, Policy and Mechanism. Classical Cryptosystems: **Hierarchy of cipher Substitution Techniques:** Monoalphabetic: Ceasar Cipher, Hill, Polyalphabetic: Vigenere Cipher (Variants: vernam, one time pad), Playfair. Transposition Techniques: Rail Fence Cipher. **Modern Ciphers:** Block Ciphers, Stream Ciphers, Symmetric Ciphers, Asymmetric Ciphers. Fiestel Cipher Structure, Substitution Permutation Network (SPN), **Data Encryption Standards (DES):** Key Generation, Encryption and Decryption Process, Weak Keys in DES, Double DES, Meet in Middle Attack, Triple DES. **Finite Fields:** Basic concepts of Groups, Rings, and Fields, GCD, Euclidean Algorithm, Modular Arithmetic, Set of Residue (Zn), Congruence, Residue classes,			

Quadratic residue, Operations on Zn (Addition, Subtraction, Multiplication), Properties of Zn, Inverses: Additive Inverse, Multiplicative Inverse, Relatively Prime, Extended Euclidean Algorithm, Galois Fields (GF(p) & GF(2n)), Polynomial Arithmetic : Addition, Multiplication and Division over Galois Field. **Advanced Encryption Standards (AES):** Key Generation, Encryption and Decryption Process. Modes of Block Cipher Encryptions (Electronic Code Book, Cipher Block Chaining, Cipher Feedback Mode, Output Feedback Mode, Counter Mode). **Number Theory:** Prime Numbers, Primality Testing, Miller-Rabin Algorithm, Fermat's Theorem, Euler's Totient Function and Euler's Theorem, Primitive Root, Discrete Logarithms. Public Key Cryptosystems, Applications of Public Key Cryptosystems. Distribution of public key, Distribution of secret key by using public key cryptography, Diffie-Hellman Key Exchange, Man-in-the-Middle Attack, RSA Algorithm: Key Generation, Encryption. **Cryptographic Hash Functions and Digital Signatures, Authentication, Network Security and Public Key Infrastructure and Decryption Process, Malicious Logic**
Lab Outline
Monoalphabetic Ciphers: Ceasar, Hill Polyalphabetic Cipher: Vigenere Cipher (Vernam, OTP), Playfair Transposition Cipher: Rail Fence Cipher Some basic components of DES like functioning of S-Box, Key generation Modular Arithmetic (Finding additive inverse, multiplicative inverse (Extended Euclidean algorithm, relatively prime) Number Theory (Primality testing, Totient function, Primitive root) Diffie-Helman Key Exchange, RSA Algorithm, Elgamal Cryptographic System Some basic logic for Malicious code
Recommended Books
1. W. Stallings, Cryptography and Network Security: Principles and Practice 2. William Stallings, Network Security Essentials: Applications and Standards 3. Matt Bishop, Computer Security, Art and Science. 4. Mark Stamp, Information Security: Principles and Practices. 5. Bruce Schneier, Applied Cryptography. 6. Douglas. R. Stinson. Cryptography: Theory and Practice. 7. B. A. Forouzan, Cryptography & Network Security, Tata Mc Graw Hill

Course Content

8.26 Depth Elective – II / Malware Analysis

CODE & TITLE (IST-352) Depth Elective - II	CREDIT & CONTACT HOURS (2+2) 32 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Depth –II	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** various features/packages of self-protected malware and other defense mechanisms designed by malware makers to direct, confuse, and slow down analysts.	C-2	PLO-1
CLO-2	**Explain** techniques of malicious code analysis, code debugging, malware debugging, and kernel debugging.	C-3	PLO-2
CLO-3	**Able** to defend systems from various self-protected malware and anti-malware.	C-3	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** malware knowledge to understand the behavior and impacts of malware.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			

Introduction: The cyber kill chain, Definition of malware and its role in the kill chain, Different types of malwares, The goal of malware analysis, Types of malware analysis, Setting up a safe environment for malware analysis. **Analyzing malicious Windows programs**: The Portable Executable file format, PE header and sections, The Windows loader, Windows API, Import Address Table, Import functions, Export functions, System architecture, processes, threads, memory management, registry, PE files on disk and in memory. **Basic static analysis:** Introducing concepts and tools for basic static analysis: hash functions, VirusTotal, strings, PEiD, PE Explorer, CFF Explorer, and Resource Hacker, Identifying file obfuscation techniques: packers and cryptors, Introduction to Yara. **Basic dynamic analysis:** Introducing concepts and tools for basic dynamic analysis: Sysinternals tools, sandboxes. Persistence techniques. **Network analysis:** Faking a network for safe malware analysis. Introduction to Wireshark. Command and Control communication of malware. **Advanced analysis:** Introduction to x86 architecture, Memory, instructions, opcodes, operands, registers, functions, stack. The difference between source code and compiled code. Examining simple examples using different compilers. Introduction to disassemblers and decompilers. Static code analysis with IDA/Ghidra. Obfuscation techniques. Introduction to debuggers. Dynamic analysis with OllyDbg. Process injection techniques and

hooking. User mode and kernel mode debugging. **Ransomware analysis:** Cryptographic algorithms used by ransomware. Cryptographic flaws in ransomware. **Analysis of malicious documents:** File formats: OLE2, OOXML, RTF and PDF. Malicious macro. Document exploits, e.g., exploit example for Equation editor vulnerability (CVE-2017-11882). Introduction to oletools. **Defeat malware:** Examples of how to use the information we got during malware analysis to defend against malware attacks. Threat Intelligence, IOCs. Security solutions. Open-source tools: Yara, Snort/Suricata.

Lab Outline

- Setting up a Safe Environment for Malware Analysis
    - Creating a virtual machine for malware analysis
    - Configuring network settings and isolating the environment
    - Installing essential tools and software for analysis
- Analyzing Malicious Windows Programs
    - Understanding the Portable Executable (PE) file format
    - Analyzing PE headers, sections, and import/export functions
    - Exploring Windows API and system architecture
    - Analyzing PE files on disk and in memory
- Basic Static Analysis
    - Using hash functions and VirusTotal for file analysis
    - Extracting strings and identifying file obfuscation techniques
    - Exploring tools like PEiD, PE Explorer, CFF Explorer, and Resource Hacker
    - Introduction to Yara for signature-based malware detection
- Basic Dynamic Analysis
    - Utilizing Sysinternals tools for dynamic analysis
    - Setting up and working with sandboxes for observing malware behavior
    - Analyzing persistence techniques employed by malware
- Network Analysis
    - Creating a simulated network environment for safe analysis
    - Introduction to Wireshark for capturing and analyzing network traffic
    - Analyzing Command and Control (C2) communication of malware
- Advanced Analysis
    - Understanding x86 architecture, instructions, and registers
    - Examining simple examples using different compilers
    - Introduction to disassemblers and decompilers (IDA/Ghidra)
    - Exploring obfuscation techniques and code analysis
- Dynamic Analysis with Debuggers
    - Introduction to debuggers like OllyDbg
    - Analyzing process injection techniques and hooking
    - Debugging in user mode and kernel mode
- Ransomware Analysis
    - Analyzing cryptographic algorithms used by ransomware
    - Identifying cryptographic flaws in ransomware
    - Exploring ransomware samples and their behavior
- Analysis of Malicious Documents
    - Understanding file formats: OLE2, OOXML, RTF, and PDF

- Analyzing malicious macros and document exploits
- Introduction to tools like oletools for document analysis

- Defeating Malware
  - Leveraging information obtained from malware analysis for defense
  - Introduction to threat intelligence and Indicators of Compromise (IOCs)
  - Exploring security solutions and open-source tools (Yara, Snort/Suricata)

Recommended Books

1. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software. Author(s): Michael Sikorski, Andrew Honig
2. Michael Sikorski and Andrew Honig: Practical Malware Analysis, The Hands-On Guide to Dissecting Malicious Software. No Starch Press. ISBN: 978-1-593-27290-6
3. Monnappa K A: Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware. Packt Publishing. ISBN: 978-1788392501
4. Michael Hale Ligh, Steven Adair, Blake Hartstein and Matthew Richard: Malware Analyst's Cookbook and DVD: Tools and Techniques for Fighting Malicious Code. Wiley. ISBN: 978-0-470-61303-0
5. Chris Eagle: The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler Second Edition. No Starch Press. ISBN: 978-1-59327-289-0
6. Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware. Author(s): Monnappa K A

Course Content

8.27 Professional Practices

CODE & TITLE (ISH-351) Professional Practices		CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Humanities and Social Sciences-VI
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the basic understanding of a profession, professional ethics, various moral and social issues, importance of values and professional ethics in personal life and professional career, and consequences of acting unethically in organization and society.	C-1	PLO-7
CLO-2	**Acquire** knowledge of various roles of engineering technologist in applying ethical principles at various professional levels.	A-3	PLO-6
CLO-3	**Resolve** the ethical dilemmas using common ethical values and identify possible actions to be taken in response.	A-5	PLO-7

Course Outline for Theory

Introduction: Introduction to ethics, personal and professional ethics, the nature of engineering ethics; legal, professional and historical definitions; origin of professional ethics, profession and professionalism; professional accountability, professional success, professional risks, professional associations; benefits of acting ethically and consequences of acting unethically. Value of Ethics: Values in professional ethics, central responsibility of engineering professionals, ethics in different fields of work, IEEE code of ethics, ethical code for engineering professionals, global issues in professional ethics, ethics in manufacturing and marketing, intellectual property rights, business ethics and corporate governance. Ethical Dilemmas: Common ethical dilemmas, resolution of ethical dilemmas, possible actions in response to dilemmas, probable consequences of these actions.

Recommended Books

1. Engineering Ethics Concepts & Cases by Charles E Harris, 5th Edition, Cengage 2014, (or Latest Edition)
2. Kenneth Blanchard, Professional Ethics, 4th Edition (or Latest Edition)
3. Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005. (or Latest Edition)
4. The Seven Habits of Highly effective people by Stephan r. Covey (Latest Edition)
5. Engineering Ethics: Concepts and Cases, 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008 (or Latest Edition)
6. Professional Ethics: R. Subramanian, Oxford University Press, 2015. (or Latest Edition)
7. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015. (or Latest Edition)

Course Content

8.28 Organizational Behavior / Management Elective-I

CODE & TITLE (ISM-351) **Organizational Behavior**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Management Sciences-I**	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** the field of organizational behaviour and the impact of organizational culture on individuals and the workplace.		A-1	PLO-9
CLO-2	**Explain** group dynamics within organizations, impact of diversity on the workplace, and strategies to manage groups and teams.		A-3	PLO-11
CLO-3	**Discuss** theories of motivations, importance of managing stress and emotions, and strategies to manage change and improve motivation in the workplace.		A-2	PLO-9

Course Outline for Theory

Overview; Introduction to the field of organizational behaviour; motivation; Individual and group behaviour; Personality and values; Perceiving ourselves and others in organizations; Workplace emotions; Attitudes; and stress foundations of employee motivation; Applied performance practices; Decision making and creativity; Team dynamics; Communicating in organizations; Power and politics in the workplace; Conflict and negotiation in the workplace; Leadership in organizational settings; Designing organizational structure; Organizational culture; Organizational change and development.

Recommended Books

1. Canadian Organizational Behavior McShane, Steven L. & Sheen, Sandra L. McGraw Hill Ryerson, (Latest Edition)
2. Organizational Behavior, by Robbins & Judge, Prentice-Hall Publishing, (Latest Edition)
3. Luthan Fred, Organizational Behaviour, McGraw Hill Inc, (Latest Edition)
4. Robins, Stephen, Organizational Behaviour, McGraw Hill Inc. (Latest Edition)
5. Finchan, R., & Rhodes, P. Principles of Organizational Behaviour, Oxford Press (Latest Edition)

Course Content

8.29 Technopreneurship / Management Elective-II

CODE & TITLE (ISM-361) Management Elective-II	CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Management Sciences-II	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the understanding of entrepreneurship concept as a whole and the role of entrepreneurship in economic development.	C-2	PLO-1
CLO-2	**Compare** the role and importance of the small and medium sized enterprises in the economy.	C-3	PLO-1
CLO-3	**Apply** the ability to find an attractive market and apply the understanding of business planning concept for new business creation and growth.	C-3	PLO-2

Course Outline for Theory

The concept of entrepreneurship, the economic view of entrepreneurship, the sociologist view, Behavioral approach, Entrepreneurship and Management. The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, the new venture. The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, the innovation process, Risks involved in innovation. Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, the environment, Socio cultural factors, Support systems. Teamwork, Networking organization, Motivation and compensation, Value system. Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs, Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design, Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience, Case Studies of Successful Entrepreneurs

Recommended Books

1. Technology Ventures: From Idea to Enterprise by Thomas Byers, Richard Dorf, Andrew Nelson, 4th Edition, McGraw Hill 2015, (or Latest edition)
2. Paul Burns and Jim Dew Hurst: "Small Business and Entrepreneurship", 1996, Palgrave Macmillan Publishing Company, Second Edition (or Latest edition)
3. Peter F. Drucker: "Innovation and Entrepreneurship", 2006, Harper Business, Reprint Edition (or Latest edition)
4. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank, Bob Dorf, K & S Ranch 2012, (or Latest edition)
5. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Penguin Books 2011, (or Latest edition)

Course Content

8.30 Depth Elective – III / Wireless Networks Security

CODE & TITLE (IST-361) Depth Elective - III		CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth –III
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Comprehend** the main security goals and adversarial models of wireless and mobile networks.	C-2	PLO-1
CLO-2	**Discuss** wireless security protocols and protection techniques, proposed solutions and their limitations.	C-2	PLO-1
CLO-4	**Analyze** common security vulnerabilities and the defenses used to protect network resources.	C-4	PLO-2
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** wireless communication protocols knowledge to secure wireless networks.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			

Wireless Communication: Wireless Network Overview, Wireless Channel, Signal Propagation, Signal-to-Noise Ratio, Unintentional and Intention Interference. **Risks and Threats of Wireless:** Wireless Security Objectives, Passive and Active Threat Model, Cryptography Primer, Performance vs. Security Tradeoffs, Wireless Security Toolbox. **Wireless Physical Layer Technologies:** Anti-jamming/Jamming-resistance, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Orthogonal Frequency Division Multiplexing (OFDM). **Security of Wi-Fi Networks:** IEEE 802.11 Architecture and Protocols, Control and Management Frames, Rogue Access Points, WEP, IEEE 802.11i, IEEE 802.11w, Selfish behaviour at the WLAN MAC Layer. **Security of Cellular Networks:** GSM and UMTS Network Structure and Architectures, GSM and UMTS Authentication and Confidentiality, Overview of Attacks and Countermeasures, Beyond 3G. **Security of Wireless Sensor Networks (WSNs):** WSN Architectures and Protocols, Security Threats, Cryptographic Primitives, Key Establishment and Distribution, Security of ZigBee WSNs, Security of Wireless Medical Devices, Future Trends. **Security of Near Field Communications (NFCs) and RFIDs:** Introduction to NFC and RFID Technologies, Tags and Readers, Security and Privacy Issues, Real-World Attacks, Standardization Activities, Authentication and Access Control Protocols. **Advanced Topics:** Emerging Wireless Technologies, Device Pairing, Secure Localization and Positioning, Broadcast Authentication.

Recommended Books
1. Network Security Fundamentals by GertDeLaetand GertSchauwers, Cisco Press; 1st Edition (September 18, 2004). ISBN-10: 1587051672 2. R. Nichols and P. C. Lekkas, Wireless Security: Models, Threats and Solutions., McGraw-Hill Telecom, 2006 3. Security in Fixed and Wireless Networks: Guenter Schaefer, Michael Rossberg, Wiley, 2nd Edition, 2016 4. Network Security Bible by Eric Cole, Wiley; 2nd Edition (September 8, 2009). ISBN-10: 0470502495 5. Hacking Exposed 7: Network Security Secrets & Solutions, Seventh Edition by Stuart McClure, Joel Scambray and George Kurtz, McGraw-Hill Osborne Media; 7th Edition (2012). ISBN-10: 0071780289

Course Content

8.31 Digital Forensics and Laws

CODE & TITLE (IST-362) Digital Forensics and Laws		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Breadth –VI	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** how forensic science is applied to the cyber realm.		C-2	PLO-1
CLO-2	**Describe** sources of digital evidence.		C-2	PLO-1
CLO-3	**Develop** custom scripts and programs to perform automated forensic analysis.		C-5	PLO-3
Lab : CLOs and its Mapping to PLOs				
CLO-4	**Apply** digital forensics knowledge to collect, preserve, analyze the digital evidence.		P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.		A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.		P-5	PLO-10
Course Outline for Theory				

Cyber Security Laws in Pakistan: Overview of cyber security and electronic crimes, Evolution of cyber security laws in Pakistan, **Historical Timeline: 2002:** The Electronic Transactions Ordinance (ETO) was enacted, providing legal sanctity and security for the local e-commerce sector, **2007:** The Prevention of Electronic Crimes or Cybercrimes Ordinance (PECO) was introduced to address the deficiencies observed in the ETO 2002 regarding cybercrime, **2016:** The National Assembly enacted the Prevention of Electronic Crimes Act (PECA), which provided a comprehensive legal framework to define various kinds of electronic crimes, mechanisms for investigation, prosecution, and adjudication, **Scope and Applicability of PECA 2016:** Understanding the legal framework and provisions of PECA 2016**,** Jurisdiction and extraterritorial application of the act**,** Entities and individuals covered under PECA 2016**,** Cyber Crimes and Offenses under PECA 2016**,** Unauthorized access and data theft**,** Hacking, phishing, and identity theft**,** Cyber stalking, harassment, and blackmail**,** Defamation, hate speech, and incitement to violence**, Electronic Evidence and Investigation:** Collection, preservation, and admissibility of electronic evidence**,** Forensic techniques and tools for digital investigations**,** Role of law enforcement agencies in cybercrime investigations**, Prosecution and Trial of Cyber Crimes:** Procedures for filing complaints and registering cases**,** Rights of the accused and due process considerations**,** Challenges in prosecuting cybercrimes**, Rights, Responsibilities, and Liabilities:** Privacy, data protection, and information security obligations**,** Responsibilities and liabilities of service providers**,** Intermediary liability and safe harbor provisions, **Enforcement Mechanisms and Stakeholder Roles:** Role of

judiciary in adjudicating cybercrime cases**,** Cooperation and coordination among law enforcement agencies**,** Role of other stakeholders, such as ISPs, CERTs, and industry associations, **Practical Applications and Case Studies:** Analyzing and applying PECA 2016 to real-world scenarios, Case studies on cybercrime investigations and prosecutions, Interactive exercises to develop practical skills

Lab Outlines

Overview of digital forensics and its applications, Legal and ethical considerations in digital investigations, Introduction to forensic tools and techniques, **Digital Device Analysis:** Analyzing different types of digital devices (computers, smartphones, tablets, etc.), Acquiring and preserving digital evidence from devices, Data extraction techniques and tools, **Event Reconstruction and Analysis:** Determining if an event recorded is related to a specific incident (e.g., a crash), Techniques for event reconstruction and analysis, Identifying user patterns and behavior analysis, **Computer Forensic Techniques:** File system analysis and recovery, Recovering deleted files and artifacts, Network forensic analysis and intrusion detection, **Mobile Phone Forensic Techniques:** Mobile device architecture and file systems, Recovering data from mobile devices, Extracting and analyzing call logs, messages, and application data, **CDR Analysis:** Understanding Call Detail Records (CDRs), Analyzing CDRs to identify communication patterns and connections, Utilizing CDRs as evidence in investigations, **Geo Fencing:** Introduction to geo-fencing and its applications in digital forensics, Techniques for geolocation analysis and mapping, Geo-fencing as a tool for establishing proximity and presence, **SIM Forensic Techniques:** Understanding SIM cards and their role in mobile communications, SIM card data extraction and analysis, Recovering SMS, contacts, and other information from SIM cards, **Cybercrime Investigations:** Overview of cybercrime and its impact, Investigating cybercrime incidents, Techniques for collecting digital evidence in cybercrime cases, **CCTV Forensic Analysis:** Introduction to CCTV systems and their role in investigations, Analyzing CCTV footage for evidence, Techniques for enhancing, analyzing, and interpreting CCTV footage, **Case Studies and Practical Exercises:** Applying digital forensics techniques to real-world scenarios, Hands-on exercises in data extraction, analysis, and evidence creation, Analyzing case studies related to digital forensics investigations

Recommended Books

1. The Basics of Digital Forensics - John Sammons (Latest Edition)
2. Digital Forensics Basics: A Practical Guide using Windows OS – Nihad A. Hassan (Latest Edition)
3. C. Altheide& H. Carvey Digital Forensics with Open-Source Tools, Syngress, 2011. ISBN: 9781597495868.
4. The Cuckoo’s Egg: Tracking a Spy Through the Maze of Computer Espionage, Cliff Stoll, ISBN: 1416507787
5. Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, 3rd Edition, Eoghan Casey, Publisher: Academic Press, ISBN: 9780123742681

Course Content

8.32 IT Security Audit and Evaluation

CODE & TITLE (IST-363) IT Security Evaluation and Audit		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth –IV
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Identify** and assess security risks and vulnerabilities in IT systems and networks.	C-4	PLO-2
CLO-2	**Apply** audit methodologies and standards to conduct comprehensive IT security assessments.	C-3	PLO-3
CLO-3	**Evaluate** the effectiveness of security controls and compliance with regulatory requirements.	C-4	PLO-4
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** IT Security knowledge to evaluate network systems and servers.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10

Course Outline for Theory

Understanding of the principles and practices involved in auditing and evaluating IT security systems. Risk assessment, vulnerability assessment, and security controls evaluation. Students will learn about the frameworks, standards, and methodologies used in IT security auditing, such as ISO 27001, NIST Cybersecurity Framework, and COBIT. Various types of security audits, including network security audits, application security audits, and cloud security audits. Students will gain hands-on experience through practical exercises and case studies to conduct security audits, identify vulnerabilities, and assess the effectiveness of security controls. Security metrics, compliance monitoring, and incident response evaluation. By the end of the course, students will have the knowledge and skills to plan, execute, and report on IT security audits, enabling them to assess and improve the security posture of organizations and mitigate security risks effectively.

Recommended Books

1. "Information Technology Control and Audit" by Sandra Senft and Frederick Gallegos: Latest Edition
2. "The Basics of IT Audit: Purposes, Processes, and Practical Information" by Stephen D. Gantz and Daniel P. Likarish: Latest Edition
3. "IT Auditing: Using Controls to Protect Information Assets" by Chris Davis, Mike Schiller, and Kevin Wheeler: Latest Edition

Course Content

8.33 IDTE-I / Renewable Energy

CODE & TITLE (ISI-361) Renewable Energy Technology		CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Inter Disciplinary Technology Elective-I
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Demonstrate** the fundamental characteristics of different renewable energy sources and mechanism to harness these technologies.	C-3	PLO-1
CLO-2	**Compare** the traditional energy sources and renewable energy sources to analyze their impact on the environment and the society.	C-4	PLO-6
CLO-3	**Operate** equipment and practice the design the characteristics of various renewable source configurations.	P-3	PLO-4
CLO-4	**Express** the observations during a power plant visit and write a comprehensive report.	A-3	PLO-8

Course Outline for Theory

Introduction to Renewable Energy Systems: Worldwide Energy Scenario, Types of Renewable Energy Technologies, Classifications of wind and solar systems, best locations for Solar and wind Energy systems. Designing of Wind and Solar Energy systems, Weibull probability distribution and TSR Speed-Power relations and designing of blades, Power vs speed Blade designing. Designing of Solar System Designing of parameters for maximum efficiency of solar systems, Types of solar cells and losses, Design of parameters for a high efficiency solar cell, Heterojunction, thin films and other promising solar cells. Costing of Renewable Energy Systems, Capital cost of system, Payback period, Maintenance Cost. Grid Connected Systems: Exploitation of Alternate energy sources, Review of present energy state of energy sector, Different sources of energy, Components of power systems, Energy crises. Problems in energy sector: WAPDA's Plan, Short term and long-term measures. Distributed generation Resources and their economics: Fossil fuels, Tidal, Ideal and practical values, Demand charges, Electricity utility rates

Lab Outlines

Learn the use of basic renewable energy gadgets. Study the various concepts and characteristics of renewable energy sources. Visit a thermal/solar or nuclear power plant

Recommended Books

1. Efstathios E. Stathis Michaelides 'Alternative Energy Sources' (Latest edition)
2. Bent Sorensen , " Renewable Energy ", (Latest edition)
3. Aldo Vieira Da Rosa , " Fundamental of Renewable Energy Process ", (Latest edition)
4. Bent Sorensen, " Renewable Energy Conversion, Transmission, and Storage ", (Latest edition)

Course Content

8.34 Project Part-I

CODE & TITLE (IST-364) **Project Part-I**		CREDIT & CONTACT HOURS (0+3) **0 Theory + 144 Lab**	KNOWLEDGE AREA/ DOMAIN **Senior Design Project**	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** and Identify background knowledge of engineering fundamentals in proposed idea and compare with previous related.		C-3	PLO-1
CLO-2	**Analyze** the problem statement through research and literature review.		C-4	PLO-2
CLO-3	**Defend** the impact of proposed idea in societal and environmental contexts and demonstrate knowledge of sustainable development.		C-5	PLO-10
CLO-4	**Develop** a wide range of technical skills by delivering a working prototype using latest design tools that has passed through the design, implementation, testing and evaluation stages.		C-6	PLO-3
CLO-5	**Integrate** the solution of Complex Engineering problem for improvement of Society or Environment.		A-4	PLO-7
CLO-6	**Practice** various methods to avoid Plagiarism in reports to adapt ethical values.		A-5	PLO-7
CLO-7	**Organize** effectiveness as an individual and in a teamwork management.		A-4	PLO-8
CLO-8	**Display** their communication skills through presentations, technical reports, and posters.		A-5	PLO-9
CLO-9	**Display** the results of hardware components testing which could be used for SDP.		P-5	PLO-5

Course Content

8.35 Health, Safety and the Environment

CODE & TITLE (ISH-471) Health, Safety and the Environment		CREDIT & CONTACT HOURS (1+0) 16 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Humanities and Social Sciences-VII	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** that safety standards must be maintained in compliance with regulatory requirements and within engineering limits.		C-2	PLO-1
CLO-2	**Demonstrate** an understanding of workplace injury prevention, risk management and incident investigations.		C2	PLO-1
CLO-3	**Understand** the acute and chronic health effects of exposures to chemical, physical and biological agents in the workplace.		C2	PLO-1
CLO-4	**Understand** the policies, procedures and equipment needed to deal with hazardous materials.		C3	PLO-1

Course Outline for Theory

Safety Management & Hazard Communication: Understanding safety, hazards and accidents, company policy and management responsibilities, professional certification and societies (NIOSH, NEBOSH, IOSH,OSHA), MSDS (Material Safety Data Sheet). **Accident Prevention & Control:** Accident causes & their control, recordkeeping and forms, accident cause analysis, safety & health economics, trainings, concept of hazard avoidance (FMEA, Fault Tree Analysis). **Building & Facilities:** Walking & working surfaces, exits, illumination, sanitation, miscellaneous facilities (scaffolding, elevators, boilers etc.), fire protection. **Ergonomics & Safety:** Facets of Ergonomics, workplace musculoskeletal disorders, ergonomics standards and risk analysis, NIOSH lifting equation. **Health, Toxic & Environment:** Toxic substances, measures of exposure, detecting contaminants, ventilation, noise and radiation, flammable and explosive materials. **Personal Protective Equipment & First Aid:** Protection need assessment, PPE Training; hearing, eye and face respiratory protection, confined spaces, first aid. Material handling and storage, machine guarding, welding, electrical hazards, construction hazards. **Operations Occupational Safety:** Power plant operations (preventing steam/condensate system accidents), safe operations at chemical plants, offshore drilling hazards. Boiler safety & accidents control.

Recommended Books

1. Industrial Safety and Health Management by C Ray Asfahl, David W. Rieske
2. Safety at Works by J. Ridley and J. Channing
3. Introduction to Health and Safety at Work by E. Ferrett and P. Hughes

Course Content

8.36 Depth Elective – IV / Machine Learning

CODE & TITLE (IST-471) Machine Learning		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective-IV
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Apply** supervised and unsupervised learning techniques to solve classification problems of moderate complexity.	C-3	PLO-1
CLO-2	**Apply** reinforcement learning algorithms to environments with complex dynamics.	C-3	PLO-2
CLO-3	**Develop** a reasonable size project using suitable machine learning technique.	C-6	PLO-3
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** concept of learning to solve classification problems of moderate complexity.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10
Course Outline for Theory			
Introduction to machine learning; concept learning: General-to-specific ordering of hypotheses, Version spaces Algorithm, Candidate elimination algorithm; Supervised Learning: decision trees, Naive Bayes, Artificial Neural Networks, Support Vector Machines, Overfitting, noisy data, and pruning, Measuring Classifier Accuracy; Linear and Logistic regression; Unsupervised Learning: Hierarchical Aglomerative Clustering. k-means partitional clustering; Self-Organizing Maps (SOM) k-Nearest-neighbor algorithm; Semisupervised learning with EM using labeled and unlabled data; Reinforcement Learning: Hidden Markov models, Monte Carlo inference Exploration vs. Exploitation Trade-off, Markov Decision Processes; Ensemble Learning: Using committees of multiple hypotheses. Bagging, boosting.			
Recommended Books			
1. Machine Learning, Tom, M., McGraw Hill, 1997 2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, MIT Press,2012			

Course Content

8.37 Depth Elective – V / Vulnerability Assessment & Reverse Engineering

CODE & TITLE (IST-472) Vulnerability Assessment & Reverse Engineering	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective-V	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** concepts of Hacking and Ethical Hacking.	C-2	PLO-1
CLO-2	**Apply** techniques for vulnerability assessment and penetration testing.	C-3	PLO-2
CLO-3	**Understand** Software vulnerabilities, Network vulnerabilities, Types of Malwares and its Analysis.	C-2	PLO-1
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** concept of security vulnerabilities to perform Malware analysis.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10

Course Outline for Theory

Understanding the need for security assessments; Classifying vulnerabilities; Software vulnerabilities; Network vulnerabilities; Vulnerability assessment versus penetration testing; Vulnerability Assessment Tools; Vulnerability management Regulatory compliance; Calculating ROIs; Application review process; Pre-assessment; Code navigation; Code auditing tactics; Memory corruption; understanding issues in programming languages; Steps in Reverse engineering, Common tools used for Reverse engineering; Binary Obfuscation techniques; core assembly concepts to perform malicious code analysis, Identifying key assembly logic structures with a disassembler, Malware analysis Types of malware analysis; Malware Taxonomy; Static analysis; Dynamic analysis; Malware Inspection; Malware analysis tools; Sandboxing and virtualization

Recommended Books

1. Finding and Fixing Vulnerabilities in Information Systems: The Vulnerability Assessment and Mitigation Methodology by Philip S. Anton
2. The Art of Software Security Assessment: Identifying and Preventing Software Vulnerabilities by Mark Dowd
3. Reversing: Secrets of Reverse Engineering by Eldad Eilam (latest edition)

4. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software by Michael Sikorski (latest edition)

Course Content

8.38 Ethical Hacking and Penetration Testing

CODE & TITLE (IST-473) **Ethical Hacking and Penetration Testing**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth-VII**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Analyze** the activities required to compromise a target system during an ethical hacking attack.	C-4	PLO-2
CLO-2	**Demonstrate** systematic understanding of digital forensic process and its linkage with ethical hacking.	C-4	PLO-3
CLO-3	**Classify** tools and techniques to carry out a penetration testing.	C-2	PLO-1
Lab : CLOs and its Mapping to PLOs			
CLO-4	**Apply** tools for scanning and Vulnerability Assessment.	P-5	PLO-5
CLO-5	**Work** effectively as an individual or in a group while performing laboratory experiments.	A-3	PLO-9
CLO-6	**Communicate** effectively both in oral description and written reports about each experiment.	P-5	PLO-10

Course Outline for Theory

The aim of this course is to learn how to determine potential online criminal activity at its inception, legally gather evidence, search and investigate wireless attacks. Students understand ethical approaches of operating with technology to search out weaknesses of a system taking it to future level for more development. The course discusses interactive setting wherever the students can learn the aptitudes of activity vulnerability assessment, pen-testing of systems and networks, repairing the weaknesses, creating reports of scanned vulnerabilities.

Recommended Books

1. Stuart McClure, Joel Scambray and Goerge Kurtz, "Hacking Exposed Network Security Secrets & Solutions", Tata McGraw hill Publishers, 2012
2. Android Forensics: Investigation, Analysis and Mobile Security for Google Android", by Andrew Hoog,1597496529, 9781597496520, Elsevier, 2011 2012

Course Content

8.39 IDTE-II / Bioinformatics

CODE & TITLE (ISI-471) IDTE-I/ Bioinformatics		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Inter Disciplinary Technology Elective-II
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Discuss** fundamentals of Genomics and Transcriptomics with respect to bioinformatics.	C-1	PLO-1
CLO-2	**Describe** the structure, classification, and functions of proteins and DNA.	C-2	PLO-2
CLO-3	**Compare** protein sequences.	C-4	PLO-1
CLO-4	**Carryout** research to retrieve DNA and protein sequences.	C-3	PLO-4

Course Outline for Theory

History and evolution of bioinformatics: Introduction to databases (Database types, Database formats, DNA databases, European Molecular Biology Laboratory (EMBL), Genomics, Transcriptomics, Computational proteomics. **Pairwise Sequence Alignment:** Evolutionary Basis, Sequence Homology versus Sequence Similarity, Sequence Similarity versus Sequence Identity. **Database Similarity Searching:** Unique Requirements of Database Searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST. **GenBank and DNA Data base of Japan (DDBJ):** Protein information Resource (PIR) formats, Protein Sequence (databases, SwissProt, UniProt, UniProtKB/TrEMBL), Structural databases (Protein Databank (PDB), Structural Classification of Proteins (SCOP) database: Class: Architecture: Topology: Homology (CATH) database)

Recommended Books

1. Introduction to Bioinformatics, Arthur M. Lesk, 4th Edition, Oxford University Press, ISBN 0198724675, 9780198724674 (Latest Edition)
2. Bioinformatics and Functional Genomics, Jonathan Pevsner, Wiley, ISBN 0470085851, 9780470085851 (Latest Edition)

Course Content

8.40 Project Part-II

CODE & TITLE (IST-474) **Project Part-II**		CREDIT & CONTACT HOURS (0+3) **0 Theory + 144 Lab**	KNOWLEDGE AREA/ DOMAIN **Senior Design Project**	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Devise** an experimentally verified system which can solve a Broadly Define Engineering Technology Problem.		C6	PLO-3
CLO-2	**Implement** proposed design using modern technology for solution of Broadly Define Engineering Technology Problem.		C3	PLO-5
CLO-3	**Investigate** and analyze the results obtain from the implemented design.		C4	PLO-4
CLO-4	**Practice** ethical principles (Plagiarism in particular) and engineering norms.		A5	PLO-7
CLO-5	**Display** effectiveness as an individual and in a teamwork management.		A4	PLO-8
CLO-6	**Display** their communication skills through presentations, technical reports, and posters.		A5	PLO-9
CLO-7	**Demonstrate** management skills as a member and/or leader to manage the project.		A4	PLO-10
CLO-8	**Alter/Revise** the conventional solutions by adapting modern technology.		P6	PLO-11

Course Content

8.41 Engineering Economics

CODE & TITLE (ISS-352) Engineering Economics	CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Social Science Elective	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Estimate** the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value.	C-2	PLO-10
CLO-2	**Predict** the cost effectiveness of individual projects using the methods learnt and the effects of inflation on economic analysis of engineering projects.	C-3	PLO-6
CLO-3	**Analyze** the appropriate engineering economics analysis method(s) for problem solving i.e., present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio.	C-4	PLO-10

Course Outline for Theory

Basic concepts, technological economy defined Types of Business organizations, financial statements and financial ratios, Time value of money, cash flow series and its types, basic cost concepts. Profit and interest, discrete and continuous compounding, nominal, and effective interest rate. Economic analysis of alternatives, Alternatives having identical lives, Alternatives having different lives, PW, AW, FW, Cost-benefit analysis and rate of return analysis, Break-even and payback analysis. Use of spreadsheets for economic analysis, economic effects of inflation. Replacement and retention decisions Depreciation, amortization, and depletion of economic resources. Price, Supply and Demand Relationship. Project financing. Factors of production, Capital budgeting, economic analysis in the service sector.

Recommended Books

1. Technological Economics by Shoubo Xu (Springer), (Latest Edition)
2. Engineering Economy, Latest Edition, Leland T. Blank and Anthony J. Tarquin, McGraw Hill, (Latest Edition)
3. Contemporary Engineering Economics, Latest edition, Chan S Part Pearson Prentice Hall (Latest Edition)
4. Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, 12th edition, Oxford University Press, (or Latest Edition)

Course Content

8.42 Project Management

CODE & TITLE (ISM-352) **Project Management**		CREDIT & CONTACT HOURS (3 Th + 0 Lab) **48 Th + 0 Lab**	KNOWLEDGE AREA/DOMAIN **Management Science Elective**
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Describe** and understand the basic concepts of management with a special focus on project management.	A1	PLO-10
CLO-2	**Demonstrate** competency in various project management knowledge areas, project scheduling and controlling techniques including Critical Path Method and Earned Value Management.	A3	PLO-10
CLO-3	**Use** computers in Project Management, especially a tool like MS Project & Primavera etc.	C3	PLO-5

Course Outline

Introduction to Management: History of management, functions and functional areas of management, levels of management, managerial skills, types of organizations, managerial control, principles of management. Introduction to Project Management: Definition of Project and Project Management, knowledge areas of project management, project life cycle, project characteristics, project constraints, project organization structure. Project Quality Management: History of Quality Management, defining quality, relationship between project management and quality management, Quality Management Frameworks.

Project Stakeholder Management: The roles of project manager and project sponsor, project team selection, skills, and competencies of project manager, building and managing successful project teams, stakeholder management .Project Cost Estimating and Budgeting: Cost components and methods for cost estimation in projects, cost control in projects, life cycle cost, cost scheduling and forecasting, project resource allocation and levelling, estimation of outstanding work, elements of budgets and estimates, earned value management.

Project Risk Management: Defining risk and uncertainty, business and project risk, probability and impact of risk, risk management process. Project Time Management: Introduction to project scheduling, Critical Path Method, network representation of projects, critical activities, and critical path, project Gantt Chart. Project Closure: Project evaluation, project and project management success, success criteria for projects, project audits, project termination process. Project Management Tools: Introduction and use of project management tools like MS Project and Primavera.

Recommended Books
1. Project Management: A System Approach to Planning Scheduling and Controlling by Harold Kerzner, 11th edition, John Willey 2013, (or Latest edition) 2. Project Management: A managerial approach 7th edition, Jack R. Meredith and Samuel J. Mantel, Jr. John Wiley and Sons, Inc. Project Management for Business, (or Latest edition) 3. Project Management for Engineering and Technology: Principles and Practice 3rd Edition, by John M. Nicholas and Herman Steyn, Elsevier Publications (or Latest edition) 4. Project Management: A Strategic Planning Approach by Paul Gardiner, 2nd Edition, Palgrave Macmillan, 2017, (or Latest edition)

Course Content

8.43 Marketing Management

CODE & TITLE (ISM-362) Marketing Management		CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Management Science Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** marketing philosophies and marketing environment.		C-2	PLO-1
CLO-2	**Apply** marketing mix techniques to manage business efficiently and effectively.		C-3	PLO-12

Course Outline for Theory

Introduction to Marketing: What is Marketing, understanding marketplace and customer needs, Customer strategy, preparing marketing plan and capturing customer value, changing landscape of marketing. Marketing effort. **Understanding Market and Customer:** Microenvironment, Macro environment, developing marketing information, research, analysing and using market information, Models of Consumer Behaviour, Factors Influencing Consumer, Decision, Consumer Buying Process. **Making Product the Brand- creating value:** What is product, Service and Experience, Product line and Product classification and Branding Strategy, product life cycle and new product development process? **Pricing** – understanding and capturing value: What is price, pricing strategies, new product pricing strategy, strategy and price adjustment strategy? **Marketing Channel** – delivering customer value: Supply chain and value delivery network, Types of channels, retailing and whole selling. **Promotion** – Communicating customer value: The promotion mix, integrated marketing communication, communication, socially responsible communication, advertising and public relations, personal selling and personal and sales promotion. **Creating Competitive Advantage:** Competitor analysis whom to attack and avoid and competitive strategies

Recommended Books

1. Principles of Marketing, Philip Kotler, Gary Armstrong, John Saunders and Veronica, (Latest Edition)
2. Marketing: Principles and Strategies Hardcover by Charles D. Schewe, (Latest Edition)

Course Content

8.44 Professional Psychology and Human Behavior

CODE & TITLE (ISS-353) Professional Psychology and Human Behavior	CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Social Science Elective	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the complexity of human behavior and relationships.	C-2	PLO-1
CLO-2	**Comprehend** psychology as science and empirical methods used for understanding different aspects of human behaviour.	C-2	PLO-4
CLO-3	**Apply** the skills in research and evaluation within a scientific framework to interact with different professionals and do an effective communicate information in both verbal and non-verbal way.	C-3	PLO-10

Course Outline for Theory

Understanding Psychology: Scientific perspective of Psychology; Historical perspective; Schools of psychology; Methods of psychology; Ethical issues; Fields of psychology and their application; Biological Basis of Behaviour: Neuron and its function; Central nervous system; Peripheral nervous system; Endocrine system; Sensation and Perception: Senses: Vision; audition; smell; taste and kinesthetics; introduction to perception; Kinds of Perception; Gestalt principles; Binocular and monocular cues; Illusions and extra sensory perception; Learning: Definition of learning; Types of learning: Classical and operant conditioning; Punishment and its effects; Latent and observational learning; Memory: Definition and types of memory; Processes and techniques of improving memory; forgetting: Nature and causes; Cognition and Language: Concept of cognition; Problem solving; Judgment and decision making; Language development; Language and cognition; Language and culture; Intelligence and Creativity: Concept of intelligence; Theories of intelligence; Assessment of intelligence Mental retardation; Concept of creativity and its stages; Motivation and Emotion: Introduction to motivation; Factors affecting motivation; Introduction to emotions; Types of emotions; Physiological changes during Emotions (Neural; Cardiac; Visceral; Glandular); Theories of emotion; Social Thinking and Social Influence: Definition and nature of thinking; Tools of thinking; kinds of thinking; Social facilitation; Attribution theory; Crowd behaviour; Conformity; Obedience; Helping behavior

Recommended Books

1. Atkinson R. C., & Smith E. E. Introduction to psychology(13thed.). Harcourt Brace College Publishers, (Latest Edition)

2. Fernald,L.D.,& Fernald,P.S. Introduction to psychology. USA: WMC Brown Publishers, (Latest Edition)
3. Glassman, W. E. Approaches to psychology. Open University Press (Latest Edition)
4. Hayes, N. Foundation of psychology Thomson Learning. Lahey, B. B. Psychology: An introduction McGraw-Hill Companies, Inc. (Latest Edition)
5. Coon, D., &Mutterer, J. Introduction to psychology: Gateways to mind and behavior Wadsworth Cengage Learning (Latest Edition)
6. Fredrickson, B., Nolen-Hoeksema, S.,Loftus, G., &Wagenaar, W. Atkinson & Hilgard's introduction to psychology USA: Wadsworth (Latest Edition)
7. Kalat, J. W. Introduction to psychology. USA: Cengage Learning, Inc. (Latest Edition)

Course Content

8.45 Critical Thinking

CODE & TITLE (ISS-354) Critical Thinking	CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Social Science Elective	
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Use** critical thinking skills when making business decisions and react with curiosity instead of emotion.	C-1	PLO-12
CLO-2	**Choose** the right techniques to recognize assumptions and draw conclusions.	C-3	PLO-12
CLO-3	**Translate** an abstract idea into something tangible.	P-4	PLO-12

Course Outline for Theory

Understanding Critical Thinking: What is Critical Thinking; Characteristics of a Critical Thinker; Common Critical Thinking Styles Making Connections; Left- and Right-Brain Thinking; and Whole-Brain Thinking; The Critical Thinking Process: The Critical Thinking Model; the Standards of Critical Thinking; Identifying the Issues; Identifying the Arguments; Clarifying the Issues and Arguments; Establishing Context; Checking Credibility and Consistency; Evaluating Arguments; Case Study; Developing Critical Thinking Skills: Asking Questions; Probing Techniques; Pushing My Buttons; Critical Thinking Questions; Active Listening Skills; challenging assumptions; Creating Explanations: Defining Explanations; Steps to Building an Explanation; Making Connections; Creative Thinking Techniques: Brainstorming; imagining the opposite; Mind mapping; DeBono's thinking Hats; Techniques for Thinking Creatively; Creative Thinking Exercise; Presenting and communicating your ideas to others.

Recommended Books

1. Diestler, Sherry. Becoming a Critical Thinker. New Jersey: Prentice Hall, (Latest Edition)
2. Browne, M. Neil, and Stuart M. Keeley. Asking the Right Questions. New Jersey: Prentice Hall, (Latest Edition)

Course Content

8.46 Agriculture Technologies

CODE & TITLE (ISI-362) Agriculture Technologies	CREDIT & CONTACT HOURS (1+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Interdisciplinary Technology Electives	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Discuss** economic and environmental benefits of agriculture technologies.	C-2	PLO-1
CLO-2	**Demonstrate** proper usage of various agriculture hardware technologies.	C-3	PLO-1
CLO-3	**Analyze** data utilizing various agriculture software technologies for decision-making.	C-4	PLO-2

Course Outline for Theory

Agricultural GPS applications, GIS applications in Production agriculture, Agricultural GIS software programs, Remote Sensing applications in agriculture, Soil Variability and Soil Mapping, Sensors for Gathering agriculture data and Information, Types of soil and crop sensors and operating procedures, Yield Monitoring Systems, Crop Health Monitoring, Crop Disease Detection Systems, Plant phenotyping, Robotic platforms for Agri-business, Trends in Agriculture Technology

Recommended Books

1. Introduction To Agricultural Engineering Technology: A Problem-Solving Approach by Field, H. L., & Long, J. M., Fourth Edition, Springer, ISBN: 978-3319696782, 2018 or latest edition

Course Content

8.47 Secure Software Design and Development

CODE & TITLE (IST-353) Secure Software Design and Development	CREDIT & CONTACT HOURS (2+2) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Choose** the resources required by a secure software that benefit most efficiently the expected level of security.	C-2	PLO-1
CLO-2	**Write** misuse and mal-use cases for a multipurpose, commercially viable software.	C-2	PLO-1
CLO-3	**Design** secure software following the principles of software security and security considerations at each stage of software development life cycle.	C-3	PLO-3
CLO-4	**Prepare** the architecture of a secure software by clearly marking its components and component interactions.	C-3	PLO-4

Course Outline for Theory

The process of secure software designing requires thorough understanding of security principles, security standards and security considerations during the whole software development life cycle (SDLC). As this process requires security considerations at each stage of SDLC, after introducing the basic concepts related to software security design, it is discussed, what are the threats/risks at each stage of the design and how they can be mitigated by adequate security mechanisms. Students will be given various assignments at home to study and analyze case studies related to secure software design.

Recommended Books

1. Jan Jürjens, "Secure Systems Development with UML", Springer; 2004
2. Jason Grembi, "Developing Secure Software", CENGAGE Learning, 2008
3. Adam Shostack, "Threat Modeling-Designing for Security", Wiley, 2014
4. Harvey Deitel, Abbey Deitel, "Internet and World Wide Web How to Program (Harvey & Paul) Deitel & Associates" Publisher: Prentice Hall, 2012, 5/E, ISBN-10: 0132151006, ISBN-13: 9780132151009

Course Content

8.48 Software Defined Networks

CODE & TITLE (IST-374) **Software Defined Networks**		CREDIT & CONTACT HOURS (2+1) **32 Theory + 48 Lab**	KNOWLEDGE AREA/ DOMAIN **Depth Elective**	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** the fundamental concepts and principles of Software Defined Networking.		C-2	PLO-1
CLO-2	**Analyze** and evaluate the architecture and components of Software Defined Networking.		C-4	PLO-2
CLO-3	**Assess** and optimize network performance, scalability, and security in Software Defined Networking environments.		C-4	PLO-4
CLO-4	**Apply** network virtualization and programmability techniques in Software Defined Networking.		C-3	PLO-5

Course Outline for Theory

The Software Defined Networking (SDN) course provides students with a comprehensive understanding of the principles, concepts, and technologies behind SDN. The course covers topics such as network virtualization, centralized network control, and programmability. Students will learn about the architecture and components of SDN, including the OpenFlow protocol and controller platforms. The course explores SDN applications and use cases, such as network automation, traffic engineering, and network security. Students will gain hands-on experience through lab exercises and simulations to configure and manage SDN environments. Additionally, the course covers advanced topics such as SDN orchestration, network function virtualization (NFV), and SDN in cloud computing. By the end of the course, students will have the knowledge and skills to design, deploy, and manage SDN-based networks, enabling them to optimize network performance, scalability, and security in modern network infrastructures.

Recommended Books

1. "SDN: Software Defined Networks" by Thomas Nadeau and Ken Gray: Latest Edition
2. "Software Defined Networks: A Comprehensive Approach" by Paul Goransson and Chuck Black: Latest Edition
3. "OpenFlow: Enabling Innovation in Campus, Data Center, and WAN Networks" by Fei Hu: Latest Edition

Course Content

8.49 Blockchain Technology and Security

CODE & TITLE (IST-373) Blockchain Technology and Security		CREDIT & CONTACT HOURS (2+1) 16 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Explain** the fundamental concepts and principles of blockchain technology.	C-2	PLO-1
CLO-2	**Analyze** and evaluate the security challenges and risks associated with blockchain technology.	C-4	PLO-2
CLO-3	**Design** and implement secure blockchain architectures and protocols.	C-6	PLO-3
CLO-4	**Assess** and apply cryptographic algorithms and techniques to secure blockchain networks.	C-3	PLO-5
CLO-5	**Evaluate** and mitigate security risks and vulnerabilities in blockchain-based systems.	C-4	PLO-4

Course Outline for Theory

The Blockchain Technology and Security course provides students with a comprehensive understanding of blockchain technology and its associated security challenges. The course covers the fundamental concepts of blockchain, including decentralized consensus, immutability, and smart contracts. Students will learn about different blockchain platforms and their applications across various industries. The course delves into the security aspects of blockchain technology, including cryptographic algorithms, key management, secure smart contract development, and protection against common threats such as double-spending and 51% attacks. Additionally, the course explores topics like privacy and anonymity in blockchain systems, regulatory considerations, and the role of blockchain in securing supply chains and digital identities. Through practical exercises and case studies, students will gain hands-on experience in implementing and securing blockchain solutions. By the end of the course, students will have the knowledge and skills to design and evaluate secure blockchain architectures and develop strategies to mitigate security risks in blockchain-based systems.

Recommended Books

1. "Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World" by Don Tapscott and Alex Tapscott: Latest Edition
2. "Blockchain for Dummies" by Tiana Laurence: Latest Edition
3. "Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications" by Imran Bashir: Latest Edition

Course Content

8.50 Security in Cloud Environment

CODE & TITLE (IST-379) Security in Cloud Environment		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** the fundamental concepts and principles of cloud computing and its security challenges.		C-2	PLO-1
CLO-2	**Analyze** and evaluate the security risks and vulnerabilities specific to cloud environments.		C-4	PLO-2
CLO-3	**Design** and implement effective security solutions for cloud-based systems and services.		C-6	PLO-3
CLO-4	**Apply** secure virtualization techniques and identity/access management principles in cloud environments.		C-3	PLO-5
CLO-5	**Demonstrate** knowledge and understanding of regulatory compliance and legal considerations in cloud security.		C-2	PLO-6
CLO-6	**Communicate** effectively about cloud security challenges and solutions to technical and non-technical audiences.		A2	PLO-10

Course Outline for Theory

understanding of the fundamental principles, methodologies, and best practices in securing cloud-based systems and services. The course covers topics such as cloud architecture and deployment models, cloud security challenges, secure virtualization, identity and access management, data protection, network security, and incident response in the cloud. Students will learn about cloud-specific threats and vulnerabilities, as well as techniques for securing cloud infrastructure, applications, and data. The course includes hands-on exercises and case studies to reinforce theoretical knowledge and provide practical experience in securing cloud environments. By the end of the course, students will have the skills and knowledge necessary to design, implement, and manage secure cloud-based solutions, ensuring the confidentiality, integrity, and availability of cloud resources and services.

Recommended Books

1. "Cloud Computing Security: Foundations and Challenges" by John R. Vacca: Latest Edition
2. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood: Latest Edition

Course Content

8.51 Security in AdHoc Sensor Networks

CODE & TITLE (IST-378) Security in AdHoc Sensor Networks		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** the fundamental concepts and architecture of ad hoc sensor networks.		C-1	PLO-1
CLO-2	**Identify** and analyze the security threats and vulnerabilities specific to ad hoc sensor networks.		C-4	PLO-2
CLO-3	**Evaluate** and apply security mechanisms and protocols to protect ad hoc sensor networks.		C-3	PLO-2
CLO-4	**Design** and implement secure communication and data management protocols for ad hoc sensor networks.		C-6	PLO-3

Course Outline for Theory

The Security in Ad Hoc Sensor Networks course aims to provide students with a comprehensive understanding of the security challenges and solutions specific to ad hoc sensor networks. The course covers topics such as the fundamentals of ad hoc sensor networks, sensor node architectures, communication protocols, and resource constraints. Students will learn about the unique security threats and vulnerabilities in these networks, including node compromise, message tampering, and unauthorized access. The course explores security mechanisms such as authentication, encryption, key management, and intrusion detection. Students will also gain knowledge about secure routing protocols, secure data aggregation, and privacy-preserving techniques. The course includes practical exercises and simulations to reinforce theoretical concepts and allow students to evaluate and implement security measures in ad hoc sensor networks. By the end of the course, students will have the skills and knowledge necessary to design, deploy, and secure ad hoc sensor networks in various applications such as environmental monitoring, surveillance, and healthcare.

Recommended Books

1. "Ad Hoc and Sensor Networks: Theory and Applications" by Carlos de Morais Cordeiro and Dharma Prakash Agrawal: Latest Edition
2. "Security in Wireless Ad Hoc and Sensor Networks" by Krishnendu Chakrabarty and Abu Asaduzzaman: Latest Edition
3. "Security in Ad Hoc and Sensor Networks" by Zheng Yan, Yan Zhang, and Hsiao-Hwa Chen: Latest Edition

Course Content

8.52 Embedded Systems Security

CODE & TITLE (IST-354) Embedded Systems Security		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** and interact with embedded systems components and protocols.		C2	PLO-1
CLO-2	**Understand** concepts, issues, principles, and mechanisms in embedded systems security such as embedded security trends, software vulnerabilities, physical attacks, and security policies.		C2	PLO-1
CLO-3	**Conduct** attacks on embedded systems protocols and systems.		C3	PLO-4
CLO-4	**Design** embedded systems and architectures that are resilient to attack.		C3	PLO-5
CLO-5	**Evaluate** recent research advances in embedded systems security and prepare for graduate research in embedded systems security.		C6	PLO-10

Course Outline for Theory

The embedded systems security course aims to equip students with a solid understanding of the fundamental principles, methodologies, and best practices in securing embedded systems. The course covers topics such as the basics of embedded systems architecture, threat modeling for embedded systems, secure boot processes, secure communication protocols, secure coding practices for embedded systems, and techniques for detecting and mitigating common vulnerabilities. Students will also learn about hardware security mechanisms, secure firmware updates, and techniques for protecting sensitive data in embedded systems. The course includes practical hands-on exercises, case studies, and demonstrations to reinforce the theoretical knowledge and provide practical experience in securing embedded systems. By the end of the course, students will have the skills and knowledge necessary to design, develop, and maintain secure embedded systems in various domains such as automotive, healthcare, industrial automation, and Internet of Things (IoT).

Recommended Books

1. "Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development" by David Kleidermacher: Latest Edition
2. "Embedded Systems Security: Threats, Vulnerabilities, and Countermeasures" by Anibal Ollero and Jose Maria de Fuentes: Latest Edition

Course Content

8.53 Cloud Computing and IoT

CODE & TITLE (IST-377) Cloud Computing and IoT	CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective

	After completion of this course students will be able to:	Bloom's Taxonomy Level	PLO
CLO-1	**Determine** the right sensors and communication protocols to use in a particular IoT system.	C-2	PLO-1
CLO-2	**Implement** cloud computing elements such virtual machines, web apps, mobile services, etc.	C-3	PLO-2
CLO-3	**Implement** security features to protect data stored in the cloud.	C-3	PLO-2
CLO-4	**Use** visualization techniques to show and examine data generated from the IoT device.	C-4	PLO-4

Course Outline for Theory

This course provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities. This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies (wireless/mobile/sensor) governing system implementation and the migration of the data to the Cloud for processing. This module aims to develop knowledge and critical understanding of the underlying principles of Cloud Computing and IoT systems, and the commercial and business implications of technical advances in this area. Students will gain practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

Recommended Books

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Ricardo Puttini, and Zaigham Mahmood: Latest Edition
2. "Architecting the Internet of Things" by Dieter Uckelmann, Mark Harrison, and Florian Michahelles: Latest Edition
3. "Internet of Things: Principles and Paradigms" by Rajkumar Buyya, Amir Vahid Dastjerdi, and Samee U. Khan: Latest Edition

Course Content

8.54 Web Application Security

CODE & TITLE (IST-375) Web Application Security		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Understand** the fundamentals of web and browser security.	C-2	PLO-1
CLO-2	**Discuss** the latest emerging attacks facing the Internet.	C-2	PLO-1
CLO-3	**Use** web application vulnerability scanning and testing tools.	C-3	PLO-5
CLO-4	**Explain** web application lifecycle maintenance and defense techniques.	C-2	PLO-1

Course Outline for Theory

Common web application vulnerabilities (e.g., cross-site scripting, SQL injection, and CSRF), secure coding practices, authentication and access control mechanisms, session management, input validation, secure communications, and web application firewall technologies. Students will learn how to assess and mitigate vulnerabilities through hands-on exercises and real-world case studies. The course also emphasizes the importance of security testing, including techniques such as penetration testing and code review. By the end of the course, students will possess the knowledge and skills necessary to design, develop, and maintain secure web applications in today's evolving threat Top of Form.

Recommended Books

1. "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" by Dafydd Stuttard and Marcus Pinto: Latest Edition
2. "Web Application Security: A Beginner's Guide" by Bryan Sullivan and Vincent Liu: Latest Edition

Course Content

8.55 Cryptanalysis

CODE & TITLE (IST-355) Cryptanalysis		CREDIT & CONTACT HOURS (1+2) 16 Theory + 96 Lab	KNOWLEDGE AREA/ DOMAIN Depth Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** and analyze the objectives, environment, and limitations of academic cryptanalysis.		C-4	PLO-3
CLO-2	**Use** Knowledge of cipher structures and cryptanalysis techniques to solve and extract secret information.		C-3	PLO-2
CLO-3	**Implement** the cryptanalysis techniques using tools and programming languages.		C-3	PLO-5
CLO-4	**Assess** the weakness of the cryptosystem against any break.		C-5	PLO-4

Course Outline for Theory

The Cryptanalysis course offers an overview of cryptography principles and then delves into the techniques used to break and analyze cryptographic systems. It covers various cryptographic attacks such as brute-force, statistical, differential, algebraic, and side-channel attacks. Students learn practical cryptanalysis techniques including frequency analysis, chosen plaintext and ciphertext attacks, and other methods. They are introduced to cryptanalysis tools like software, scripting languages, and statistical analysis tools. The course also explores modern cryptanalysis topics like quantum cryptanalysis, lattice-based cryptanalysis, and the analysis of post-quantum cryptography. Hands-on exercises, assignments, and real-world case studies provide practical applications, and students learn to evaluate security, identify vulnerabilities, and assess weaknesses in cryptographic systems. The course concludes by discussing emerging trends, future challenges, and career opportunities in areas such as cybersecurity, cryptography research, and intelligence agencies.

Recommended Books

1. "Introduction to Cryptography with Coding Theory" by Wade Trappe and Lawrence C. Washington: Latest Edition
2. "Cryptanalysis: A Study of Ciphers and Their Solution" by Helen F. Gaines: Latest Edition
3. "Modern Cryptanalysis: Techniques for Advanced Code Breaking" by Christopher Swenson: Latest Edition

Course Content

8.56 Sociology

CODE & TITLE (ISS-355) Sociology	CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Social Science Elective	
After completion of this course students will be able to:		**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** sociological concepts and the discipline.	C-1	PLO-1
CLO-2	**Demonstrate** significant concepts like social systems and structures, socio-economic changes and social processes.	C-2	PLO-2

Course Outline for Theory

1. Introduction i) Definition, subject matter and scope ii) Sociology as a science iii) Historical background of sociology. 2. Basic Concepts i) Group, Community, Society ii) Associations a) non-voluntary b) Voluntary iii) Organization a) Informal b) Formal iv) Social Interaction a) Levels of social interaction b) Process of social interaction (Cooperation, Competition, Conflict, Accommodation, Acculturation and Diffusion, Assimilation, Amalgamation). 3. Social Groups i) Definition and Functions ii) Types of social groups a) In and out groups b) Primary and secondary group c) Reference groups d) Informal and formal groups e) Pressure groups
4. Culture i) Definition, Aspects and Characteristics of Culture a) Material and non-material culture b) Ideal and real culture ii) Elements of culture a) Beliefs b) Values c) Language d) Norms and social sanctions iii) Organizations of culture a) Traits b) Complexes c) Patterns d) Ethos e) Theme iv) Other related concepts a) Cultural relativism b) Subcultures c) Ethnocentrism and Xenocentrism d) Cultural lag. 5. Socialization and Personality i) Personality, factors in personality formation ii) Socialization, agencies of socialization iii) Role and status. 6. Deviance and Social Control i) Deviance and its types ii) Social control and its importance iii) Forms of social control iv) Methods and agencies of social control. 7. Collective Behaviour i) Collective behavior and its types ii) Crowd behavior iii) Public opinion iv) Propaganda v) Social movements

Recommended Books

3. Anderson, Margaret and Howard F. Taylor. 2001. Sociology the Essentials. Australia: Wadsworth.
4. Brown, Ken 2004. Sociology. UK: Polity Press
5. Gidden, Anthony 2002. Introduction to Sociology. UK: Polity Press.
6. Macionis, John J. 2006. 10th Edition Sociology, New Jersey: Prentice-Hall
7. Tischler, Henry L. 2002. Introduction to Sociology 7th ed. New York: The Harcourt Press.

Course Content

8.57 Leadership

CODE & TITLE (ISM-363) **Leadership**		CREDIT & CONTACT HOURS (3+0) **48 Theory + 0 Lab**	KNOWLEDGE AREA/ DOMAIN **Management Science Elective**	
After completion of this course students will be able to:			**Bloom's Taxonomy Level**	**PLO**
CLO-1	**Understand** different leadership theories and models.		C-2	PLO-1
CLO-2	**Illustrate** different leadership principles in real-world scenarios.		C-2	PLO-2
CLO-3	**Apply** the ethical dimensions of leadership.		C-3	PLO-8

Course Outline for Theory

Introduction to Leadership: Definition and theories of leadership, Importance of leadership in organizations, Different styles of leadership. **Leadership Traits and Skills:** Identifying and developing leadership traits, Essential leadership skills, Emotional intelligence and its role in leadership, **Leadership Communication:** Effective communication strategies for leaders, Active listening and feedback techniques, Nonverbal communication and body language. **Leading Teams:** Building and managing high-performing teams, Team dynamics and conflict resolution, Motivating and inspiring team members. **Strategic Leadership:** Strategic thinking and planning, Decision-making processes for leaders, Leading change and innovation. **Ethical Leadership:** Ethical considerations in leadership, Values-based leadership, Leading with integrity and accountability, **Leadership in a Global Context:** Cultural intelligence and cross-cultural leadership, Leading diverse teams, Global leadership challenges and opportunities. **Leadership Development:**
Self-awareness and personal growth, Leadership coaching and mentoring, Creating a personal leadership development plan.

Recommended Books

1. Northouse, P. G. (2014). Introduction to Leadership: Concepts and Practice (3rd ed.). SAGE ISBN: 97 8-1-4522-5966-6
2. "The Leadership Challenge" by James M. Kouzes and Barry Z. Posner
3. "Leaders Eat Last: Why Some Teams Pull Together and Others Don't" by Simon Sinek
4. "Primal Leadership: Unleashing the Power of Emotional Intelligence" by Daniel Goleman, Richard Boyatzis, and Annie McKee
5. "Drive: The Surprising Truth About What Motivates Us" by Daniel H. Pink
6. "Daring Greatly: How the Courage to Be Vulnerable Transforms the Way We Live, Love, Parent, and Lead" by Brené Brown
7. "Leadership and Self-Deception: Getting Out of the Box" by The Arbinger Institute
8. "Start with Why: How Great Leaders Inspire Everyone to Take Action" by Simon Sinek

Course Content

8.58 Biotechnology

CODE & TITLE (ISI-472) Biotechnology		CREDIT & CONTACT HOURS (2+1) 32 Theory + 48 Lab	KNOWLEDGE AREA/ DOMAIN Inter Disciplinary Technology Elective
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Define** and understand biotechnology and its different types with their applications.	C-2	PLO-1
CLO-2	**Have** an awareness of the global significance of modern technologies and its role in the development of biotechnology.	C-3	PLO-4
CLO-3	**Understand** the current and future ethical issues surrounding the relationship between biotechnology and government, investors, the environment and consumers and their impact on the future biotechnological approaches.	C-4	PLO-12

Course Outline for Theory

Introduction to Biotechnology, History of Biotechnology, Biotechnology and interdisciplinary pursuit, Branches of Biotechnology, Industrial biotechnology, Applications of Industrial Biotechnology, Isolation and culturing of microorganisms, Medical Biotechnology ,Medical applications of biotechnology, Recombinant DNA Technology, Gene Therapy / Pharmacology, Environmental Biotechnology, Environmental Biotechnology Applications, Plant Biotechnology, Plant Biotechnology Applications, Fermentation, Safety in biotechnology, Biological Containment, Biosafety Levels ,Biosafety Equipment's, Biosafety guidelines for laboratories, Biosafety cabinets, Proper waste disposal and handling of biotechnological products, Protection of biotechnological products, Intellectual Property Protection, Legal protection of biotechnological products, Patenting of products, Main criteria for patentability, Types of patent, Difference between copyright, patent and trademark, Public perception of Biotechnology, Biotechnology and genetic engineering, Public approval of the use of biotechnology in animal, Ethics in biotechnology, Ethical consideration of biotechnological products, Ethics in disease prevention, Genetically modified food, Ethical consideration of GMOs, GMOs in agriculture and development, Different aspects in developing countries, Biotechnology and the environment, Ethics concerning animal rights, Bioethics in biotechnology, Biotechnology and the developing world

Recommended Books

1. Daugherty E, 2012. Biotechnology: Science for the New Millennium. 1st Edition, Revised, Paradigm Publication.
2. Smith JE, 2009. Biotechnology. 5th Edition; Cambridge University Press.
3. Nicholl TSD, 2004. An Introduction to Genetic Engineering. 2nd Edition; Cambridge University Press, UK.
4. Purohit SS, 2005. Biotechnology Fundamentals & Application. 4th Edition; Agro Bios, India.
5. Ratlegde C and Kristiansen B, 2006. Basic Biotechnology. 2nd Edition; Cambridge University Press, UK.
6. Thomas JA and Fuchs RL, 2002. Biotechnology and Safety Assessment. 3rd Edition; Academic Press, UK.

Course Content

8.59 Criminology

CODE & TITLE (ISS-356) Criminology		CREDIT & CONTACT HOURS (2+0) 32 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Social Science Elective
After completion of this course students will be able to:		Bloom's Taxonomy Level	PLO
CLO-1	**Understand** the basic concepts, theories and methodologies used in the discipline.	C-1	PLO-1
CLO-2	**Demonstrate** significant concepts like crime, criminal behavior and crime statistics.	C-2	PLO-2

Course Outline for Theory

1. Introduction i) Social construction of crimes and Criminals ii) Types of criminal and crimes iii) Law and crime iv) Deviancy v) Sin vi) Vice vii) Crime and social organization viii) Crime as a social problem ix) Criminology and its scope x) Criminology and criminal law. 2. Approaches to criminal behaviour i) Biological factors ii) Environmental factors iii) Psychological and psychiatric determinants iv) Sociological approaches v) Economic approaches vi) Islamic perspective. 3. Crime and criminals a. Types of crime i) Crime against person ii) Crime against property iii) Crime against state iv) Victimless crime v) Organized crime vi) White collar crime vii) Corporate crime b. Types of criminals i) The occasional criminals ii) The habitual criminals iii) The professional criminals. 4. Detection of crimes i) Agencies of crime detection ii) Techniques of detection iii) Problems of detection. 5. Forms of punishment i) Corporal punishment ii) Capital punishment iii) Imprisonment iv) Fine v) Restitution vi) Probation vii) Parole viii) Exile. 6. Trial and conviction of offenders i) Agencies: formal and informal ii) Criminal courts: procedures and problems 7. Prevention of crimes i) Long term measures ii) Short term measures

Recommended Books

8. Walsh, Anthony. (2010). Introduction to Criminology: A Text/Reader
9. Siegel, Larry J. (2011). Criminology
10. Hagan, F. (2010). Introduction to Criminology, 7th Edition, Beverly Hills
11. Bloch, H. A. (1962). Crime and Society. New York: Random House.
12. Carey, H. (1978). An Introduction to Criminology. Englewood Cliffs, N. J.: Prentice Hall, Inc.

Course Content

8.60 Financial Accounting

CODE & TITLE (ISM-364) Financial Accounting		CREDIT & CONTACT HOURS (3+0) 48 Theory + 0 Lab	KNOWLEDGE AREA/ DOMAIN Management Science Elective	
After completion of this course students will be able to:			Bloom's Taxonomy Level	PLO
CLO-1	**Understand** the fundamental principles and concepts of financial accounting.		C-2	PLO-1
CLO-2	**Demonstrate** an understanding of the accounting cycle, including the preparation of trial balances and financial statements.		C-3	PLO-1
CLO-3	**Apply** accounting concepts to measure and report revenue, expenses, assets, liabilities, and equity accurately.		C-3	PLO-2

Course Outline for Theory

Accounting And Its Role: Development of accounting, Accounting Theory and Conceptual framework, Accounting Defined, why study Accounting, Financial statements, Major fields of accounting, Accounting as a Career, **Basic Accounting Concepts:** The Entity Concept, The Reliability (or Objectivity) principle, The cost Principle, The Going-Concern Assumptions, The Stable Currency Assumptions, Ethics-the-Most Fundamental Principle of Accounting, Qualitative characteristics of financial statements. **The Recording Process:** The Recognition Issue, The Valuation Issue, The Classification Issue, The Recording Process, Analysis of Transaction, The Journal, The Ledger, Balancing the Accounts. **Preparation of Financial Statements:** Preparing Trial Balance, Locating and correcting errors in recording process, Preparing Profit and Loss Account and Balance Sheet, The Adjusting and Closing Entries, Need for Adjusting Entries , Recording adjusting entries, preparing adjusted trial balance, recording closing entries, Preparing post-closing trial balance, Preparing work-sheet, Preparation of Financial Statements. **Accounting For Trading Organization:** The Purchase Function, Accounting for Purchases and Sales, Return and allowances, Periodic System, Perpetual System, Worksheet, Preparation of financial Statements, Departmental Accounts. **Accounting Systems:** Developing a System, Subsidiary Journals, Subsidiary ledgers, Cash Book, Petty cash book, Control Accounts. **Cash And Temporary Investment:** Nature and Composition of Cash, Cash Management and Control, Maintaining Bank Account, Bank Reconciliation, Short term investments

Accounting For Debtors and Stock: Accounting Treatment of Bad Debts, Direct Write-Off Method, Aging Schedule, Percentage of Sales Method, Recoveries of Bad debts, Stock, Measurement of Stock Quantity, Measurement of Stock Cost, Perpetual Stock System, Periodic Stock System. **Accounting For Property, Plant and Equipment:** Property, Plant and Equipment, Lump-sum Purchase, Subsequent Expenditure, Depreciation methods, Revaluation, Review of Useful life, Intangible Assets and Amortization, Wasting Assets and Depletion

Recommended Books

1. Williams, Haka, Bettner: Financial & Managerial Accounting, Latest Edition, Prentice Hall
2. Professor Muhammad Ammanullah Khan: Financial Accounting, Latest Edition
3. Frank Wood‟s: Business Accounting 1, Eleventh Edition
4. Meigs and Meigs, Accounting for Business Decision, 9th Edition/Latest Edition

9. Supervised Industrial Training

9.1 Background

Supervised Industrial Training refers to students supervised hands-on experience in an environment where engineering is practiced, familiarizing them with professional engineering work prior to graduation. The training curriculum consists of minimum 16 weeks of continuous industrial training, comprised of 8 hours per day, 5 working days per week. A Bachelor of Engineering Technology student shall undergo mandatory SIT during the 8th semester (16 weeks), or 7th and 8th semesters (16 weeks mandatory and 16 weeks in 7th semester optional), after he/ she has passed all subjects up to the 6th semester.

SIT covers a range of activities, such as design implementation, production processes, laboratory experiments, on-site field works and maintenance. It also serves as a mechanism to integrate engineering practices and the curriculum to achieve Program Learning Outcomes that cover Engineering Technologists Graduate Attributes in line with the Sydney Accord. While SIT provides practical exposure to engineering processes and helps develop professional skills required for an Engineering Technologist, it also offers an opportunity to prospective employers to assess potential skills of a future employee.

9.2 Objectives:

Through the SIT, students will:

a. Learn to apply engineering technology knowledge learned in classroom environment in real industrial situations.
b. Be provided exposure to professional practices in the industries.
c. Understand the role and responsibilities and code of ethics that Engineering Technologists should uphold.
d. Develop awareness about general workplace behavior and build interpersonal skills.
e. Maintain professional work records and reports.
f. Learn to write reports and network with probable future employers to increase employability.

9.3 Responsibility of HEI: Placement in SIT Program

During 7th (Optional) and 8th semester, Bachelor of Engineering Technology (Information Security) students will be undergoing continuous SIT of 16 (or 32) weeks. This training shall be arranged by HEIs in leading industry, and preferably should sign an MoU for the SIT. A designated Administrator/Coordinator of HEI shall complete all necessary documentation, preferably 12 weeks prior to the commencement of the training, and issue Training Schedule for 16 (or 32) weeks so that all stakeholders and the students are aware and assured of undergoing SIT training in 7th (optional) and 8th semester according to a scheduled timeline.

9.4 Responsibilities of Students:

a. Bachelor of Engineering Technology students shall get enrolled for SIT during the 6th semester and before commencement of 7th semester.
b. Students shall have to undergo continuous training of 16 (or 32) credit hours. One week's training of 8 hours daily for 5 days (40 contact hours) will be counted as 1 credit hour. Accordingly, 16 weeks (One semester) will help earn students 16 credit hours.
c. Total contact hours per semester are: 16 weeks per semester x 5 working days per week x 8 hours per day = 640. If an HEI opts SIT in 2 semesters (7th and 8th), these credit hours and contact hours will be doubled.

d. Students will maintain a daily Logbook, signed by the SIT supervisor at site, Training Administrator appointed by HEI and the student.
e. Students must observe safety & security rules of the Organization where they receive Training.
f. Students must wear specified working dress during training.
g. Students must obey all rules and regulations of the organization.
h. Students must observe working timings of the training Organization. Students may be allowed 10 days leave during Training period of 16 (or 32) for genuine reasons. The leave shall only be used to cater for emergencies, with prior sanction from the training Administrator/Coordinator.
i. Leave will be deducted from training hours and required to be made up later.
j. Unsanctioned leaves shall be treated as "absent", and liable to disciplinary action.
k. Public holidays and leave should not be counted as working hours.

9.5 Training Progress Assessment and Review by HEI

Every HEI should appoint a focal person as SIT Administrator/Coordinator for each program who will monitor progress randomly through site visits, phone calls or emails to the industrial organization's counter-part focal person. Progress reports will be maintained after coordination with training supervisor(s) as well as the students.

The purpose of monitoring of SIT by Training Administrator/Coordinator are:

a. To ensure the training organization is providing suitable and appropriate training to students.
b. To obtain feedback on students' performance and training progress through discussion with training supervisor(s).
c. To make courtesy visits and establish industrial relations between the HEI and the industries where students will receive their SIT.
d. To discuss the possibility of students' job placement with the training organization.
e. To survey new industries as potential training placement locations in the future.

9.6 Changing Student Placement During SIT

a. Students are discouraged to change placement during the training period from one organization to another.
b. However, written permission may be granted by the training Administrator/Coordinator, if new placement of the student is available and confirmed in another organization, provided the student does not suffer loss of training hours due to this changeover.
c. After getting written permission from the Training Administrator/Coordinator, a fresh approval should be applied for the new placement.

9.7 Daily Training Logbook

All training activities must be recorded on daily basis in the Training Logbook [See Appendix F]. Students must get it signed, on daily basis, by on-the-job Trainer.

The Training logbook must reflect:

a. The student's learning experience during the industrial training
b. Training records and evidence of supervised training, with evidence of participation of student, on- the-job Trainer and HEI's training Administrator/Coordinator.
c. Part of professional practice in engineering profession where incidence and evidence are properly documented.
d. Information that becomes a source of reference in preparing the Industrial Training Report.
e. The Logbook must be submitted along with the Industrial Training Report.

9.8 Industrial Training Report

An Industrial Training Report will be submitted upon completion of SIT. The Report must describe student's learning and development in technical knowledge, engineering practices and professional skills acquired through practical experience. The Industrial Training Report should also reflect student's ability in communication skills and understanding of engineering practices. Students should seek advice from their on-the-job Trainer at site, to ensure that no confidential materials are included in the report. The report shall be submitted to the Training Administrator. The student may present a copy of the report to the prospective employer. Any references made in preparation of the report should be recognized using standard referencing formats. Students should refer to the Industrial Training Report Template as provided [See Appendix G] and guidelines given below in preparing the Report. The Daily Training Logbook should be submitted together with the Report.

9.9 Guidelines for Preparation of Industrial Training Report

Under the guidance of supervisors, students need to properly document their experience and learning during the SIT in form of an Industrial Training Report. A properly prepared Report can portray their practical experience precisely in an orderly manner. The Report must be prepared according to the format and the guidelines below:

9.9.1 Contents of Industrial Training Report

(a) Table of Contents

This section of the report shall consist of:

i. Headings
ii. Sub-headings
iii. Page numbers

Every appendix requires a title, and each page needs to be numbered accordingly.

(b) Background & Profile of the Training Organization

Brief and concise description of the organization in which the student is undertaking the SIT. The main items are:

i. Backgrounds/profile of the organization
ii. Vision and Mission
iii. Organogram.
iv. Title and position of the supervisor in charge
v. Other necessary information only (not more than three pages)

(c) Schedule of Duties Performed as Trainee

This section briefly describes the time, duration and types of duties performed during the training. The description must follow the schedule of the training, i.e., in chronological order (for 16/32 weeks). The days when the student was not on duty must be properly recorded with cogent reasons.

(d) Experience During SIT

In this section, the student must fully describe the industrial training experience gained. Some suggested areas include:

i. Project (s) carried out, if any.
ii. Supervisory works
iii. Problems encountered

iv. Problems solving process or approach
v. Hands-on skills acquired.
vi. How productivity can be further enhanced.
vii. Quality Management system in place.
viii. Safety at work.

(e) Conclusion

Students provide an overall assessment in this section and arrive at a conclusion with regards to the SIT undergone. Content may include:

i. Types of major work performed during SIT
ii. Different modules of SIT
iii. Comments whether SIT met the training objectives
iv. Suggestions and recommendations for improvement of the SIT

(f) References

A complete list of the references used in the report must be included according to standard referencing format.

(g) Appendixes

Appendixes are additional information appended to support the main text of the Report. A copy of the letter of permission from the Training Organization must be attached as an appendix. Other suggested appendixes are:

i. Investigation and project report during SIT
ii. Technical drawings, so far these are not secret documents or proprietary etc.
iii. Any other document that adds to the Report

(h) Figures and Tables

All figures, tables and similar content must be captioned, labeled, and mentioned in the main text of the Report.

(i) Notations, Symbols & Acronyms

If the report contains notations, symbols, and acronyms, these must be defined before they first appear in the main text. It is good practice to put list of notations, symbols, and acronyms on a separate page, appropriately titled, and placed after 'Tables of Contents' page.

Every appendix must have a title and be mentioned in the main text of the Report. All page numbers for appendixes must be in continuation of page numbers of the main Report.

9.9.2 Format of the Report

(a) General

i. Students are advised to start writing the SIT Report as soon as training commences to ensure timely completion and submission.
ii. Do not include irrelevant materials, e.g., brochures from the organizations, or any publicity materials in the report.
iii. The Report must be typewritten on plain white A4 size paper, with 12-point Times New Roman font type and line spacing of 1.5.

(b) Abstract or Preface

The Report should start with an abstract of maximum 2 pages, and should briefly describe:

i. Description of Organization providing SIT
ii. Summary of the Report
iii. Acknowledgements

9.10 SIT Assessment

Assessment of the SIT should be based on the following parameters:

i.	On-the-Job Trainer Report	(20% marks)
ii.	Training Advisor Report through visits or survey	(10% marks)
iii.	Industrial Training Report	(50% marks)
iv.	Viva voce	(20% marks)

It is also be noted that:

i. Minimum 50% marks are required to pass the SIT.
ii. Students are advised to be diligent in writing their Report.
iii. The Report must be of good quality and portray in full the industrial experience and knowledge gained.
iv. The Report should not be in the form of short notes and figurative form.
v. If the Report is not satisfactory, students shall rewrite the Report until it is deemed satisfactory.

i. Upon completion of a 16- or 32-week continuous SIT, a Confirmation Letter to this effect must be obtained from the training organization and/or probable employer.
ii. The Confirmation Letter must be submitted to the Industrial Training Administrator/Coordinator, together with the (1) On-the-Job Trainer's Report, (2) Student Feedback Form, and (3) Industrial Training Report for grading.

APPENDIX A: Sydney Accord Knowledge and Attitude Profile

(Retrieved from www.ieagreements.org)

A Sydney Accord program provides:
SK1: A systematic, theory-based understanding of the natural sciences applicable to the sub-discipline and awareness of relevant social sciences.
SK2: Conceptually based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed consideration and use of models applicable to the sub-discipline.
SK3: A systematic, theory-based formulation of engineering fundamentals required in an accepted sub-discipline.
SK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for an accepted sub-discipline.
SK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations using the technologies of a practice area.
SK6: Knowledge of engineering technologies applicable in the sub-discipline.
SK7: Knowledge of the role of technology in society and identified issues in applying engineering technology, such as public safety and sustainable development (represented by the 17 UN-SDGs).
SK8: Engagement with the current technological literature of the discipline and awareness of the power of critical thinking.
SK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

APPENDIX B: Engineering Technologist Graduate Attribute Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to have the following attributes:
Engineering Technology Knowledge: **SA1:** An ability to apply knowledge of mathematics, natural science, Engineering Technology fundamentals and Engineering Technology specialization to defined and applied Engineering Technology procedures, processes, systems, or methodologies.
Problem Analysis **SA2:** An ability to Identify, formulate, research literature and analyze Broadly Defined Engineering Technology problems reaching substantiated conclusions using analytical tools appropriate to the discipline or area of specialization.
Design/Development of Solutions **SA3:** An ability to design solutions for broadly- defined Engineering Technology problems and contribute to the design of systems, components, or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Investigation **SA4:** An ability to conduct investigations of broadly defined problems; locate, search and select relevant data from codes, data bases and literature, design and conduct experiments to provide valid conclusions.
Modern Tool Usage **SA5:** An ability to Select and apply appropriate techniques, resources, and modern technology and IT tools, including prediction and modelling, to Broadly Defined Engineering Technology problems, with an understanding of the limitations.
The Engineering Technologist and Society **SA6:** An ability to demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Engineering Technology practice and solutions to broadly defined Engineering Technology problems.
Environment and Sustainability **SA7:** An ability to understand and evaluate the sustainability and impact of Engineering Technology work in the solution of broadly defined Engineering Technology problems in societal and environmental contexts.
Ethics: **SA8:** Understand and commit to professional ethics and responsibilities and norms of Engineering Technology practice.
Individual and Teamwork

SA9: An ability to Function effectively as an individual, and as a member or leader in diverse teams.
Communication **SA10:** An ability to communicate effectively on broadly defined Engineering Technology activities with the Engineering Technologist community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project Management **SA11:** An ability to demonstrate knowledge and understanding of Engineering Technology management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments.
Lifelong Learning: **SA12:** An ability to recognize the need for and have the ability to engage in independent and life-long learning in specialist Engineering Technologies.

APPENDIX C: Engineering Technologist Professional Competence Profile

(Retrieved from www.ieagreements.org)

As per Sydney Accord, Engineering Technologist Graduate is expected to demonstrate the following competencies:
Comprehend and apply universal knowledge: **TC1:** Comprehend and apply the knowledge embodied in widely accepted and applied procedures, processes, systems, or methodologies.
Comprehend and apply local knowledge: **TC2:** Comprehend and apply the knowledge embodied procedures, processes, systems, or methodologies that is specific to the jurisdiction of practice.
Problem analysis: **TC3:** Identify, clarify, and analyze broadly defined problems using the support of computing and information technologies where applicable.
Design and development of solutions: **TC4:** Design or develop solutions to broadly defined problems considering a variety of perspectives.
Evaluation: **TC5:** Evaluate the outcomes and impacts of broadly defined activities.
Protection of society: **TC6:** Recognize the foreseeable economic, social, and environmental effects of broadly defined activities and seek to achieve sustainable outcomes (represented by the 17 UN-SDGs).
Legal, regulatory, and cultural: **TC7:** Meet all legal, regulatory, and cultural requirements and protect public health and safety during all activities.
Ethics: **TC8:** Conduct activities ethically
Manage engineering activities: **TC9:** Manage part or all of one or more broadly defined activities.
Communication and Collaboration: **TC10:** Communicate and collaborate using multiple media clearly and inclusively with a broad range of stakeholders during all activities.
Continuing Professional Development (CPD) and Lifelong learning:

TC11: Undertake CPD activities to maintain and extend competences and enhance the ability to adapt to emerging technologies and the ever-changing nature of work.
Judgement: **TC12:** Choose appropriate technologies to deal with broadly defined problems. Exercise sound judgement in the course of all broadly defined activities.
Responsibility for decisions: **TC13:** Be responsible for making decisions on part or all of one or more broadly defined activities.

APPENDIX D: Minutes of Preliminary Meeting of NCRC

1. Preliminary meeting of National Curriculum Review Committee (NCRC) in the discipline of Information Security Engineering Technology for bachelor's degree program was held on March 1st to 3rd, 2023 for 3 days at the Usman Institute of Technology University Karachi.

2. Welcome session was started with recitation of Holy Quran, and it was chaired by Honorable Engr. Imtiaz Hussain Gilani, Chairman NTC. In a welcome speech, objectives, and arrangements for NCRC were presented by the registrar of the host university (Usman Institute of Technology University Karachi). Then, the Chairman NTC explicitly elaborated importance of curriculum development for B.Sc. engineering technology programs through more practical work engagement as well as keeping in view the futuristic approach, market demand and societal needs as per the scope of NTC and guidelines of Sydney Accord.

3. Mr. Hafiz Ghulam Muhammad represented NTC, highlighted the agenda of this meeting and emphasized for adaptation of general rules of curriculum development and revision such as scope of the subject/program, horizontal & vertical alignment, rule of flexibility and adaptability. Moreover, scope and template for adopting new undergrad policy was discussed to adopt for the uniformity and alignment of curriculum.

4. In the second session, Honorable Engr. Prof. Dr. Madad Ali Shah, Vice Chancellor, The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mirs (BBSUTSD), Kahirpur shared procedure and execution of agenda in NCRC. Then he invited the house to nominate the Convener, Co-Convener, Secretary and Co-Secretary of the NCRC for smooth functioning. After discussion with members Prof. Dr. Zafar Nasir was nominated as Convener, Dr. Khan Bahadar Khattak as a Secretary and Prof. Dr. Qamar Ul Arafeen and Dr. Faheem Yar Khuhawar were nominated as Co-Convener, and Co-Secretary for the Committee, respectively. Following nominated members represented various HEIs from all over the Pakistan in NCRC for B.Sc. Engineering Technology (Information Security).

Sr#	NCRC Members	Role
1.	Prof. Dr. Zafar Nasir Acting Vice Chancellor / Dean FCIT Indus University, Karachi	Convener
2.	Prof. Dr. Qamar Ul Arafeen Director (industrial Representative) International Institute of Digital Forensic Science and Technology, Karachi	Co-Convener
3.	Engr. Dr. Khan Bahadar Khattak Associate Professor The Islamia University of Bahawalpur (IUB), Punjab.	Secretary
4.	Engr. Dr. Faheem Yar Khuhawar Associate Professor Mehran University of Engineering and Technology (MUET), Jamshoro	Co-Secretary

Sr#	NCRC Members	Role
5.	Engr. Prof. Dr. Madad Ali Shah Professor and former Vice Chancellor, Sukkur IBA University / The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mir's.	Member
6.	Dr. Muhammad Ashraf Associate Professor Balochistan University of Information Technology, Engineering & Management Sciences (BUITEMS), Quetta	Member
7.	Dr. Naveed Jan Assistant Professor University of Technology (UoT), Nowshera	Member
8.	Prof. Dr. Sheikh Muhammad Munaf Professor Ziauddin University, Karachi	Member
9.	Dr. Huma Hasan Rizvi Assistant Professor Sir Syed University of Engineering and Technology, Karachi	Member
10.	Prof. Dr. Muhammad Khalid Khan Professor and HoD PAF-Karachi Institute of Economics & Technology (KIET), Karachi	Member
11.	Mr. Saqib Jawaid Head Industrial Representative Head of Group IT (Burj Group of Companies), Karachi	Member
12.	Prof. Dr. Muhammad Ghazanfar Ullah Professor Usman Institute of Technology University (UITU), Karachi	Member
13.	Engr. Fauzan Saeed Assistant Professor Usman Institute of Technology University (UITU), Karachi	Member
14.		HEC Representative
15.	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

5. After taking charge by the nominated Committee, Convener, Prof. Dr. Zafar Nasir chaired the meeting and emphasized to ensure the reflection of Sydney Accord in curriculum and course titles as well as to develop curriculum that provides a unified framework for offering degrees under the title of Engineering Technology (Information Security).

6. In continuation of above guidelines, Dr. Khan Bahadar Khattak, Secretary, Prof. Dr. Qamar Ul Arafeen, Co-Convener, and Dr. Faheem Yar Khuhawar, Co-Secretary highlighted the objectives of curriculum development.

7. Agreed upon objectives were categorized and assigned to Subcommittees, where Honorable Members reviewed, discussed, and submitted the following resolutions:

- Develop an undergraduate curriculum of Engineering Technology (Information Security) which is at par with international standards and in substantial conformity with the Sydney Accord.
- Clearly define program education objectives (PEOs), course learning outcomes (CLOs) with Bloom's Taxonomy levels, and course contents aligned with program learning outcomes (PLOs).
- Incorporate latest relevant reading materials/ references.
- Ensure that course content that is uniform across other disciplines (HEC's Gen Ed requirements) is not duplicated.
- Curriculum must be futuristic, and answer needs of society.

8. In next session, the house discussed the nomenclature of the discipline, preface, objectives of the programs, PLOs, methods of instruction and learning environment, assessment, and operational framework.

9. After long deliberation, the Committee proposed the curriculum framework, the duration of the program, number of semesters, number of weeks per semester, total number of credit hours, weightage of technology domain and non-technology domain courses and weightage of theory and practical of undergraduate 4-years program in Engineering Technology (Information Security).
10. Furthermore, list of courses (core and elective) and semester wise breakup of courses were also discussed thoroughly and finalized.

11. Admission/intake criteria were discussed and adopted same as defined in NTC Accreditation Manual.

12. Supervised industrial training (SIT) was discussed in detail. There was a consensus that SIT will be mandatory for 8th Semester.

13. Those HEI's that can provide only one semester of SIT (in 8^{th}), shall offer optional courses instead of SIT in the 7^{th} semester to cover credit hours and other requirements.

14. HEI's that are geared to provide SIT in two semesters can do this in 7^{th} and 8^{th} Semesters.

15. In line with the experience and expertise of NCRC members, list of courses of various domains were distributed among the Sub-Committees.

16. These Committees were assigned responsibility for reviewing course objectives, adding course learning outcomes, appropriate mapping with Bloom's Taxonomy and PLOs, updating list of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.

17. The following Core Committee's, along with four Sub-Committees, were constituted with separate Convenors and Secretaries:

Engineering Technology (Information Security) Core Committee		
Sr#	**Name**	**Role**
1	Prof. Dr. Zafar Nasir	Convenor
2	Prof. Dr. Qamar Ul Arafeen	Co-convenor
3	Engr. Dr. Khan Bahadar Khattak	Secretary
4	Engr. Dr. Faheem Yar Khuhawar	Co-secretary
1. Sub-Committee: Non-Engineering courses, Humanities and Social Sciences Courses		
Sr#	**Name**	**Role**
1	Prof. Dr. Syed Zafar Nasir	Convener
2	Dr. Khan Bahadar Khattak	Secretary
3	Dr. Naveed Jan	Member
2. Sub-Committee Engineering Technology (Information Security) Foundation Courses		
Sr#	**Name**	**Role**
1	Dr. Faheem Yar Khuhawar	Convener
2	Dr. Muhammad Ghanzafar Ullah	Member
5	Engr. Fauzan Saeed	Secretary
3. Sub-Committee: Engineering Technology (Information Security) Core (Breadth) Courses		
1	Prof. Dr. Sheikh Muhammad Munaf	Convener
2	Prof. Dr. Muhammad Khalid Khan	Secretary
3	Dr. Huma Hasan Rizvi	Member
4. Sub-Committee: Engineering Technology (Information Security) Core (Depth) Courses		
Sr#	**Name**	**Role**
1	Engr. Prof. Dr. Madad Ali Shah	Convenor

2	Prof. Dr. Qamar Ul Arafeen	Secretary
3	Dr. Muhammad Ashraf	Member
4	Mr. Saqib Jawaid	Member

18. After conclusion of the Preliminary Meeting, the Sub-Committees submitted the proposed course contents for theory and practical's, along with CLOs, list of recommended books, list of experiments and relevant information of each course.

19. The first draft was compiled by the Engr. Dr. Khan Bahadar Khattak, Secretary NCRC, and distributed to Members for review.

20. Preliminary curriculum draft was submitted to NTC and sent to international reviewers.

APPENDIX E: Minutes of the Final Meeting of NCRC

1. The second meeting of the NCRC in the discipline of Engineering Technology (Information Security) for the bachelor's degree program was held on 31-05-2023 to 02-06-2023 for 03 days at the Usman Institute of Technology University (UITU), Karachi.

2. The inauguration session started with recitation of Holy Quran, and chaired by Honorable Vice Chancellor Usman Institute of Technology University (UITU), Karachi.

3. Engr. Imtiaz Hussain Gilani, Chairman NTC, joined the meeting online. He appreciated the efforts by Members, and highlighted their valuable contribution for the national cause in setting standards for quality-education in Engineering Technology (Information Security).

4. The Chair also extended his gratitude to the entire team and briefed the objectives and arrangements for the second NCRC.

5. Mr. Muhammad Fahd Amin, Acting Registrar, NTC with Mr. Hafiz Ghulam Muhammad represented NTC.

6. The following members attended the meeting:

Sr#	NCRC Members	Role
1.	Prof. Dr. Zafar Nasir Acting Vice Chancellor / Dean FCIT Indus University, Karachi	Convener
2.	Prof. Dr. Qamar Ul Arafeen Director (industrial Representative) International Institute of Digital Forensic Science and Technology, Karachi	Co-Convener
3.	Engr. Dr. Khan Bahadar Khattak Associate Professor The Islamia University of Bahawalpur (IUB), Punjab.	Secretary
4.	Engr. Dr. Faheem Yar Khuhawar Associate Professor Mehran University of Engineering and Technology (MUET), Jamshoro	Co-Secretary
5.	Engr. Prof. Dr. Madad Ali Shah Professor and former Vice Chancellor, Sukkur IBA University / The Benazir Bhutto Shaheed University of Technology & Skill Development, Khairpur Mir's.	Member
6.	Dr. Naveed Jan Assistant Professor University of Technology (UoT), Nowshera	Member
7.	Prof. Dr. Sheikh Muhammad Munaf Professor Ziauddin University, Karachi	Member
8.	Dr. Huma Hasan Rizvi Assistant Professor	Member

Sr#	NCRC Members	Role
	Sir Syed University of Engineering and Technology, Karachi	
9.	Prof. Dr. Muhammad Khalid Khan Professor and HoD PAF-Karachi Institute of Economics & Technology (KIET), Karachi	Member
10.	Mr. Saqib Jawaid Head Industrial Representative Head of Group IT (Burj Group of Companies), Karachi	Member
11.	Prof. Dr. Muhammad Ghazanfar Ullah Professor Usman Institute of Technology University (UITU), Karachi	Member
12.	Engr. Fauzan Saeed Assistant Professor Usman Institute of Technology University (UITU), Karachi	Member
13.		HEC Representative
14.	Mr. Hafiz Ghulam Muhammad NTC, Pakistan	NTC Representative

7. After the introductory session, deliberations on the agenda of the second meeting formally commenced which was headed by Convener Prof. Dr. Syed Zafar Nasir, Co-Convener Prof. Dr. Qamar Ul Arafeen, Secretary Engr. Dr. Khan Bahadar Khattak and Co-Secretary Engr. Dr. Faheem Yar Khuhawar.

8. Honorable Members were informed that valuable feedback was received from the following international experts:

Sr#	Foreign Expert Name	Affiliation
1	?????	?????
2	?????	?????
3	?????	?????
4	?????	?????
5	?????	?????

9. In this regard, international experts appreciated the efforts done by NCRC to compose a balanced and standardized curriculum for Engineering Technology (Information Security).

10. Their proposed suggestions are incorporated in the curriculum, particularly an additional course titled “Environment, Health and Safety” of 1 credit hour in 2nd Semester, as this has great importance in the field.

11. Various issues were thoroughly deliberated upon by Members of NCRC in Sub-Committees, and Honorable Members submitted the following resolutions:

    - Agreed upon curriculum preface, mission, vision, preamble, rationale, scope, course scheme etc.
    - Finalized bench marking of Recommended Scheme of Studies, Engineering Technology domain and non-Engineering technology domain courses in comparison with framework and list of Electives as defined earlier.
    - Approved the Semester-wise break-up of courses, credit hours allocations and Breadth and Depth courses.
    - Recommended sample course profiles and contents.
    - Recommend sample weekly lecture plan and laboratory work for Foundation and Breath courses.

12. The final draft was compiled by Secretary Engr. Dr. Khan Bahadar Khattak and Co-Secretary Engr. Dr. Faheem Yar Khuhawar.

13. After review by Members and with the approval of Convener Prof. Dr. Syed Zafar Nasir and Co-Convener Prof. Dr. Qamar Ul Arafeen, it was submitted to NTC.

APPENDIX F: Supervised Industrial Training Logbook Sample Format

Student Details:
Name:
Roll Number:
Address:
Email:

Course of Study:
Year/Semester of Study:

Training Start Date:
Training End Date:

Training Organization Details:

Name of Organization:
Address:

Contact Person:
Contact Number:

On-the-job Trainer Name:
On-the-job Trainer Contact Number:

Daily Training Log

Please specify training information by descriptive statements, tables, sketches, figures, photographs, and so forth. Feel free to incorporate attachments wherever necessary.

Training Week: _____

Date	Time	Training Log

Declaration:

I, _____ Roll Number_____, do hereby declare that all information provided above is true and correct to the best of my knowledge.

_____
Student signature with date

_____
Supervisor signature with date

APPENDIX G: Supervised Industrial Training Report Sample Format

Sample table of content for supervised industrial training report is provided so that students can develop an understanding of what is expected of them when making the submission. Students are encouraged to expand upon the content presented below. A declaration page validating the originality of work duly signed by the student and the trainee is also to be attached at the beginning of the submitted report.