HITEC UNIVERSITY

Taxila Cantt

SELF ASSESSMENT REPORT

BS IoT

Computer Engineering

Faculty of Engineering and Technology

Heavy Industries Taxila Education City (HITEC) University

May 2023

Prepared by:	**Department of Computer Engineering**
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Reviewed by:	**QEC, Chairman, Dean, Vice-Chancellor**
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Contents

Executive Summary

This self-assessment report is being prepared for BS Internet of Things program offered in the Department of Computer Engineering as prescribed by the Higher Education Commission. Quality Enhancement Cell was formed in HITEC University in 2011. Program Team and Assessment Team of Computer Engineering department were formulated by HITEC University to collaborate with QEC to accomplish the following report in line with HEC guidelines and with the support of Vice Chancellor and Department Heads.

This self-assessment report provides an analysis and evaluation of the academic standards followed and implemented by BS Internet of Things Program. HEC prescribed Self-Assessment Manual is used as a reference and the program is being evaluated based on 8 criteria and 31 standards of quality improvement. Initially, Program Team(PT) of Computer Engineering Department prepared the report and later the same was further assessed by the Assessment Team (AT). The report finds the prospects of maintaining and continually enhancing academic standards and learning for students in view of the latest technology and trends.

This report also investigates the strong and weak areas and other improvements needed by the Department. A feedback is then provided in the form of corrective actions and implementation plan for quality assurance and improvement of academic programs in the future.

Objectives

- To document the entire program into one report for the purpose of accountability, quality enhancement and accreditation.
- To make aware all the stake-holders about their rights and duties as per the Self-Assessment Manual.
- To be eligible for HEC funding proportionate to our ranking.
- To be eligible for evaluation by external evaluators.

Execution

The hierarchy of the execution tree was fundamental to the efficient working of all the stake-holders. Formulation of PT and AT was the very first step towards the goal.

Self-Assessment Manual was distributed to all the faculty members for awareness and especially to the Program and Assessment Teams for SAR to prepare one for the Computer Engineering Department. Lectures and workshops were arranged for senior faculty members along with the Registrar, Treasurer, Controller of Examination, Deans and Vice-Chancellor where qualified professionals of their fields highlighted the role of Quality and Accountability in education; especially in Higher Education.

The senior faculty members then became mentors for their juniors and hence the knowledge of the subject was spread to each and every faculty member along with supporting individuals/groups, until all were on the same page.

Once the criteria were ready, the task holder sent the soft copy for review and proof reading to the chair of the Program Team. The chair reviewed and proof read in company with the Quality Representative of the respective Department. Once all the corrections and revisions were done in line with the Self-Assessment Manual, the task holders sent a signed hard copy and a soft copy to the chair of the Program Team who then incorporated the finished criteria into a single report and the report was given a draft shape.

This draft was then sent as a soft and hard copy to the Quality Enhancement Cell, Chairman Computer Engineering Department, Dean and Vice-Chancellor who gave their valuable inputs.

Once the draft was finalized, QEC arranged for the Self-Assessment Report of the BS Internet of Things Program to be assessed by the Assessment Team in middle of May 2023.

The findings of the Assessment Team (AT) are given in the annexure-D. It outlines the improvements required in the infrastructure, syllabi and training of the faculty and support staff. The implementation plan (annexure-E) was prepared after discussion with all the stake-holders and it indicates the resources required to improve the Quality. Responsible bodies, timelines and goals were set for the execution of the implementation plan.

Self-Assessment Report

Introduction

Heavy Industries Taxila Education City (HITEC) University is a private sector university. It was established in 2007 and was awarded in 2009 by the Government of Punjab. The University is sponsored by Heavy Industries Taxila Education Welfare Trust (HITEWT). The university was

established with a vision to produce skilled professionals having moral, ethical and patriotic values who can serve the society and who will be guardians of national, social and religious values.

University Mission Statement

HITEC University will be a center of excellence in teaching, learning and research. We shall instill and inspire intellectual curiosity, lifelong quest of knowledge and a keen urge for social and moral responsibility. The University will establish strong linkages with industry ensuring innovative research leading to economic prosperity of Pakistan.

Department of Computer Engineering

Department of Computer Engineering is currently running following first intake of the BS Internet of Things Program.

- BS Internet of Things 2022

Program Selected

HITEC University has selected the BS Internet of Things Programfor Self-Assessment Report (SAR) under the directives of Higher Education Commission (HEC). It was initially under the umbrella of CE department but a separate setup was launched in 2022.

Program Evaluation

The program is being evaluated based on 8 criterion and 31 standards as given in the Self-Assessment Manual provided by the Higher Education Commission (HEC).

Criterion 1: Program Mission, Objectives and Outcomes

Standard 1-1 The program must have documented measurable objectives that support institution mission statements.

Vision of the HITEC University, Taxila

HITEC University shall be a premier institution and bastion of academic excellence. It must become a citadel of our ideological moorings, national integration and socio-religious values. HITEC ought to trigger the human mind to think clearly perceiving the environment and issues confronting human beings, seeking intelligent, viable and practical solutions, leading to the societal development and the overall betterment of human race. The campus shall provide our progeny with the environment for intellectual flourishing, nurturing fertility of thought and creativity. HITEC University faculty will focus on preparing our youth to face the challenges of life with honor, confidence and fortitude through character building and grooming. In HITEC University merit, justice, honesty and adherence to moral and social values must prevail. The University shall provide a pedestal for the fulfillment of our youth's aspirations and hopes to live an honorable life as citizens of Pakistan.

Mission of the HITEC University, Taxila

HITEC University will be a center of excellence in teaching, learning and research. We instill and inspire intellectual curiosity, lifelong quest for knowledge and keen urge for social and moral responsibility. The University will establish strong linkages with industry, ensuring innovative research leading to economic prosperity of Pakistan.

Faculty Vision

Endure to propagate knowledge and perpetuate truth for prosperity.

Faculty Mission

The mission is to produce IoT professionals well-versed in the knowledge of their domain and its application in the service of industry and community for creating innovative designs and solutions, keeping in view the ethical, environmental and societal concerns.

Program Educational Objectives

The graduates of IoT will have the following skills/attributes/capabilities in 4-5 years after their graduation:

PEO 1:	Ability to serve completely in the national and international market/industry/academia by demonstrating high-quality knowledge and skills in the field of computer science.
PEO 2:	Show quest for learning and improvement of skills through qualification enhancement or continued professional development.
PEO 3:	They will contribute as effective team members and managers in their organizations.
PEO 4:	Demonstrate commitment to social responsibilities, moral/ethical values and community services.

The first draft of PEOs was formulated in the Departmental Board of Studies (DBS) meeting which was attended by all faculty members. Following points were considered while designing the PEOs.

- Various aspects of the program educational structure and attributes,
- PEOs should be in line with university vision and mission statement,
- Desired attributes of the graduates, and
- The requirement of the industry.

Alignment of PEOs with the University Vision and Mission

While defining the PEOs, it was ensured that the University Vision and Mission, the requirements of Employers and the requirements of Society have been considered. The alignment of PEOs with University Vision and Mission and program mission is shown in Table 1-1. The PEOs are shared on the university website, included in the latest prospectus and also displayed in the departmental building.

Table 1-1. Alignment of PEOs with the University Vision and Mission

Vision & Mission	PEOs			
	1	2	3	4
HITEC University shall be a premier institution and bastion of academic excellence. It must become a citadel of our ideological moorings, national integration and socio-religious values. HITEC ought to trigger the human mind to think clearly perceiving the environment and issues confronting human beings, seeking intelligent, viable and practical solutions, leading to the social development and the overall betterment of human race. The campus shall provide our progeny with the environment for intellectual flourishment, nurturing fertility of thought and creativity. HITEC University faculty will focus on preparing our youth to face the challenges of life with honor, confidence and fortitude through character building and grooming. In HITEC University merit, justice, honesty and adherence to moral and social values must prevail. The	✓	✓	✓	✓

Vision & Mission	PEOs			
	1	2	3	4
University shall provide a pedestal for the fulfilment of our youth's aspirations and hopes to live an honorable life as citizens of Pakistan.				
HITEC University will be a center of excellence in teaching, learning and research. We instill and inspire intellectual curiosity, lifelong quest for knowledge and keen urge for social and moral responsibility. The University will establish strong linkages with industry, ensuring innovative research leading to economic prosperity of Pakistan.	✓	✓	✓	✓

The vision of HITEC University and the mission of the Faculty of Engineering covers all the four PEOs defined in the previous section. Table below specifies the University Vision/Faculty of Engineering mission related to respective PEO.

Program Educational Objectives	Keywords
PEO 1: Our graduates will have professional career in industry, academia, R&D organizations or in a self-initiated entrepreneurial undertaking.	**University Vision:** • Intellectual flourishment • Nurturing thought • Creativity **University Mission:** • Center of excellence in teaching, learning and research • Strong linkages with industry **Faculty of Engineering Vision:** • Propagate knowledge **Faculty of Engineering Mission:** • Application in the service of industry • Creating innovative solution
PEO 2: Our graduates will be able to analyze problems and create sustainable solutions using their domain knowledge and modern IT tools. Also, they will have the ability to adapt to the changes in technology and the needs of society.	**University Vision:** • Intellectual flourishment • Nurturing thought • Creativity **University Mission:** • Center of excellence in teaching, learning and research • Strong linkages with industry **Faculty of Computer Engineering Vision:** • Propagate knowledge

Program Educational Objectives	Keywords
	Faculty of Computer Engineering Mission: • Computer engineering professionals well versed in the knowledge of their domain • Application in the service of industry • Creating innovative solution
PEO 3: Our graduates will continue to seek knowledge for professional advancement and enhanced awareness about computing practices and societal concerns.	**University Vision:** • Confidence and fortitude • Character grooming • Intellectual flourishment • Creativity **University Mission:** • Urge for social responsibility **Faculty of Computer Engineering Vision:** • Propagate knowledge **Faculty of Computer Engineering Mission:** • Computer engineering professionals well versed in the knowledge of their domain • Application in the service of industry • Societal concerns
PEO 4: Our graduates will manage assigned projects as individuals or as a part of an interdisciplinary team. They will be effective communicators and will conduct themselves with integrity, upholding the principles of ethics and social responsibility.	**University Vision:** • Character building and grooming • Adherence to moral and social values **University Mission:** • Urge for social responsibility **Faculty of Computer Engineering Vision:** • Perpetuate truth **Faculty of Computer Engineering Mission:** • Ethical environmental and societal concerns

Standard 1-2 The program must have documented outcomes for graduating students. It must be demonstrated that the outcome supports the program objectives and that graduating students are capable of performing these outcomes.

Strategic Plan to Evaluate PEOs

Department of Computer Engineering is committed to providing standard education, conducting international level research, addressing the rapidly changing needs of the industry, and meeting the increasing demand of the society.

The various elements of each PEO are discussed in detail followed by adopted strategies. Benchmarks are also identified that define the various measures of success, which would be used over the next five years to quantify the achievements and progress.

PEO — 1

ABILITY TO SERVE COMPLETELY IN THE NATIONAL AND INTERNATIONAL MARKET/INDUSTRY/ACADEMIA BY DEMONSTRATING HIGH-QUALITY KNOWLEDGE AND SKILLS IN THE FIELD OF COMPUTER SCIENCE.

Elements

- To design and review curriculum while maintaining parallelism with industry and corporate based on the standards of esteemed national and international institutions.
- Promotion of the concept of self-initiated entrepreneurship.
- Encouragement for higher studies.

Strategies

- Invite professors from different reputable academic institutions and R&D organizations to give seminars and hold workshops on important technical subjects.
- Faculty members organize seminars in their respective research fields.
- The curriculum should be revised periodically under recommendations of postgraduate faculty members.
- Attract and retain highly qualified and motivated faculty in all core areas of the program.
- Provide latest relevant software in laboratories to ensure that students get practical training along with theoretical concepts.
- Identify and invite key scientists of international standing for seminars.
- Invite various companies to give seminars on important industrial developments.
- Develop linkages with the industry.

Key Performance Indicators

- 60% of the students should be employed.
- At least 10% of the students should go for higher studies.
- At least 10% of the students should manage self-initiated business activities.
- Employer Feedback should be above 60%.

PEO — 2

SHOW QUEST FOR LEARNING AND IMPROVEMENT OF SKILLS THROUGH QUALIFICATION ENHANCEMENT OR CONTINUED PROFESSIONAL DEVELOPMENT.

Elements

- Design the curriculum based on recommendations of international and national academic bodies, keeping in view the requirements of local industry and national needs.
- Lay strong emphasis on laboratory work and honing practical skills.
- Strive for the top-quality teaching of the designed curriculum.

Strategies

- Undergo extensive review of curriculum recommendations of Higher Education Commission of Pakistan (HEC) and Pakistan Engineering Council (PEC) for Computer Engineering.
- Attract and retain highly qualified and motivated faculty in all core areas of the program.
- Maintain a strong faculty to student ratio, ideally under the range of 1:20.

Key Performance Indicators

- Employer Feedback should be above 60%.
- Alumni Feedback Should be above 60%.
- At least 10% of the students should go for higher studies.

PEO — 3

THEY WILL CONTRIBUTE AS EFFECTIVE TEAM MEMBERS AND MANAGERS IN THEIR ORGANIZATIONS.

Elements

- Comprehensive knowledge base development of computer engineering with emphasis on core concepts.
- Respectable awareness development regarding the advancements made in the field of computer engineering.
- Basic understanding of the traditional industrial practices and engineering standards.

Strategies

- Invite industry professionals and organize seminars on leadership and ethical practices related to the workplace environment.

- Revision off the curriculum at regular intervals using the suggestions and recommendations of senior faculty members regarding modern day tools.
- Special attention is given to the labs having greater relevance to modern day hardware and software.

Key Performance Indicators

- The curriculum of courses with modern day tools should be up to date.
- At least 10% of the students should manage self-initiated business activities.
- Employer Feedback should be above 60%.
- Alumni Feedback should be above 60%.

PEO — 4

DEMONSTRATE COMMITMENT TO SOCIAL RESPONSIBILITIES, MORAL/ETHICAL VALUES AND COMMUNITY SERVICES.

Elements

- Comprehensive knowledge-based development of computer science with sufficient emphasis on interdisciplinary concepts.
- The morality of the student as a human being.
- Ethical standard of the student as an IoT professional.

Strategies

- Revision of the curriculum at regular intervals using the suggestions and recommendations of senior faculty members regarding interdisciplinary concepts.
- Revision of the ‘ethics’ subject curriculum at regular intervals using the suggestions and recommendations of senior faculty members.
- Establishing managerial tasks that test the morality of the student.

Key Performance Indicators

- Employer Feedback should be above 60%.
- Alumni Feedback should be above 60%.

Criterion 2: Curriculum Design and Organization

The curriculum of the Internet of Thing (IoT) Program adhered to the HEC guidelines. Students are to complete a total of 137 credit hours within a minimum of four years. Details of the curriculum are listed below.

Title of Degree Program

Bachelor of Science in Internet of Thing

Definition of credit hour:

One credit hour represents one contact hour a week in class or three contact hours a week of laboratory work per semester. An academic semester represents 16 weeks of classes exclusive of exams.

Degree plan & Course Breakdown

Following is the list of courses taught in the selected program. Section 4.5 shows the details about these courses including pre-requisites.

Semester 1				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	BS-105	Applied Physics	2+1	3
2	HS-101	English	3+0	3
3	MT-101	Calculus & Analytical Geometry	3+0	3
4	EE-102	Electric Circuit Analysis	3+1	4
5	HS-102	Pakistan Studies	2+0	2
6	IOT-101	Fundamentals of IOT	3+0	3
7	QT-101	Translation of Quran: Beliefs	*1+0	0
		Total	16+2	18

Semester 2			
Sr. No.	**Course Code**	**Course**	**Credit Hours**

1	IOT-102	Introduction to Information and Communication Technologies	2+0	2
2	EC-111	Programming Fundamentals	3+1	4
3	EE-205	Electronic Devices and Circuits	3+1	4
4	EC-121	Digital Logic Design	3+1	4
5	MT-303	Applied Linear Algebra	2+0	2
		Total	13+3	16

Semester 3				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	MT-103	Differential Equations	3+0	3
2	EC-231	Operating Systems	3+1	4
3	IOT-201	IoT Communication	3+1	4
4	HS-203	Community Service	0+1*	0
5	HS-103	Communication Skills	3+0	3
6	EC-230	Object Oriented Programming	3+1	4
7	QT-201	Translation of Quran: Worship	*1+0	0
		Total	15+3	18

Semester 4				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	MT-201	Complex Variables and Transforms	3+0	3
2	EC-223	Signals and Systems	3+1	4
3	EC-222	Data Structures and Algorithms	3+1	4
4	EC-228	Computer Architecture and Organization	3+1	4
5	IOT-202	IoT Applications	2+1	3
		Total	14+4	18

Semester 5

Sr. No.	Course Code	Course	Credit Hours	
1	xx-xxx	IoT Elective-1	3+0	3
2	EC-390	Digital Signal Processing	3+1	4
3	HS-201	Technical Report Writing	3+0	3
4	EC-341	Digital System Design	3+1	4
5	EE-334	Database Systems	3+1	4
6	QT-301	Translation of Quran: Moral Values	*1+0	0
		Total	14+4	18

Semester 6				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	MT-302	Probability and Statistics	3+0	3
2	CS-204	Software Engineering	3+0	3
3	EC-442	Embedded Systems	2+1	3
4	xx-xxx	IoT Elective-2	3+0	3
5	xx-xxx	IoT Elective-3	3+0	3
6	xx-xxx	IoT Elective-4	2+1	3
		Total	16+2	18

Semester 7				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	HS-401	Professional Values and Ethics	2+0	2
2	SE-401	Software Project Management	3+0	3
3	xx-xxx	IoT Elective-5	2+1	3
4	xx-xxx	IoT Elective-6	2+1	3
5	EC-499	Final Year Project-I	0+3	3
6	QT-401	Translation of Quran: Dealing and Communication	*1+0	1

		Total	9+6	15

Semester 8				
Sr. No.	**Course Code**	**Course**	**Credit Hours**	
1	IS-211	Islamic Studies	2+0	2
2	ME-407	Health Safety and Environment	1+0	1
3	xx-xxx	IoT Elective-7	2+1	3
4	xx-xxx	IoT Elective-8	2+1	3
5	xx-xxx	IoT Elective-9	2+1	3
6	EC-499	Final Year Project II	0+3	3
		Total	9+6	15

TOTAL CH	**136**

IoT Elective Courses:

EE-436	Cyber Security
IOT-302	Data Analysis for IoT
IOT-441	Introduction to Human Computer Interaction
IOT-412	Telecommunications Networks
IOT-333	Edge Computing
IOT-421	Embedded Operating Systems
IOT-332	Introduction to Security of Internet of Things and Cyber-Physical Systems
IOT-331	Cloud Computing for IoTs
IOT-341	Introduction to Circuits & Electronic Hardware
IOT-351	Introduction to Computer Design
IOT-401	Microcontrollers for IoT Devices
IOT-403	Introduction to Wireless Communications for IoT

IOT-402	Sensors for IoT
IOT-411	Network Protocols for IoT
IOT-312	Industrial IoT
IOT-321	IoT boards Programming
IOT-311	Smart IoT Devices
IOT-301	Machine Learning for IoT
IOT-412	Machine to Machine and IoT interface for embedded systems
CS-407	Data Mining
EC-444	Parallel and Distributed Computing
CS-433	Deep Learning and Applications
CS-311	Data Warehousing
IOT-413	Wireless Networks for IoTs
IOT-431	Neural Networks for IoTs

Courses Information:

The course description is attached in Annexure D.

Standard 2-1The curriculum must be consistent and supports the program's documented objectives.

Group 1: Humanities

English	HS-101
Communication Skills	HS-103
Technical Report Writing	HS-201
Pakistan Studies	HS-102

Group 2: Basic Sciences

Islamic Studies	IS-211
Professional Ethics	IS-411

Group 3: Electrical Engineering and Computer Science

Electric Circuits	EE-102

Basic Electronics	EE-201
Network Analysis	EE-103
Engineering Physics	BS-101

Group 4: Mathematics Courses

Calculus & Analytical Geometry	MT-101
Differential Equations	MT-103
Complex Variables and Transforms	MT-201
Linear Algebra	MT-203
Numerical Methods	MT-202
Probability and Statistics	MT-302

Group 5: Management Sciences

Engineering Economics	MS-201
Engineering Management	MS-401
Technology Entrepreneurship	MS-410

Group 6: Courses of Internet of Thing Domain

IOT-202	IoT Applications
IOT-201	IoT Communication
IOT-102	Introduction to Information and Communication Technologies
IOT-101	Fundamentals of IOT
IOT-302	Data Analysis for IoT
IOT-441	Introduction to Human Computer Interaction
IOT-412	Telecommunications Networks
IOT-333	Edge Computing
IOT-421	Embedded Operating Systems
IOT-332	Introduction to Security of Internet of Things and Cyber-Physical Systems
IOT-331	Cloud Computing for IoTs
IOT-341	Introduction to Circuits & Electronic Hardware
IOT-351	Introduction to Computer Design
IOT-401	Microcontrollers for IoT Devices
IOT-403	Introduction to Wireless Communications for IoT
IOT-402	Sensors for IoT
IOT-411	Network Protocols for IoT
IOT-312	Industrial IoT
IOT-321	IoT boards Programming
IOT-311	Smart IoT Devices

Standard 2-2 Theoretical backgrounds, problem analysis and solution design must be stressed within the program's core material.

Table 2: Standard 2-2 Requirement (table 4.5)

Elements	Courses	
Theoretical Background	CE-101	Computing Fundamentals
	EE-102	Electric Circuits
	BS-101	Engineering Physics
	CE-106	Computer Applications in Engineering
	CE-108	Programming Fundamentals
	EE-201	Basic Electronics
	CE-201	Data Structures and Algorithms
	CE-202	Digital Logic Design
	CE-306	Operating Systems
	CE-402	Digital System Design
Problem Analysis	CE-203	Discrete Structures
	EE-103	Network Analysis
	CE-207	Object Oriented Programming
	CE-208	Database Systems
	CE-301	Microprocessor and Interfacing Techniques
	CE-302	Signals and Systems
	CS-311	Digital Image Processing
Solution Design	CE-107	Computer-Aided Engineering Drawing
	MT-201	Complex Variables and Transforms
	HS-201	Technical Report Writing
	CE-307	Computer Communication Networks
	CS-406	Artificial Intelligence

Standard 2-3, 2-4, 2-5 The Curriculum must satisfy the core/ major, general requirements for the program as specified by the respective accreditation body.

Program	Math & Basic Science	IoT Topics	General Education	Others
BS IoT	15	20	0	0

Standard 2-6 Information technology component of the curriculum must be integrated throughout the program.

Since, the Department of Computer Engineering significant amount of IT related courses, the goal is to provide students with in-depth knowledge and problem solving skills through which they can excel in the industry and academia.

Semester 1 contains the 2+1 credit hours of information technology topics (Computing Fundamentals), out of which 2 credit hours are for theoretical work and 1 credit hour is dedicated to laboratory work. This course educates the students with the basics of the computer sciences and its application in the field of engineering.

Semester 7 and 8 comprises of the Final Year Project (FYP) which is the litmus paper through which a student can be evaluated for its designing and implementation skills. And hence, all major courses and technologies learnt till then come into play during FYP.

The knowledge provided during these courses is applicable throughout the program whenever students do practical work in laboratory for any course and that requires the knowledge of Information technology concepts to execute their work. These courses also help them during the final project which always requires the designing of their projects using relevant software applications.

Following are the courses that are related to IT.

Course Code	Course Title	Credit Hours
EC-110	Computing Fundamentals	2+1
EC-111	Programming Fundamentals	3+1
EC-230	Object Oriented Programming	3+1
EC-231	Operating Systems	3+1
EC-228	Computer Architecture and Organization	3+1
CS-204	Software Engineering	3+0
EC-332	Computer Communication Networks	3+1
EC-445	System Programming	2+1
EC-448	Introduction to Robotics	2+1

EC-482	Network Security and Cryptography	3+0
CS-302	Artificial Intelligence	2+1

Standard 2-7 Oral and written communication skills of the student must be developed and applied in the program.

Students go through the compulsory course of 3 credit hours titled Communication Skills (course number HS 201) and 3 credit hours Technical Report Writing (course number HS 202) which develops the oral and written communication skills of the students. These courses are given due weightage and correspondingly evaluated during their Final Year Project. Following are list of courses for oral and communication skills courses.

Course Code	Course Title	Credit Hours
HS-101	English	3+0
HS-102	Pakistan Studies	2+0
HS-103	Communication Skills	3+0
HS-201	Technical Report Writing	3+0
HS-401	Professional Values & Ethics	2+0
HS-404	Foreign Language	2+0
HS-405	Health Safety and Environment	1+0

Criterion 3: Laboratories and Computing Facilities

Department of CE have established multiple laboratories for students to enhance the practical skills. Following is the list of available laboratories:

- Embedded Systems Lab
- Data Communication and Networks Lab
- Digital Signal Processing Lab
- Computing Lab
- Database Systems Lab
- Artificial Intelligence Lab
- Digital Systems Lab
- Electronics Lab
- Workshop Lab

The details about these laboratories are provided on the following pages:

Sr. No.	Name of Laboratory	Location and area	Objectives	Adequacy for instruction	Lab(s) of Course(s) Conducted in the Lab	Software available	Type(s) of Workstations (No. of each Type)	Safety Regulations
Dedicated Labs								
1	Computing Lab	Israr Block (2nd floor)	The lab gives pupils practical practice using a variety of computing hardware and software, including desktop and laptop computers, servers, and programming tools. For students to develop practical skills that are useful in the workplace, this experience is crucial. The lab can assist with computing-related teaching and learning tasks. Students can gain a hands-on grasp of ideas	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EC-110 Computing Fundamentals [Fall19] EC-111 Programming Fundamentals [Sp20]	Matlab 2020 Cisco Packet Tracer Pycharm / python Microsoft Visio Net Beans Wamp server	HP Compaq Dx 7400, Core 2 Duo (47 Units), Dell OptiPlex 360, Core 2 Duo (10 Units)	Safety regulations are being strictly followed and displayed in each lab.

			like programming,					
2	Digital Signal Processing Lab	Israr Block (2nd floor)	Giving students the chance to get them hands on experience with real-world signal processing issues. The lab can give students the chance to work on real-world signal processing issues like filtering, noise reduction, image processing, and voice processing.	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EC-230 Object Oriented Programming [Fall19] ME-211 Computer Aided Engineering Design [Fall19] EC-223 Signal and Systems [Sp20] EC-390 Digital Signal Processing [Sp20]	Matlab 2016 Ansys SQL Server Model Sim AutCAD Python-pycharm Sublime text Ubuntu 20.04 LTS Codeblocks Dev C Cisco Packet Tracer Microsoft Visio 2013	Dell OptiPlex corei7 (26), Dell OptiPlex corei3 (10), Dell OptiPlex 755, Core 2 Duo (51 Units), Dell OptiPlex 360, Core 2 Duo (7 Units), Digital Signal Processing Kits and associated components.	
3	Database Systems Lab	Israr Block (2nd floor)	Research in fields like data administration, data mining, machine learning, and artificial intelligence can be done in the database systems lab. Students, researchers, and faculty members can conduct experiments, analyse data, and create novel database technologies in the lab. The instruction and learning of database	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EC-334 Database Systems [Fall19] EC-222 Data Structures and Algorithms [Sp20]	Code blocks Visual studio Matlab 2021 Office 2016 SQL Server Python-pycharm Ubuntu 20.04 LTS Cisco Packet Tracer Wire Shark	Dell OptiPlex 745, Core 2 Duo (51 Units), Dell OptiPlex 360, Core 2 Duo (2 Units), Dell OptiPlex 755, Core 2 Duo (2 Units)	
4	Artificial Intelligence Lab	Israr Block (2nd floor)	The lab can be used for study in fields like computer vision, robotics, natural language processing, machine learning, and AI ethics. Students, researchers, and faculty members can perform experiments, analyze data, and create new AI technologies in the lab. The lab can assist with AI-related	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	CS-302 Artificial Intelligence [Fall19] CS-406 Digital Image Processing [Fall19] EC-231 Operating Systems [Sp20] EC-445 Systems Programming [Sp20]	Matlab 2016 Jupiter anaconda Visual Studio Dec C	Dell OptiPlex 9020, Core i5 (50 Units), Dell Gx-620 (10 Units)	

			education and learning initiatives. The lab can be used to teach courses in AI, machine learning, and related areas as well as to give students practical experience designing and implementing AI systems.					
5	Data Communication and Networks Lab	Israr Block (2nd floor)	This laboratory is utilized to facilitate hands-on experiments for communication courses in the fields of wired and wireless communications. It would help in grasping theoretical concepts and visualization of how data in terms of bits and bytes gets transmitted. Peer-to-Peer and Client-Server models along with various network topologies are covered. Different simulation tools are installed in the lab to get an in depth understanding and practical expose to network communication technologies.	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EC-334 Computer Communication Networks [Fall19] EC-444 Parallel and Distributed Computing [Sp20]	Matlab 2016 Ansys SQL Server Model Sim AutCAD Python-pycharm Sublime text Ubuntu 20.04 LTS Codeblocks Dev C Cisco Packet Tracer Microsoft Visio 2013	Dell OptiPlex 9020, Core i5 (50 Units), Dell OptiPlex 620, Core 2 Duo (9 Units), Dell OptiPlex 755, Core 2 Duo (1 Unit)	
6	Embedded Systems Lab	Israr Block (2nd floor)	This lab provides embedded and other hardware resources that are required to design, analyze and implement embedded systems. In addition, the lab also has a number of analog and digital equipment required for	All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EC-333 Microprocessor and Interfacing Techniques [Fall19] EC-442 Embedded Systems [Fall19] EC-228 Computer Architecture and Organization [Sp20]		Workbenches (i7), Embedded Trainer Boards, MTS-51 Microprocessor Trainer Boards, Power Supplies, Digital Multi-meter and associated electric components.	

			experimentation and project building at both junior and senior level of undergraduate studies.		EC-341 Digital System Design [Sp20]			
Shared Labs								
7	Digital Systems Lab (Shared)	Israr Block (1st floor)		All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EE-102 Electric Circuit Analysis [Fall19] EC-121 Digital Logic Design [Fall19]		Workbenches (16), Digital Logic Trainer board, Adv. Digital Logic Trainer, Micro-controller 8051 based, Embedded Trainer	
8	Electronics Lab (Shared)	Israr Block (1st floor)		All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EE-205 Electronic Devices and Circuits [Sp20]		Workbenches (16), Signal Generator, Oscilloscope, Multi-meter, DC Power Supply, Electricity Trainer Module	Safety regulations are being strictly followed and displayed in each lab.
9	Workshop Lab (Shared)	Israr Block (1st floor)		All required instruction material and charts are displayed in the lab at appropriate places for use by faculty, students and support staff.	EE-101 Engineering Workshop [Sp20]		Power supply, Signal generator, Oscilloscope, Multimeters, Wiring Trainer, Soldering Iron, Project Board	

Table 3: Laboratories Details 1

Standard3-1Laboratory manuals/documentation/instructions for experiments must be available and easily accessible to faculty and students.

All manuals and instructions are available with the Laboratory in-charge and copies of these are also available with program coordinator and program in-charge to be used by faculty members and students. These manuals and instructions are issued to desired entity through a defined process and proper record is being kept. The laboratory in-charge keeps the manuals and instructions in laboratory for immediate access to students and faculty members during the laboratory work.

Laboratory equipment and facilities in HITEC are comparable to any high reputed university of the country.

Standard 3-2There must be support personal for instruction and maintaining the laboratories.

Each laboratory has 2 staff members which are Laboratory In-charge and Laboratory Assistant. Laboratory In-charge is responsible for overall maintenance of laboratory and also maintains the manuals and instructions while the Laboratory Attendant is responsible for the maintenance of the laboratory equipment and general duties within the lab.

Standard 3-3The University computing infrastructure and facilities must be adequate to support program's objectives.

The computer laboratories are equipped with state of the art computers and relevant equipment. The program objectives require the students to be equipped with IT skills at the end of the program and facilities (equipment and software) provided in the computer laboratories are adequate enough to achieve program objectives. Computing facilities in HITEC are comparable to any high reputed university of the country.

Criterion 4: Student Support and Advising

Since the launch of HITEC University in year 2007, all its programs have started and finished on schedule. The beauty of the HITEC culture is that teachers and students have facility of frequent interaction, even after classes, for any professional and academic advice. This aspect is even highlighted and indicated by the students in the feedback on HEC Performa number 10, taken by the Quality Enhancement Cell (QEC) in the University.

Standard 4-1Courses must be offered with sufficient frequency and number for students to complete the program in a timely manner.

The core and elective courses are offered in a logical sequence that grooms the students to obtain the program's defined objectives and outcomes. The courses offered outside the Department are of Faculty of Basic Sciences and Faculty of Electrical Engineering. The Engineering program coordinator, coordinates with the respective coordinator in both the faculties and accommodate the desired courses in program's time table. This is done well in advance prior to the commencement of classes to avoid any clashes in the schedule.

Standard 4-2Courses in the major area of study must be structured to ensure effective interaction between students, faculty and teaching assistants.

All courses in the program are taught by the faculty member(s) as per HEC approved loading. Courses are structured in the board of studies before commencement of each semester. Faculty members interact frequently among themselves and with the students. Students are encouraged to participate in providing feedback and their views about course contents during and after the classes.

Standard 4-3Guidance on how to complete the program must be available to all students and access to qualified advising must be available to make course decisions and career choices.

Students are informed about the program requirements at the start of the session during orientation week by in-charge program and QEC staff. Session coordinator acts as advisor to guide students to choose appropriate courses and also provide guidance on different issues. He/She also maintain a list of guidance points provided to students during the semester and program, which is being evaluated at the end of the program to take necessary improvement.

Session coordinator provides professional counseling to students when needed. Students can get in touch directly with him/her for any advice.

Director Student Affairs arranges industrial tours for students to improve their subject vision and technical know-how. He also invites professionals from different industries to conduct interactive sessions with students for advice on professional matters/future career planning.

Program coordinator maintains a list of professional societies and technical bodies, that is provided to students on demand and students can get membership of such organizations on individual basis. For example IEEE student body membership is open for all students.

CRITERION 5: PROCESS CONTROL

Standard 5-1

Eligibility Criteria for admission in BS in IoT program at Department of Computer Engineering

• F Sc/A Level / DAE
• Minimum 50 % marks.

Medical Fitness

A student is required to be medically fit to undertake the studies and practical/physical work.

Waiting List

A waiting list is prepared strickly on merit by the admission committee. Students in the waiting list may be offered an admission in BS program subjected to availability of vacant seats or refusal of admission due to any deficiency.

Rejection of Application

- Admissions at HITEC University Taxila can be cancelled at any stage of the academic career if any document / information provided by the student is found to be false / incorrect or not meeting the eligibility criteria, with no liability on HITEC University Taxila.
- The University reserves the right to reject any aplication for admission without assigning any reason.

Award of Discipline

There is only one discipline, i.e., Computer Engineering (BS-IoT).

Migration and transfer of credits

Migration and tranfer of credits may be transferred from other local accredited or HEC recognized foreign institution(s) only if they are relevant to BS program in any of two disciplines approved by the university. In such cases, following conditions must be fulfilled.

- Ony the course(s) wiıh 'B' grade, equivalent or higher shall be considered for transfer.
- The candidate will have to complete the program in the stipulated time as laid down by the HEC/
  Universiıy, and it shall include the time already spent in the previous institution.
- A maximum of 12 Credit Hours from previous institution can be transferred to HITEC University.
- The transfer of credits is subjected to acceptance by the Deparımental Board of Studies.
- Admission by migration shall not be allowed after expiry of three weeks of the commencement of classes/ semester.
- Migration shall not be allowed from affiliated colleges or institutions.

International Students

No policy exists for admission of international students at graduate level (BS) in HITEC University Taxila.

Standard 5-2
Program Registration

Students, after appearing in the entrance examinations are assigned a merit number based on their score. Once enrolled in a program, the students progess is continuously monitored within the semester and throughout the degree program. This is done through Batch advisor and Head of Department through course teacher and supervisor (if the student is in thesis phase).

Standard 5-3
Recruiting and Training Highly Qualified Faculty

Highly qualified faculty is inducted on merit basis which includes that subject expertise, teaching experience (if required) and research experience (research publications and grants won). The faculty recruitment process starts with the advertisement on university website and in regional newspapers. The applicants has to apply online with scanned copies of educational/experience documents. After initial scrutiny at department and then at Dean level, the applicant is invited for a formal interview (if he/she meets the eligibility criteria of the advertised post). He/she is also asked to prepare a presentation in the area of interest. Before the formal interview, the applicant delivers his presentation infront of department faculty and other invited audience. After the presentation, the applicant is required to appear infront of the selection board for formal interview. Both presentation and interview contributes towards the final score and subsequently the selection of the applicant.

Standard 5-4
Emphasis on Active Learning through Course Material

The course contents of all courses being taught are evaluated regularly and any improvements/suggestions are discussed and evaluated. The department is planning to conduct faculty and student feedback from Fall 2022 semester.

Standard 5-5

Ensuring Graduates Meet Program Requirements

Department of Computer Engineering follows the HITEC University Statutes which clearly defines the graduation criteria. As per HITEC University statutes, a student is dropped from BS program, if

- He/she fails in more then one course in course work.
- Fails to clear the "**F**" grade
- CGPA remains below 2.50 after comptetion of the course work even after availing repetition of courses allowed under the rules
- "**I"** (lncomplete) grade in any course.
- CGPA less than 2.0.

Criterion 6: Faculty

Standard 6-1There must be enough full time faculties who are committed to the program to provide adequate coverage of the program areas/courses with continuity and stability. The interests and qualifications of all faculty members must be sufficient to teach all courses, plan, modify and update courses and curricula. All faculty members must have a level of competence that would normally be obtained through graduate work in the discipline. The majority of the faculty must hold a Ph.D. in the discipline.

There are three PhD faculty members, specialist in the fields of Quantum Computing, Wireless Communication, Digital image processing, image forensic, and multimedia networks. Including these following ranks are available in the Computer Engineering department:-

- Associate Professor – 1
- Assistant Professor – 4
- Lecturer – 3
- Lab Engineers - 3

Sr. #	Course Name	Course Code	Number of faculty members in each area	Number of PhD faculty
1	Fundamentals of IOT	IOT-101	-	1
2	Introduction to Information and Communication Technologies	IOT-102	1	-
3	IoT Communication	IOT-201	-	2
4	IoT Applications	IOT-202	1	-

Table 4: Elective Courses vs. Availability of Faculty

The ratio of faculty vis-ã-vis courses being taught is satisfactory. The present faculty is in position to take up all courses of under graduate as well as post graduate students. Each faculty member is assigned subjects along with approved syllabus at the beginning of the semester. The faculty member prepares lecture plans and delivers to his / her students. Remaining restricted to the approved syllabus, the faculty member can update the already taught subject material according to the current developments in the field. Thus students are kept updated to the latest developments. Each faculty member is assigned access to the internet. Time

table is scheduled in such a way so as to provide enough time to each teacher for research work. The courses being taught and commitment of the faculty is shown in the Table 16 for prescribed regular courses.

Standard 6-2 All faculty members must remain current in the discipline and sufficient time must be provided for scholarly activities and professional development. Also, effective programs for faculty development must be in place. Effective Programs for Faculty Development

University has an efficient and committed faculty. Each faculty member is assigned to teach subjects according to the syllabus prescribed in the light of HEC and PEC directives. Every faculty member is provided an opportunity at the end of semester through faculty satisfaction report to evaluate his/her performance and comment on the suitability of the contents of curriculum being taught by him according to the latest trends / developments. If deemed necessary, suitable changes to the curricula are made by a board in the light of the suggestions of the concerned faculty member.

The university has organized groups for research in different fields of engineering. Group members are chosen according to their interest in a particular field of engineering. Each group is headed by an experienced / senior teacher. Group members are motivated for research in their respective fields and competitions.

Enough time is provided to the faculty members for devoting their time to research in their fields. The faculty members are assisted by university through provision of internet facility and library.

Standard 6-3 All faculty members should be motivated and have job satisfaction to excel in their profession.

Students' feedbacks about their teachers are received after termination of each semester. Basing on these feedbacks, faculty members graded best by their students are awarded with appreciation letters. Letter of caution is served to the faculty member with whom students are not satisfied.

The faculty survey as per Performa prescribed by HEC is evaluated and basing on the inputs of the Performa, the system is further improved to provide beneficial teaching / learning environment. Faculty Surveys results are attached as per Annexure C.

Criterion 7: Institutional Facilities

Standard 7-1The institution must have the infrastructure to support new trends in learning such as e-learning.

The university has provided e-learning facilities to faculty members and students. Students have been provided a number of computer systems in the library to access e-learning section. Every student has been provided with user ID to access the e-learning resources from within the university library. The support staff to look after the e-learning resources is sufficient in number, trained and responsive. The university has provided enough funding to support the e-learning.

Internet Facility

HITEC University Taxila boasts an internet connectivity of 100 Mbps. The department also has Wi-fi capability enabling mobility to the laptop users. E-mail addresses are also provided by the department and the availability of intranet improves local communication.

Computer Labs

The computer labs available in Department are utilized for conducting lab and research work. It consists of 50 workstations and a server with the latest operating systems and software packages. The lab serves for teaching computer related subjects to the students. The lab also provides an opportunity for preparing Assignments and project write ups by the students.

Standard 7-2The library must possess an up-to-date technical collection relevant to the program and must be adequately staffed with professional personnel.

The university library has enough technical books in hard copies to support the program learning. The library is staffed with more than 8 professionals to help students and faculty members to get access to required book or learning material efficiently. Library statistics related to computer engineering department is given below.

Computer Engineering (Present Copies)	4183
Computer/ Electrical Engineering Journals (IEEE)	13

Standard 7-3Class-rooms must be adequately equipped and offices must be adequate to enable faculty to carry out their responsibilities.

All classrooms are equipped with state of the art equipment like multimedia projectors and whiteboards. Faculty offices are appropriately furnished by provisioning of necessary tables/ bookshelves, computers and printers. Internet connectivity for desktop and WiFi for laptops has been made available.

Criterion 8: Institutional Support

Standard 8-1 There must be sufficient support and financial resources to attract and retain high quality faculty and provide the means for them to maintain competence as teachers and scholars.

University allocates enough financial resources each year to hire competent faculty as required.

As already listed in standard 5-3, Faculty members are retained by giving them favorable teaching environment and management support.

As listed in standard 6-2, Faculty members are provided with adequate resources for research and academic activities to maintain their competence. Faculty members have access to the internet and library materials for academic and research activities. Professional training is also provided to faculty if required to enhance their capabilities.

Standard 8-2 There must be an adequate number of high quality graduate students, research assistants and Ph.D. students.

The university follows the guidelines of PEC for admission in this program. There are no graduate students, research assistants and Ph. D students.

Faculty to graduate student's ratio for the last three years remained in the range of 1:2.

Standard 8-3 Financial resources must be provided to acquire and maintain Library holdings, laboratories and computing facilities.

Library at HITEC holds more than 33,000 books for all programs. Sufficient numbers of computers are available to be used by the students. Library is organized to accommodate 100 to 150 students at a time.

Laboratories at HITEC holds adequate equipment to be used by the students to carry out desired experiments and laboratory work. Each year a handful of budget is allocated for laboratories to maintain and upgrade the equipment and other facilities.

Computing facilities at HITEC provide excellent platform to students to enhance their learning capabilities. There are 3 computer laboratories in Faculty of computing, which are accessible to all students for their use.

Appendices

Appendix – A

Faculty Publications

Sr. No.	Faculty Name	Journal	Conferences	Total
i.	Dr. Raza Ali Shah	14	7	21
ii.	Dr. Imran Ashraf	27	10	37
iii.	Dr. Mehwish Naseer	2	3	5
iv.	Dr. Muhammad Bilal	8	-	8
v.	Asst. Prof. Tehseen Ahsan	0	1	1
vi.	Lect. Sara Tehsin	1	8	9
vii.	Lect. Kaynat Rana	3	-	3
viii.	Lec. Qasim Javaid	2	1	3
ix.	Mr. Ali Raza	2	8	9
				Grand Total: 96

Appendix – B-1

Faculty Resume

Name:	Dr. Raza Ali Shah
Education:	**PhD (ICT)** **Asian Institute of Technology**, Pathumthani, **Thailand** PhD in Information and Communication Technologies (ICT) - (January 2015) **Thesis Topic:** *Performance analysis of dual-hop OFDM relay system with subcarrier mapping in Rayleigh and Nakagami-m fading* **Area of Study:** Wireless communications

	ME (ICT) **Asian Institute of Technology**, Pathumthani, **Thailand** M.E. in Information and Communication Technologies (ICT), (2009) **Thesis Topic:** *Analysis of power efficiency in channel estimation for joint ZP-* *NZP OFDM* **Area of Study:** Telecommunication Engineering **BSc (Electrical Engineering)** **University of Engineering and Technology**, Peshawar, **Pakistan** B.Sc. (with Honors) in Electrical Engineering, (2000) Major: Communications and Electronics **HSSC (Pre-Engineering)** **Pakistan Education Academy**, Dubai, **UAE** (1984-1995) Schooling: Grade 2 to Grade 12 Certificate awarded: HSSC, SSC Major subjects (Mathematics, Physics, Chemistry)
Personal:	**Contact Address:** **House 1210, St. 21, Block C-1,Multi-garden, B-17, Islamabad, Pakistan** **Tel (home): +92-51-7069657** **Tel (Mobile): +92-344-3037466** **Email: raza.ali.shah@hitecuni.edu.pk**
Experience	**Academic Experience:** **Associate Professor & Chairman,** (2023– Till date) Department of Computer Engineering, HITEC University

	Assistant Professor, (2022 – 2023) Department of Computer Engineering, HITEC University **Assistant Professor,** (2015 – 2022) Department of Electrical Engineering, HITEC University **Lecturer** (2004 - 2007) NFC Institute of Engineering and Technological Training, Multan, Pakistan **Lecturer** (2003 - 2004) COMSATS Institute of Information Technology, Abbotabad, Pakistan **Professional/Industrial Positions Held** **RFID Trainee Engineer,** **LifeWAY Holdings Pte Ltd, AIT, Thailand (2009 - 2010)** **RFID Test and Development Engineer,** **LifeWAY Holdings Pte Ltd, AIT, Thailand (2011 - 2013)**
Memberships	**Membership: IEEEP Communication Society**, Pakistan Membership number: M-1320 **Membership: IEICE Communication Society**, Japan Membership number: 1385984 **Membership: Pakistan Engineering Council (PEC) Life member**, Pakistan Membership number: ELECT/17894
Service Activity	
Publications	**International Refereed Journals** 1. Ologun, O., Wu, S., Shah, R. A., Khattak, S. B. A., & Nasralla, M. M. (2023). BER Reduction and Capacity Enhancement with Novel Guard Sequence Selection for Multi-Carrier Communication. Sensors, 23(1), 217.

2. Rehman, Mubashir, Raza Ali Shah, Najah Abed Abu Ali, Muhammad Bilal Khan, Syed Aziz Shah, Akram Alomainy et. al. "Enhancing System Performance through Objective Feature Scoring of Multiple Persons' Breathing Using Non-Contact RF Approach." Sensors 23, no. 3 (2023): 1251.

3. Rehman, Mubashir, Shah, R.A. et al. Improving machine learning classification accuracy for breathing abnormalities by enhancing dataset. MDPI Sensors 21.20 (2021): 6750.

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5. Rehman, Mubashir, Shah, R.A. et al. RF Sensing Based Breathing Patterns Detection Leveraging USRP Devices. MDPI Sensors 21.11 (2021): 3855.

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7. Khan, M. B. Rehman, M., Mustafa, A., Shah, R. A., Yang, X. (2021). Intelligent Non-Contact Sensing for Connected Health Using Software Defined Radio Technology. MPDI Electronics, 10(13), 1558.

8. Ahmed, Iftikhar, Sultan Shoaib, and Raza Ali Shah. Quad Sector HMSIW Tapered Slot Antenna Array for Millimeter-Wave Applications. Electronics 10.14 (2021): 1645.

9. R. A. Shah, N. Rajatheva, and Y. Ji. Performance analysis of dual-hop OFDM relay system with subcarrier mapping in Nakagami-m fading. IEICE Transactions on Communications, vol.E98-B, No.4, Apr 2015.

10. Zahid, Muhammad, and Raza Ali Shah. "BER Analysis for two-hop Co-operativeNon-orthogonal multiple access (CNOMA) relaying scheme." Journal of Engineering and Applied Sciences 37.2 (2018).

11. R. A. Shah, N. Rajatheva, and Y. Ji. Outage analysis of a dual-hop OFDM amplify-and-forward relay system with subcarrier mapping in Rayleigh fading. EURASIP Journal on Wireless Comm. and Networking, Dec 2014.

12. Riaz, Mamoon, Jameel Ahmed, Raza Ali Shah, and Ashiq Hussain. Novel Secure Pseudorandom Number Generator Based on Duffing Map. Wireless Personal Communications 99, no. 1 (2018): 85-93.

Conference Papers

1. Beenish Noor and Raza Ali Shah. BER Analysis of a class of Linear Block Codes in AWGN and Rayleigh Fading Channels. IEEE ICFEAS'23, Taxila, Pakistan.

2. R. A. Shah, N. Rajatheva, and Y. Ji. Outage Analysis of dual-hop OFDM relay system with Subcarrier Mapping in Nakagami-m fading. Proc. IEEE ICC 2015.

3. R. A. Shah, N. Rajatheva, and Y. Ji. Analysis of BER and capacity for dual-hop OFDM relay system with subcarrier mapping in Nakagami-m fading. Proc. IEEE ICC, Sydney, Australia, pp. 5089-5094, June 2014.

4. R. A. Shah, N. Rajatheva, and Y. Ji. Outage probability and outage capacity analysis of cooperative OFDM system with subcarrier mapping. Proc. IEEE ICC, Sydney, Australia, pp. 314-319, June 2014.

5. Raza Ali Shah, and Poompat Saengudomlert. Iterative Channel Estimation Using Joint Zero Padding and Nonzero Padding for TDS-OFDM Systems. Proc. IEEE ECTI-CON, Chiang Mai, pp. 983-987 Thailand, May 2010.

6. Kaiser M.S., Ahmed K.M., Shah R.A. Power allocation in OFDM-based cognitive relay networks. Proc. IEEE WCNIS, pp. 202-206, 2010.

7. Kaiser M.S., Chaudary M.H., Shah R.A., Ahmed K.M. Neuro-Fuzzy (NF) based relay selection and resource allocation for cooperative networks. IEEE ECTI-CON 2010.

8. Chaudary M.H., Khan I., Shah R.A., Rajatheva N., Performance and optimal resource analysis of MIMO-OFDMA uplink system with carrier frequency offset . IEEE WCSP 2009, Nanjing, China, 2009.

Books/Monograph

Raza Ali Shah, "OFDM Relaying System with Subcarrier Pairing". Publisher: HEC, Pakistan 2017. (Published and distributed five hundred copies by HEC in HEC recognized universities in Pakistan).

Other Publications

	Raza Ai Shah, "IAI Manual for ultrasonic bonding". LifeWAY™ , Thailand, pp 1-11, 2012 Raza Ai Shah, "Instruction Manual for LifeWAY EEA TT Demo". LifeWAY™, Thailand, pp 1-16, 2012 Raza Ai Shah, "Operational Manual Reel-to-Reel Machine UHF scan". LifeWAY™, pp 1-11, Thailand, 2012

Faculty Resume

Name:	Dr. Imran Ashraf
Education:	PhD Computer Engineering, 2011 - 2016 TU Delft, The Netherlands MSc Computer Engineering, 2009 - 2011 TU Delft, The Netherlands BSc Electrical Engineering, 2002 - 2006 UET Peshawar, Pakistan
Personal:	House A-82, Street 5, Shah Wali Colony, Wah Cantt, Pakistan
Experience	● HITEC University, Taxilla, Pakistan ○ Assistant Professor Sep 2018 - to date.
Memberships	PEC
Service Activity	● Director IT (sep 2022 - till date) ● Head of Department (sep 2022 - apr 2023)
Publications	1. Efficient decomposition of unitary matrices in quantum circuit compilers, 2022, Anna Maria Krol, Aritra Sarkar, Imran Ashraf, Zaid Al-Ars, Koen Bertels, Applied Sciences, Impact Factor: 2.679 2. OpenQL: A Portable Quantum Programming Framework for Quantum Accelerators, 2022, N. Khammassi, I. Ashraf, J. v. Someren, R. Nane, A. M. Krol, M. A. Rol, L. Lao, K. Bertels, C. G. Almudever, ACM Journal on Emerging Technologies in Computing Systems (JETC), Impact Factor: 1.652 3. Don't wait for quantum hardware to mature, 2021, Koen Bertels, Aritra Sarkar, Imran Ashraf, HiPEAC Info, Technology Opinion, 64, https://www.hipeac.net/magazine/7160/#HIPEACinfo_64.indd%3A.419126%3A1371

	4. Quantum Computing -- from NISQ to PISQ, 2021, Koen Bertels, Aritra Sarkar, Imran Ashraf, IEEE Micro, Impact Factor: 2.57 5. HEVC's Intra Mode Process Expedited using Statistical Model, 2021, Junaid Tariq, Ayman Alfalou, Amir Ijaz, Hashim Ali, Imran Ashraf, Hameedur Rahman, Ammar Armghan, Inzamam Mashood and Saad Rehman, Computers, Materials & Continua, Impact Factor: 4.896 6. A Multilevel Deep Feature Selection Framework for Diabetic Retinopathy Image Classification, 2021, Farrukh Zia, Isma Irum, Nadia Nawaz Qadri, Yunyoung Nam, Kiran Khursheed, Muhammad Ali, Imran Ashraf, Muhammad Attique Khan, Computers, Materials & Continua, Impact Factor: 4.896 7. Light weight model for intra mode selection in HEVC, 2021, Junaid Tariq, Ammar Armghan, Amir Ijaz, Imran Ashraf, Multimedia Tools and Applications, Impact Factor: 2.313 8. A framework of human action recognition using length control features fusion and Weighted Entropy-Variances based Feature Selection, 2020, Farhat Afza, Muhammad Attique Khan, Muhammad Sharif, Seifedine Kadry, Gunasekaran Manogaran, Tanzila Saba, Imran Ashraf, Robertas Damas evic ius, Image and Vision Computing, Impact Factor: 3.103 9. Timing and Resource-aware Mapping of Quantum Circuits to Superconducting Processors, 2020, Lingling Lao, Hans van Someren, Imran Ashraf and Carmen G. Almudever, IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems, Impact Factor: 2.16810. StomachNet: Optimal Deep Learning Features Fusion for Stomach Abnormalities Classification, 2020, Attique Khan; Muhammad Sarfraz; Majed Alhaisoni; Abdulaziz Albesher; Shuihua Wang; Imran Ashraf, IEEE Access, Impact Factor: 3.745 11. Multimodal Brain Tumor Classification using Deep Learning and Robust Features Selection: A Machine Learning Application for Radiologist, 2020, Muhammad Attique Khan, Imran Ashraf, Majed Alhaisoni, Robertas Damas evic ius, Rafal Scherer, Amjad Rehman, Syed Ahmad Chan Bukhari, MDPI: Diagnostics, Impact Factor: 3.11 12. Quantum Computer Architecture Towards Full-Stack Quantum Accelerators, 2020, Koen Bertels, A. Sarkar, T. Hubregtsen, M. Serrao, A. A. Mouedenne, A. Yadav, A. Krol, I. Ashraf, C. Garcia Almudever, IEEE Transactions on Quantum Engineering. 13. A Unified Design of ACO and Skewness based Brain Tumor Segmentation and Classification from MRI Scans, 2020, Umaira Nazar Hussain, Muhammad Attique Khan, IkramUllah Lali, Kashif Javed, Imran Ashraf, Junaid Tariq, Hashim Ali, Ahmed

	Din, Journal of Control Engineering and Applied Informatics, Impact Factor: 0.589 14. Pure Intra Mode Decision in HEVC Using Optimized Firefly Algorithm, 2020, Junaid Tariq, Ammar Armghan, Amir Ijaz, Imran Ashraf, Journal of Visual Communication and Image Representation, Impact Factor: 2.259 15. Prosperous Human Gait Recognition: An End-to-End System based on Pre-trained CNN Features Selection, 2020, Asif Mehmood, Muhammad Attique, Muhammad Sharif, Sajid Ali Khan, Muhammad Shaheen, Tanzila Saba; Naveed Riaz, Imran Ashraf, Multimedia Tools and Applications, Impact Factor: 2.1 16. Review of Automated Computerized Methods for Brain Tumor Segmentation and Classification, 2019, Umaira Nazar, Muhammad Attique Khan, Ikram Ullah Lali, Hong Lin*, Hashim Ali, Imran Ashraf, Junaid Tariq, Current Medical Imaging, Impact Factor: 0.56 17. Mapping of lattice surgery-based quantum circuits on surface code architectures, 2019, L Lao, B van Wee, I Ashraf, J van Someren, N Khammassi, K Bertels and C G Almudever, Quantum Science and Technology, Impact Factor: 3.022 18. Energy Optimization for Large-Scale 3D Manycores in the Dark-Silicon Era, 2019, S. Majzoub, R. A. Saleh, I. Ashraf, M. Taouil and S. Hamdioui, IEEE Access, Impact Factor: 3.557 19. A Microarchitecture for a Superconducting Quantum Processor, 2018, X. Fu, M. A. Rol, C.C. Bultink, J. van Someren, N. Khammassi, I. Ashraf, R.F.L. Vermeulen, J. C. de Sterke, W.J. Vlothuizen, R. N. Schouten, C.G. Almudever, L. DiCarlo, K.L.M. Bertels, IEEE Micro, Impact Factor: 1.913 20. Multi-path Summation for Decoding 2D Topological Codes, 2018, Ben Criger, Imran Ashraf, Quantum, Impact Factor: 2.921 21. Memory and Communication Profiling for Accelerator-based Platforms, 2017, I. Ashraf, N. Khammassi, M. Taouil, K.L.M. Bertels, IEEE Transactions on Computers, Impact Factor: 3.052 22. Skeleton-based Synthesis Flow for Computation-In-Memory Architectures, 2017, J. Yu, R. Nane, I. Ashraf, M. Taouil, S. Hamdioui, H. Corporaal, K.L.M. Bertels, IEEE Transactions on Emerging Topics in Computing, Impact Factor: 3.636

Faculty Resume

Name:	Dr. Muhammad Bilal
Education:	PhD Software Engineering (2022)

	UET, Taxila MS Computer Engineering (2013) **NUST, EME College, Rawalpindi** BS Computer Engineering (2008) **COMSATS Wah**
Personal:	House: H#96, S#4, Wah Model Town Phase 1, Wah Cantt Phone: +923045147137 Email: muhammad.bilal@hitecuni.edu.pk
Experience	**1.1.1.1 HITEC University, Taxila, Computer Engineering Department** **Assistant Professor** Since-2023 **1.1.1.2 CUST Islamabad, Software Engineering Department** **Assistant Professor** 2022–2023 **1.1.1.3 CUST Islamabad, Software Engineering Department** **Lecturer** 2020–2022 **1.1.1.4 UET Taxila, Software Engineering Department** **PhD Scholar / Lecturer** 2017–2020 **1.1.1.5 Xtendum Services** **1.1.1.6 Android Developer** 2015–2017 **1.1.1.7** **1.1.1.8 PAKATS** **1.1.1.9 Android Developer** 2013–2015 **1.1.1.10 University of Wah, Computer Science Department** **1.1.1.11 Lecturer**

	2009–2013
Memberships	
Service Activity	1. Conveyor Industrial Outreach Committee (IOC), HITEC University, Taxila 2. Head Quality Assurance Cell (QAC), HITEC University 3. Member Curriculum Review Committee (CRC), HITEC University 4. Member Industrial Advisory Board (IAB), HITEC University 5. Member CRC, CUST Islamabad 6. Member IAB, CUST Islamabad 7. Member Outcome Based Education (OBE) Team, UET Taxila
Publications	1. Bilal, M., Habib, H. A., Mehmood, Z., Saba, T., & Rashid, M. (2020). Single and multiple copy–move forgery detection and localization in digital images based on the sparsely encoded distinctive features and DBSCAN clustering. *Arabian Journal for Science and Engineering*, *45*(4), 2975-2992. 2.334 (ISSN 2191-4281) https://doi.org/10.1007/s13369-019-04238-2 2. Bilal, M., Habib, H. A., Mehmood, Z., Yousaf, R. M., Saba, T., & Rehman, A. (2021). A robust technique for copy-move forgery detection from small and extremely smooth tampered regions based on the DHE-SURF features and mDBSCAN clustering. *Australian Journal of Forensic Sciences*, *53*(4), 459-482. 1.21 (ISSN 450618) https://doi.org/10.1080/00450618.2020.1715479 3. Yousaf, R. M., Habib, H. A., Mehmood, Z., & Bilal, M. (3/10/2020). Image dehazing based on dark channel spatial stimuli gradient model and image morphology. *Journal of Ambient Intelligence and Humanized Computing*, *12*(8), 8483-8495. 3.662 (ISSN 1868-5145) https://doi.org/10.1007/s12652-020-02581-z 4. Nawaz, M., Mehmood, Z., Bilal, M., Munshi, A. M., Rashid, M., Yousaf, R. M., ... & Saba, T. (2021). Single and multiple regions duplication detections in digital images with applications in image forensic. *Journal of Intelligent & Fuzzy Systems*, *40*(6), 10351-10371. 1.737 (ISSN 18758967) 5. Mehmood, Z., Chaudhry, H. N., Naqvi, R. A., Kulsoom, F., Munshi, A., & Bilal, M. (22 june 2022). Passive Framework of Sparse Region Duplication Detection from Digital Images. *Journal of Sensors*, volume *2022*. 3.567 (ISSN 16877268) https://doi.org/10.1155/2022/6580508

Faculty Resume

Name:	Engr.Tehseen Ahsan
Education:	**PhD in Electrical Engineering 2018(In Progress).** Riphah International University, Peshawar Rd، near Hajj Complex، I-14/3 I-14, Islamabad, Islamabad Capital Territory 46000. Specialization: Deep Learning (Human Action Recognition) **(MSc) in Electronics Engineering 2009-2010** University of Surrey, Guildford United Kingdom. Specialization: Electronics Engineering (Mobile and Satellite Communications) **BE in Computer Engineering 2004-2007** Bahria University Islamabad , Pakistan Final Year Project: Explosive Mine Detector Vehicle Robot.
Personal:	House: 2, Sector A, 2nd Avenue DHA-5 , Islamabad, Pakistan. Phone: +92-300-5365396. tehseen.ahsan@hitecuni.edu.pk
Experience	● HITEC University, Taxila, Pakistan ○ Assistant Professor Feb 2016 - to date. ○ Lecturer Feb 2013 - Feb 2016.
Memberships	Professional Engineer – PEC, Pakistan
Service Activity	● OBE Head 2019 - 2022. ● DQAC Head 2021 - 2022 ● Deputy Superintendent 2020 - 2021 ● Exam Superintendent 2021 - 2022
Publications	1. HRNetO:Human Action Recognition Using Unified Deep Features Optimization Framework; Tehseen Ahsan, ,Sohail Khalid1 Shaheryar Najam, Muhammad Attique Khan,YeJin Kim and Byoungchol Chang.

Faculty Resume

Name:	Sara Tehseen
Education:	PhD Computer Engineering (2018 to Present)

	National University of Sciences and Technology, Islamabad MS Computer Engineering (2016) National University of Sciences and Technology, Islamabad BS Computer Engineering (2013) Islamia University Bahawalpur
Personal:	Address: House # 25, Street # 5, J Block, New city phase II, wah cantt Phone No.: 03316061843 Email: saratehsin@gmail.com
Experience	HITEC University, Taxila (Sept '19 — Present) Lecturer, DCE Sharif College of Engineering and Technology, Lahore (April '17 — Sept '18) Lecturer, DCS National University of Sciences and Technology, Islamabad (Sept '16 — Feb '17) Teaching Assistant, DCE Foundation University, Islamabad (April '16 — July '16) Visiting Lab engineer, DCS
Memberships	PEC
Service Activity	1. Conveyor Outcome Based Education (OBE), HITEC University, Taxila 2. Head Final Year Projects , HITEC University 3. Deputy Superintendent of Exam(DCE) , HITEC University
Publications	1. Tehsin, Sara, et al. "Self-organizing hierarchical particle swarm optimization of correlation filters for object recognition." IEEE Access 5 (2017): 24495-24502. 2. Saad, Syed Muhammad, Bilal, Abdullah, Tehsin, Sara, et al. "Spoof detection for fake biometric images using feature-based techniques." SPIE Future Sensing Technologies . Vol. 11525. International Society for Optics and Photonics, 2020. 3. Tehsin, Sara, et al. "Selection of CPU scheduling dynamically through machine learning." Pattern Recognition and Tracking XXXI. Vol. 11400. International Society for Optics and Photonics, 2020. 4. Akbar, Naeem, Tehsin, Sara et al. "Detection of moving human using optimized correlation filters in homogeneous environment." Pattern Recognition and Tracking XXXI . Vol. 11400. International Society for Optics and Photonics, 2020.

	5. Akbar, Naeem, Tehsin, Sara, et al. "Hardware design of correlation filters for target detection." Pattern Recognition and Tracking XXX, vol. 10995, p. 109950E. International Society for Optics and Photonics, 2019. 6. Asfia, Yame, Tehsin, Sara, et al. "Visual Person Identification Device using Raspberry Pi." Proc. of 25th Conference of FRUCT Association, 2019. 7. Tehsin, Sara, et al. "Fully invariant wavelet enhanced minimum average correlation energy filter for object recognition in cluttered and occluded environments." Pattern Recognition and Tracking XXVIII , vol. 10203, p. 1020307. International Society for Optics and Photonics, 2017. 8. Tehsin, Sara, et al. "Comparative analysis of zero aliasing logarithmic mapped optimal trade-off correlation filter." Pattern Recognition and Tracking XXVIII , vol. 10203, p. 1020305. International Society for Optics and Photonics, 2017. 9. Tehsin, Sara, et al. "Improved maximum average correlation height filter with adaptive log base selection for object recognition." In Optical Pattern Recognition XXVII, vol. 9845, p. 984506. International Society for Optics and Photonics, 2016.

Faculty Resume

Name:	Kaynat Rana
Education:	**MS Electrical Engineering, 2020** University of Engineering and Technology, Taxila **BS Electrical Engineering, 2016** Comsats University, Wah Campus
Personal:	House # 50, Street 6, Block A, New City Phase II, Wah Cantt Phone: 0311-9811421 Email: kayynat@hitecuni.edu.pk
Experience	● HITEC University, Taxila, Pakistan o Lecturer (CED) Feb 2023 - to date o Lab Engineer (CED) Sep 2017 - Feb 2023 ● TEVTA Taxila o Visiting Lecturer (EE) Sep 2016-Nov 2016
Memberships	Registered Engineer – PEC, Pakistan
Service Activity	1. Convener Departmental Management Committee, DCE HITEC University, Taxila 2. Member PEC/OBE Committee, DCE HITEC University, Taxila
Publications	**1.** A. Niaz et al., "Inhomogeneous Image Segmentation Using Hybrid Active Contours Model With Application to Breast Tumor Detection," in IEEE Access, vol. 8, pp. 186851-186861, 2020, doi: 10.1109/ACCESS.2020.3029333.

	2. K. Rana, A. Niaz, S. Hanif, and M. Ali, "4x4 Bit Multiplier Designs using Different CMOS Schematics, and their Comparison", TJ, vol. 24, no. 04, pp. 15-22, Jan. 2020. 3. A. Niaz et al., "Hybrid Active Contour Based on Local and Global Statistics Parameterized by Weight Coefficients for Inhomogeneous Image Segmentation," in IEEE Access, vol. 8, pp. 57348-57362, 2020, doi: 10.1109/ACCESS.2020.2982487.

Faculty Resume

Name:	Qasim Javaid
Education:	**PhD Computer Engineering (In Progress)** HITEC University, Taxila **MS Electrical Engineering, 2020** UET Taxila **BS Electrical Engineering, 2016** CUI Wah Campus
Personal:	House: A-244 Gulistan Colony, Wah Cantt Phone: +923045390529 Email: qasim.javaid@hitecuni.edu.pk
Experience	**HITEC University, Taxila, Computer Engineering Department** **Lecturer** Feb-2023- to date **COMSATS UNiversiy Islamabad, Attock Campus** **Research Associate** 2017-2023
Memberships	PEC
Service Activity	3. Convener Lab Management Committee, DCE HITEC University, Taxila 4. Member Industrial Outreach Committee (IOC), DCE HITEC University, Taxila 5. Member PEC/OBE Committee, DCE HITEC University, Taxila
Publications	1. Traffic Congestion Avoidance System Using Foreground Estimation and Cascade Classifier (IEEE Access, 8. ISSN 2169-3536, DOI: 10.1109/ACCESS.2020.3027715, IF:3.367)

	2. Low power 4×4 bit multiplier design using dadda algorithm and optimized full adder(IEEE Xplore, DOI: 10.1109/IBCAST.2018.8312254)

Faculty Resume

Name:	Engr. Ali Raza
Education:	MS Computer Engineering, 2023 University of Engineering and Technology, Taxila BS Computer Engineering, 2020 HITEC University Taxila
Personal:	Firdous street House no 38 Mohallah Tarkhana wala Bahawalnagar Punjab Pakistan Phone: +923042946417 Email: ali.raza.ce@hitecuni.edu.pk
Experience	**HITEC University, Taxila, Computer Engineering Department** **Lab Engineer** **Sep 2022 - to date** **Swarm Robotics Lab UET Taxila** **Research Assistant** **Oct 2020 - Sep 2022**
Memberships	PEC
Service Activity	1. Member PEC/OBE Committee, DCE HITEC University, Taxila 2. Member Lab Management Committee, DCE HITEC University, Taxila 3. Member of Departmental Maintenance committee, DCE HITEC University, Taxila
Publications	10 international Conference/Journal Publications

Faculty Resume

Name:	Bushra Fiaz
Education:	**MS Computer Engineering (In Progress)** HITEC University, Taxila

	BS Computer Engineering 2022 HITEC University, Taxila
Personal:	House: Shahzeb House Faisal Town Street No 5 HMC Road Taxila Phone: +923095046462 Email: Bushra.fiaz@hitecuni.edu.pk
Experience	**HITEC University, Taxila, Computer Engineering Department** **Lab Engineer** **October 2022 - to date**
Memberships	PEC
Service Activity	4. Member PEC/OBE Committee, DCE HITEC University, Taxila 5. Member of FYP & AEM committee, DCE HITEC University, Taxila 6. Member Lab Management Committee, DCE HITEC University, Taxila 7. Member of Alumina Interaction and career counseling committee, DCE HITEC University, Taxila
Publications	no

Faculty Resume

Name:	Fasih Ahmad
Education:	**MS Electrical Engineering (In Progress)** FAST NUCES, Islamabad **BS Computer Engineering 2022** HITEC University, Taxila
Personal:	House No# 80-A, Street No# 19, Gulzar-E Quaid Society, Chaklala Cantt, Rawalpindi
Experience	**HITEC University, Taxila, Computer Engineering Department** **Lab Engineer** **February, 2023 - to date**

	PUGSDE Solutions (Pvt) Ltd, Wah Cantt **Game Developer** **October, 2022 - February, 2023**
Memberships	PEC
Service Activity	Member of Departmental Maintenance committee, DCE HITEC University, Taxila
Publications	Nill

Appendix – B-2

Full Time Lab Engineers

Name	Details of Qualifications			Specialization	Experience (Years)
	Degree	Year	Institution		
Engr. Ali Raza	MS	2022	UET Taxila	Computer Vsion AI on the edge	2.5
	BS	2020	HITEC Taxila		
Engr. Bushra Faiz	BS	2022	HITEC Taxila	Embeded system	1
Engr. Fasih Ahmed	BS	2022	HiTEC Taxila	Embeded systems	1

Appendix – C

Lab Safety Precautions

Rules for all Computer Engineering labs

- Do not eat, drink, smoke, or apply cosmetics in the laboratory.
- Avoid all horseplay in the laboratory.
- Do not reboot, turn off, or move any workstation or PC. Do not load any software on any lab computer. Only lab operators and technical support personnel are authorized to carry out these tasks.
- Do not reconfigure the cabling/equipment without prior permission.

- Do not leave a workstation or a login unattended. Do not leave processes in the background without prior approval from the Systems Manager. Do not lock your workstation for more than 20 minutes.
- Place your ID card through the card reader each time you enter a secured lab whether the door is already open or not. **Do not open a secured door for anyone.** Entry to secured labs is recorded and lab users shall be held responsible for the condition of the lab.
- Unauthorized users are not permitted in the computer labs. The departmental computer resources are to be used to support the instructional and research activities of the Computer Science Department. Abuse of these resources or conduct not in accord with University policy shall not be tolerated.

Games may not be played on Computer Science lab systems or servers

Appendix – A-2

Student Course Evaluation Proforma

Student Course Evaluation Questionnaire

(To be filled by each Student at the time of Course completion)

Department:_____ Course Code _____ _____

Course Title: _____Teacher Name: _____

Year of Study _____ Semester / Term_____

1: Highly unsatisfied 2: Unsatisfied 3: Uncertain 4: Satisfied 5: Highly Satisfied

Please give us your views so that Course quality can be improved. You are encouraged to be frank and constructive in your comments

Course Content and Organization	Highly unsatisfied	Unsatisfied	Uncertain	Satisfied	Highly satisfied	Score
1. The course objectives were clear	1	2	3	4	5	
2. The Course workload was manageable	1	2	3	4	5	
3. The Course was well organized (e.g. timely access to materials, notification of changes, etc.)	1	2	3	4	5	
4. Comments						

Learning Environment and Teaching Methods	Highly unsatisfied	Unsatisfied	Uncertain	Satisfied	Highly satisfied	Score
5. I think the Course was well structured to achieve the learning outcomes	1	2	3	4	5	
6. The learning and teaching methods encouraged participation.	1	2	3	4	5	
7. The overall environment in the class was conducive to learning.	1	2	3	4	5	
8. Classrooms were well equipped	1	2	3	4	5	
9. Campus support staff (security, transport etc)	1	2	3	4	5	
10. Comments: _____ _____ _____ ___						

Learning Resources	Highly unsatisfied	Unsatisfied	Uncertain	Satisfied	Highly satisfied	Score
11. Learning materials (Lesson Plans, Course Notes etc.) were relevant and useful.	1	2	3	4	5	
12. Recommended reading Books etc. were relevant and appropriate	1	2	3	4	5	
13. The provision of learning resources in the library was adequate and appropriate	1	2	3	4	5	
14. The provision of learning resources on the Web was adequate and appropriate (if relevant)	1	2	3	4	5	
15. Comments						

Quality of Delivery	Highly unsatisfied	Unsatisfied	Uncertain	Satisfied	Highly satisfied	Score

16. The Course stimulated my interest and thought on the subject area	1	2	3	4	5	
17. The pace of the Course was appropriate	1	2	3	4	5	
18. Ideas and concepts were presented clearly	1	2	3	4	5	
19.Comments						

Assessment	**Highly unsatisfied**	**Unsatisfied**	**Uncertain**	**Satisfied**	**Highly satisfied**	**Score**
20. The method of assessment were reasonable	1	2	3	4	5	
21. Feedback on assessment was timely	1	2	3	4	5	
22. Feedback on assessment was helpful	1	2	3	4	5	
23. Comments						

Additional Core Questions

Instructor / Teaching Assistant Evaluation	**Highly unsatisfied**	**Unsatisfied**	**Uncertain**	**Satisfied**	**Highly satisfied**	**Score**
24. I understood the lectures	1	2	3	4	5	
25. The material was well organized and presented	1	2	3	4	5	
26. The instructor was responsive to student needs and problems	1	2	3	4	5	
27. Had the instructor been regular throughout the course?	1	2	3	4	5	
Comments:						

Overall Evaluation
28.The best features of the Course were:

29.The Course could have been improved by:

Equal Opportunities Policy (Optional)

30. The University does not tolerate discrimination on any irrelevant distinction (e.g. race, age, religion, gender) and is committed to work with diversity in a wholly positive way. Please indicate below anything in relation to this Course which may run counter to this objective:

Demographic Information: (Optional)

31.Do you consider yourself to be disabled: Yes ○ No ○

32. Domicile:

33.Gender: Male ○ Female ○

34. Age Group: less than 22 ○ 22-29 ○ over 29 ○

THANK YOU

Appendix – A-3

Faculty Course Review Report

(To be filled by each teacher at the time of Course Completion)

For completion by the course instructor and submit to DQAC HITEC University Taxila..

Department:			Faculty Member Name:		
Course Code:		Course Title:			
Session:		Semester:	Fall ◯	Spring ◯	
Credit Hours:	3-0	Level:	PG	Prerequisites:	
Name of Course Instructor:		No. of Students Contact Hours	Lectures		

Assessment Methods: give precise details (no & length of assignments, exams, weightings etc)	Quizzes (Number & percentage)	Assignments (Number & percentage)	Course Projects (Percentage)	Mid Semester Exam (Length & percentage)	Final Exams (Length & percentage)	Total

Distribution of Grade/Marks and other Outcomes: (adopt the grading system as required)

Post-Graduate	Initially Enrolled	Above 85% (or A, A-Grade)	Between 70% & 84.99% (B+, B, B-)	Between 55% & 69.99% (C+, C, C-)	Between 50% & 54.99 %(D)	Less Than 50% (F)	Withdrawal	Total

No. of Students								

Overview/Evaluation (Course Co-coordinator's Comments)

Feedback: first summarize, then comment on feedback received from:

1) Student (Course Evaluation) Questionnaires
2) External Examiners or Moderators (if any)

3) Student /staff Consultative Committee (SSCC) or equivalent, (if any)

4) Curriculum: comment on the continuing appropriateness of the Course curriculum in relation to the intended learning outcomes (course objectives) and its compliance with the HEC Approved / Revised National Curriculum Guidelines. The curriculum has been designed according to international standards. All the universities in the world are following almost the same contents as followed by HITEC University Taxila.

5) Assessment: comment on the continuing effectiveness of method(s) of assessment in relation to the intended learning outcomes (Course objectives) The course objectives have been achieved as the student are practicing the theory taught in the subject.

6) Enhancement: comment on the implementation of changes proposed in earlier

Faculty Course Review Reports. Nil is reported.

7) Outline any changes in the future delivery or structure of the Course that this semester/term's experience may prompt.

Name: _____ Date: _____

(Course Instructor)

Name: _____ Date: _____

(Head of Department)

Appendix – A-4

Alumni Survey Form

(To be filled in by Alumni – after the completion of each academic year)

The purpose of this survey is to obtain alumni input on the quality of education they received and the level of preparation they had at University. The purpose of this survey is to assess the quality of the academic program. We seek your help in completing this survey.

A: Highly unsatisfied B: UnsatisfiedC: Uncertain D: Satisfied E: Highly Satisfied

S/#	Attributes	A	B	C	D	E
	1. Knowledge					
1.	Math, Science, Humanities and Professional Discipline (if applicable)					
2.	Problem formulation and solving skills					
3.	Collecting and analyzing appropriate data					
4.	Ability to link theory to practice.					
5.	Ability to design a system component or process					
6.	IT Knowledge					
	II. Communication Skills					
1.	Oral Communication					
2.	Report Writing					
3.	Presentation Skills					
	III. Interpersonal Skills					
1.	Ability to work in teams					
2.	Ability to work in arduous / challenging situation					
3.	Independent thinking					
4.	Appreciation of ethical Values					
	IV. Manage / Leadership Skills					
1.	Resource and Time Management Skills					
2.	Judgment					
3.	Discipline					

V. General Comments

Please make any additional comments or suggestions, which you think would help strengthen our programs. (New courses that you would recommend and courses that you did not gain much from)

VI. Career Opportunities:

VI. Department Status						
1.	Infrastructure					
2.	Faculty					
3.	Repute at National Level					
4.	Repute at International Level					

VII. Alumni Information:

1. Name (Optional) _____

2. Name of Organization _____

3. Position in Organization _____

4. Year of graduation _____

Appendix – A-5

Employer Survey Form

(To be filled in by Employer – after the completion of each academic year)

The purpose of this survey is to obtain employers' input on the quality of education HITEC University is providing and to assess the quality of the academic program. The survey is with regard to HITEC University Taxila graduates employed at your organization. We seek your help in completing this survey.

A: Highly unsatisfied B: UnsatisfiedC: Uncertain D: Satisfied E: Highly Satisfied

S/#	Attributes	A	B	C	D	E
	1. Knowledge					
1.	Math, Science, Humanities and Professional Discipline (if applicable)					
2.	Problem formulation and solving skills					
3.	Collecting and analyzing appropriate data					
4.	Ability to link theory to practice.					
5.	Ability to design a system component or process					
6.	Computer Knowledge					
	II. Communication Skills					
1.	Oral Communication					
2.	Report Writing					
3.	Presentation Skills					
	III. Interpersonal Skills					
1.	Team Work Ability					
2.	Leadership					
3.	Independent thinking					
4.	Motivation					
5.	Reliability					
6.	Appreciation of ethical values					
	IV. Work Skills					
1.	Time Manage Skills					
2.	Judgment					
3.	Discipline					

V. General Comments

Please make any additional comments or suggestions, which you think would help strengthen our progra the preparation of graduates who will enter your field. Did you know as to what to expect from graduates

VI. Information About Organization:

1. Organization Name _____
2. Type of Business _____
3. Number of Graduates (specify the program) in your Organization:
4. Name of Graduates (Optional)

Appendix – A-6

Faculty Survey Form

(To be submitted on semester basis by each faculty member)

The purpose of this survey is to assess faculty members' satisfaction level and the effectiveness of programs place to help them progress and excel in their profession. We seek your help in completing this survey and th information provided will be kept in confidence. Indicate how satisfied are you with each of the following aspects at your department ?

- Name : _____
- Designation : _____
- Departmetn : _____

A: Highly unsatisfied B: UnsatisfiedC: Uncertain D: Satisfied E: Highly Satisfied

S/#	Attributes	A	B	C	D	E
1.	You are satisfied with your pursuits like teaching, research and the secondary duties					
2.	The overall environment in the department provides intellectual stimulation for improvement.					
3.	The overall workload is reasonable					
4.	The cooperation you receive from your department / colleagues.					
5.	Whenever needed, the mentoring is available to you.					
6.	You are satisfied with the encouragement given for inter-disciplinary initiatives.					
7.	You are satisfied with the opportunities given to voice concerns/provide feedback.					
8.	You are satisfied with receiving recognition for individual accomplishments					
9.	You are satisfied with the administrative support from the university.					
10.	You are quite clear about the faculty promotion policies and processes.					
11.	You are satisfied with the opportunities available for professional growth in teaching and research.					
12.	You are satisfied with the speed of redressal of complaints in the University.					
13.	Your salary package is commensurate with your qualification and experience.					
14.	Your perception about job-security in the present position.					
15.	Your primary and secondary duties permit you to have sufficient quality-time for yourself and your family.					

16. Please suggests three factors which could improve your motivation as a faculty member:

COMPUTER ENGINEERING

Dr. Imran Ashraf / Object Oriented Programming

Variables	Evaluation
Satisfied with Online Teaching by the Teacher	4.70
The teachers use of technology is adequate	4.50
The teacher uploaded online lectures and relevant material (audio, video, PPT/PDF) on weekly basis.	4.40
The teacher was available for online consultation during the week at specific timings	4.70
The teacher takes online assignments and quizzes regularly	4.80
The teacher returned all marked quizzes, assignments, and sessional exam on time.	4.80
The teacher provide timely and constructive feedback on your performance regularly	4.60
The teacher maintained liaison/link with you to address your queries related to the teaching material	4.80
How much you properly understand the lectures given/taught by the teacher online	4.70
How much are you satisfied with the quality of online lectures and course/lab materials shared/taught by the teacher/lab engineer?	4.70
How much are you satisfied with the grading and evaluation system followed by the teacher?	4.50
You want to be taught by this teacher in the next semester	**4.70**
Evaluation	**4.65**

Annexure D

BS-101 Engineering Physics (3+0)

Prerequisites: Nil

Course Objectives: To introduce the students basic concepts of physics as applied in electrical and computer engineering.

Course Outline: Wave Motion, Mathematical Concepts of Simple and Damped Harmonic Motion, Analytical Treatments of Superposition of Waves, Basics of Electricity (ohm's law KCL KVL), Electric Charge, Coulomb's Law, Electric Field and Intensity, Electric Potential, Capacitors and Charge Storage Concepts, Magnetism, Magnetic Fields, Faraday's and Lenz's Laws, Ampere's Law and its Applications, Eddy Currents, Inductance, Induced Current and their applications. Basics of Optics, Introduction to Semiconductor Physics. Atomic structure of elements, Energy band diagram for solids, intrinsic semi-conductor and extrinsic semi-conductors, Electron hole pairs, Distribution of electrons and holes in a conduction and valence band, Recombination and life time.

Recommended Books:

- Fundamentals of Physics Extended by David Halliday, David, Robert Resnick, and Jearl Walker, 10th edition, John Wiley & Sons, 2013

EC-110 Computing Fundamentals (2+1)

Prerequisites: Nil

Course Objectives: To develop understanding of basics of computer components, their operations, algorithm development techniques and basic programming.

Course Outline: Introduction to numbers systems, CPU, memory, input/output devices, data organization, file storage, programs and software, system and application software, operating systems, communication technology, Compiler, DBMS, Computer networks and internet, WWW, web mail applications, Computer graphics, AI, Viruses and Anti-Viruses. Programming languages, compilation and interpretation, problem specification, algorithms, flow chart, pseudo code, basic programming techniques, data types and declaration, header file and linkage, variables and constants, arrays, input/output, termination, remark, control structures, Branching, conditional structures, repetition and loops, basic library functions.

Recommended Books:

- Computer Science: An Overview by Glenn Brookshear and Dennis Brylow, 12th edition, Pearson, 2014, ISBN: 978-0133760064
- C++ How to Program by Dietel and Dietel, 10th edition, Pearson, 2014, ISBN: 978-0134448237
- Computer Science Illuminated by Nell Dale and John Lewis, 6th edition, Jones & Bartlett Learning, 2014, ISBN: 978-1284055917
- C++ Programming: From Problem Analysis to Program Design by D.S. Malik, 7th Edition, Course Technology, 2014, ISBN: 978-1285852744

EC-111 Programming Fundamentals (3+1)

Prerequisites: Computing Fundamentals

Course Objectives:

- To study programming with emphasis on modular and structured programming technique

- To apply the techniques of structured (functional) decomposition to break a program into smaller pieces.
- To design, implement, test and debug program that uses standard conditional and iterative control structures, functions, arrays, strings and structures to solve complex engineering problems

Course Outline: Arrays, c-strings, 2-d arrays, multi-dimensional arrays, Records (structs), Pointers, Classes and Data Abstraction, Inheritance and Composition, polymorphism, Operator Overloading, Recursion, Procedural versus object oriented programming languages, object oriented design strategy and problem solving.

Recommended Books:
- C++ How to Program by Dietel and Dietel, 10th edition, Pearson, 2014, ISBN: 978-0134448237
- Programming in C, Stephen G. Kochan, 4th Edition, Addison-Wesley Professional, 2013, ISBN: 978-0321776419

EC-121 Digital Logic Design (3+1)

Prerequisites: Computing Fundamentals, Programming Fundamentals

Course Objectives: To introduce the basic knowledge of Boolean algebra, design and analysis of Combinational Logic Circuits, design and analysis of Sequential Logic Circuits, Registers, Counters, Memory and programmable logic devices.

Course Outline: Number Systems, Logic Gates, Boolean Algebra, Combination logic circuits and designs, Simplification Methods K-Maps, Quinne, Mc-Cluskey,, Flip Flops and Latches, Asynchronous and Synchronous circuits, Counters, Shift Registers, Shift Registers Counters, Triggered devices & its types. Binary Arithmetic and Arithmetic Circuits, Memory Elements, State Machines. Introduction Programmable Logic Devices (CPLD, FPGA); Lab Assignments using tools such as Verilog HDL/VHDL, ModelSim, Logisim etc.

Recommended Books:
- Digital Design: With an Introduction to the Verilog HDL by by M. Morris R. Mano, Michael D. Ciletti, 5th edition, Prentice Hall, 2013, ISBN-13: 9780132774208
- Digital Fundamentals by Thomas L. Floyd, 11th edition, Pearson Education, ISBN-13: 978-0132737968

EC-225 Discrete Structures (3+0)

Prerequisites: Calculus & Analytical Geometry

Course Objectives: Introduces the foundations of discrete mathematics as they apply to Computer Science, focusing on providing a solid theoretical foundation for further work. Further, this course aims to develop understanding and appreciation of the finite nature inherent in most Computer Science problems and structures through study of combinatorial reasoning, abstract algebra, iterative procedures, predicate calculus, tree and graph structures. In this course more emphasis shall be given to statistical and probabilistic formulation with respect to computing aspects.

Course Outline: The Foundation: Logic and Proofs, Basic Structures; Sets, Functions, Sequence, and Sums, The Fundamentals: Algorithm, the Integers, and Matrices, Induction and Recursion, Counting, Advanced Counting Techniques, Relations, Graphs, Trees, Boolean Algebra, Modelling Computation.

Recommended Books:
- Discrete Mathematics and its Applications by Kenneth H Rosen, 7th edition, McGraw-Hill Education, 2011, ISBN: 978-0073383095

- Discrete Mathematics with Applications by Susanna S. Epp, 2003, 4th edition, Cengage Learning, 2010, ISBN: 978-0495391326

EC-230 Object Oriented Programming (3+1)

Prerequisites: Programming Fundamentals

Course Objectives:

- To study and understand the object oriented programming paradigm.
- To justify the philosophy of object-oriented design and concepts of encapsulation, abstraction, inheritance and polymorphism
- To design, implement, test and debug simple and complex programming problems using object oriented programming.
- To design, implement and test the implementation of a "is-a" relationships among objects using a class hierarchy and inheritance
- To compare and contrast the notion of overloading and overriding methods in an object-oriented language.
- To design, implement, test and debug event-driven programs that respond to user events.
- To develop code that responds to exception conditions raised during execution.

Course Outline: Procedural versus object oriented programming languages, UML modeling, object oriented design strategy and problem solving, objects and classes, member functions, public and private members, dynamic memory management, constructors and destructors, templates, object encapsulation, derived classes, class hierarchies, inheritance and polymorphism, operator overloading, stream class, practical design through Object Oriented Programming.

Recommended Books:

- Beginning Java Programming: The Object-Oriented Approach by Bart Baesens, Aimee Backiel and Seppe vanden Broucke, 1st edition, Wrox, 2015, ISBN: 978-1118739495
- Object-Oriented Data Structures Using Java by Nell Dale, Daniel T. Joyce and Chip Weems, 3rd edition, Jones & Bartlett Learning, 2011, ISBN: 978-1449613549

EC-201 Engineering Project Management (3+0)

Prerequisites: Nil

Course Objectives: To develop ability to plan and manage computer engineering projects successfully, maximizing the return from each stage of the hardware and software development life cycle.

Recommended Books:

- To be decided by the instructor.

EC-222 Data Structures & Algorithms (3+1)

Prerequisites: Programming Fundamentals

Course Objectives:

- To understand. the design and analysis of fundamental data structures and algorithms
- Discuss the use of primitive data types and built-in data structure.
- Employ different types of data structures such as arrays, lists, stack, queues, trees, and graphs.
- Analyze sorting, searching, recursion, divide-conquer, hashing techniques.
- Write programs that use each of the following data structures: arrays, strings, linked lists, stacks, queues, and hash tables.

Course Outline: Fundamental data structures, data types, abstract data types, user defined data types, algorithms and their complexity, time-space trade off, arrays, records and pointers, matrices, linked lists, circular lists, two way lists, sequential (array) and linked implementation of stacks and queues, polish notation, recursion, towers of Hanoi, recursive implementation of stacks and queues, priority queues, tree, binary tree, binary search tree, traversals, threaded trees, heap, general trees, graphs, depth-first/breadth first traversal, adjacency matrix, shortest distance algorithms, sorting ,insertion sort, selection sort, merge sort, radix sort), hashing, searching: (linear search, binary search, depth first /breadth first search).

Recommended Books:

- Data Structures and Algorithms in Java by Michael H. Goldwasser, Michael T. Goodrich, and Roberto Tamassia, 6th edition, Wiley, 2014, ISBN: 978-1118771334

EC-223 Signal and Systems (3+1)

Prerequisites: Complex Variables and Transforms

Course Objectives: To provide theoretical and practical understanding of Signals, Systems and Transform.

Course Outline: Linear Time-invariant systems, convolution integral for continuous-time systems, convolution sum for discrete-time systems, properties of linear time-invariant systems, systems described by differential and difference equations, Fourier Series, properties of continuous-time Fourier series, Continuous-time Fourier Transform and its inverse, properties of the transform, common transform pairs, discrete-time Fourier transform and its properties, frequency response corresponding to difference equations. sampling, uniform sampling, sampling theorem, aliasing, decimation, interpolation. Laplace Transform, region of convergence, properties, analysis of LTI systems, solution of differential equations, continuous and discrete-time filtering.

Recommended Books:

- Signals and Systems by Alan S. Willsky, S.Hamid Nawad, Alan V. Oppenheim, 2nd Edition, Pearson, 2015, ISBN: 978-9332550230

EC-227 Electronic Design and Practices

Prerequisites: Electronic Devices and Circuits

Course Objectives: To introduce small signal "analysis and design" of amplifiers, and analysis of wave generation and regulation circuits.

Course Outline: BJT & FET Small Signal Equivalent Circuit Models, Differential Amplifiers, BJT Differential Amplifier, MOS Differential Amplifier, Multistage Amplifiers, Basic Op-Amp Circuits, Analysis of the Op-Amp, Gain and Frequency Response of the op-amp, Op-amp as an Inverting and Non-inverting Amplifier, Applications of op-amp; General Structure of Feedback Amplifiers and Feedback Topologies, Feedback Stability Study and Compensation Techniques Using Negative Feedback, s-Domain Analysis, Poles, Zeros, Bode Plots, Transfer Function. Power Amplifiers, Class A Power Amplifier, Class B Power Amplifier, Class AB Power Amplifier, Class C Power Amplifier, Oscillators Circuits & Tuned Amplifiers, Oscillator Characteristics, LC and Crystal Oscillators, 555 Timer IC, VCO, PLL, Series, Shunt & Switching Regulators, IC Regulators.

Text Book:

- Electronic Devices and Circuit Theory, Robert Boylestad and Louis Nashelsky, Prentice Hall, 8th Edition. ISBN-10: 013769282X
- Electronic Devices and Circuits by Theodore F. Bogart Jr,Prentice Hall, 6th Edition. ISBN-10: 0131111426.

EC-228 Computer Architecture and Organization (3+1)

Prerequisites: Digital Logic Design

Course Objectives: Upon completion of this course, the student will have basic understanding of computer system architecture including CPU design, memory subsystem design and performance enhancement techniques.

Course Outline: Difference between architecture & organization, Introduction to Flynn's classification of Computer Architecture (SISD, SIMD, MISD, MIMD systems), Design of computer systems and components. Processor design, CPU architecture, functional blocks and development of instruction set, design of basic functional blocks PC, IR, CU, ALU etc.), instruction set design, and addressing; control structures and microprogramming; memory management, caches, and memory hierarchies; and interrupts and I/O structures. Pipelining of processor Issues and Hurdles, exception handling, Parallelism, Multiprocessor Systems. Introduction to superscalar processors (CISC, RISC), cache memory, different designs of cache memory system, virtual memory system, address mapping using pages, pipelining and threading, instruction level parallelism (ILP), introduction to parallel processing. Branch prediction, pre-fetching, multithreading.

Recommended Books:

- Computer Architecture: A Quantitative Approach by David A. Patterson, John L. Hennessy, Morgan Kaufmann, 5th Edition, 2011, ISBN: 978-0123838728
- Computer Organization and Architecture by William Stallings, 10th edition, Pearson, 2016, ISBN: 9780134101613

EC-231 Operating Systems (3+1)

Prerequisites: Data Structures & Algorithms

Course Objectives: To introduce various basic operational and management functions of an operating system.

Course Outline: Evolution of operating systems, different types of operating systems, computing environment, computer system operation, I/O and storage structure, hardware protection, system architecture, system components, services, system calls & programs, virtual machines, systems design and implementation, process scheduling, operations on processes, inter-process communication, client-server systems, threads & threading models, thread types & issues, threads on popular operating systems, CPU scheduling, criteria & algorithms, real-time scheduling & solution, critical-section problem, synchronization, critical-section resolution methods, deadlock characterization, handling of deadlocks, deadlock prevention, detection & recovery, address binding for memory management, swapping, memory allocation, paging, segmentation, virtual memory, file system concept, access methods & protection.

Recommended Books:

- Operating System Concepts by Silberschatz, A., Galvin, P. B., and Gagne, G., 9th edition, Wiley, 2012, ISBN: 978-1118063330
- Operating Systems - Internals and Design Principles by William Stallings, 6th edition, Pearson Practice Hall, 2009.

EC-332 Computer Communication Networks (3+1)

Prerequisites: Data Structures & Algorithms

Course Objectives: To introduce basics of computer communication and fundamental principles behind modern data networks such as Internet

Course Outline: Introduction of Computer Networks and Services, Network Design Principles, OSI and TCP/IP Reference Models, Network Topologies, The Physical Layer and Data Communication Fundamentals, Transmission Medias, Data Encoding, Data Communication Interfaces, Data Link Layer and its Protocols, Multiplexing, FDM and TDM, Medium Access Control and Various Multiple Access Methods, Ethernet and Token Ring Systems, Wide Area Networks, Network Layer and Routing, Hub, Bridges and Switches, Internetworking, IP Protocol, IP Addressing, Transport Layer, Services provided by Transport Layer, TCP & UDP, Congestion Control & Quality of Service, Application Layer, Domain Name System, Worldwide Web, Overview of Network Security.

Recommended Books:

- Data and Computer Communications by Stallings William, 10th edition, Prentice Hall, 2013, ISBN: 978-0133506488
- Computer Networks by Peterson and Davie, Morgan Kaufmann, 5th edition, 2011, ISBN: 978-0123850591
- Data Communication and Networks by Behroz A. Fourozan, 5th edition, Osborne Publishing, 2012, ISBN: 978-0073376226

EC-333 Microprocessor and Interfacing Techniques (3+1)

Prerequisites: Computer Architecture and Organization, Programming Fundamentals

Course Objectives: To acquaint the students with the organization, low level programming (Assembly Language), interfacing and applications of microprocessor-based systems.

Course Outline: Introduction to microprocessors, microcontrollers and assembly language programming (Instruction set of 8-bit and 16-bit microprocessor), programming exercises on various modes of operation and interfacing with EPROM and RAM, IOs, Parallel port interfacing, Keyboard and display controller, UART operation, Interrupts Structure, Event driven applications, interfacing A/D and D/A converters.

Recommended Books:

- The 8051 Microcontroller and Embedded Systems by Mazidi & Mazidi, 2nd edition, Prentice Hall, 2005, ISBN: 978-0131194021
- Thex86 family by John Uffenbeck, 3rd edition, Prentice Hall, 2002 ISBN:978-8178086422
- The Intel Microprocessors, Architecture, Programming and Interfacing by Barry B. Brey, 8th edition, Walter Triebel, 2008, ISBN: 978-0135026458

EC-334 Database Systems (3+1)

Prerequisites: Data Structures & Algorithms

Course Objectives: To introduce different database design methodologies.

Course Outline: Basic database concepts; Entity Relationship modeling, Relational data model and algebra, Structured Query language; RDBMS; Database design, functional dependencies and normal forms; Transaction processing and optimization concepts; concurrency control and recovery techniques; Database recovery techniques; Database security and authorization. Introduction to data mining, object oriented, distributed and multi-dimensional databases. Small Group Project implementing a database.

Recommended Books:

- Database Systems: A Practical Approach to Design, Implementation and Management by R. Connolly and P. Begg, 6th edition, Addison-Wesley Pub. Co., 2014, ISBN-13: 978-0132943260
- Database Systems by C. J. Date, 8th edition, Addison Wesley Pub. Co, 2003, ISBN: 978-0321197849

EC-340 Computer Architecture

Prerequisites: Computer Organization and Assembly Language

Course Objectives: Upon completion of this course, the student will have basic understanding of computer system architecture including CPU design, memory subsystem design and performance enhancement techniques.

Course Outline: Overview of main computer architectures and their performance comparison, instruction set architecture, CPU design, cache memory, different designs of cache memory system, virtual memory system, address mapping using pages, pipeling, super scaling, and threading, instruction level parallelism (ILP), introduction to parallel processing. Branch prediction, pre-fetching, multithreading.

Text Book:

- Computer Architecture: A Quantitative Approach by David A. Patterson, John L. Hennessy, Morgan Kaufmann, 5th Edition, 2011, ISBN-13: 978-0123838728

EC-341 Digital System Design (3+1)

Prerequisites: Computer Architecture and Organization

Course Objectives: To introduce the skills to write VHDL/ Verilog code that can be synthesized to efficient logic circuits.

Course Outline: High-level digital design methodology using VHDL/Verilog, Design, Implementation, and Verification, Application requiring HW implementation, Floating-Point to Fixed-Point Conversion, Architectures for Basic Building Blocks, Adder, Compression Trees, and Multipliers, Transformation for high speed using pipelining, retiming, and parallel processing, Dedicated Fully Parallel Architecture, Time shared Architecture, Hardwired State Machine based Design, Micro Program State Machine based Design, FPGA-based design and logic synthesis.

Recommended Books:

- Advanced Digital Design with Verilog HDL by Michael D. Ciletti, 2nd Edition, Prentice Hall, 2010, ISBN: 978-0136019282
- VHDL for Programmable Logic by Kevin Skahill, 2nd edition, Addison Wesley, 1996, ISBN: 978-0201895735
- The Designer's Guide to VHDL by Peter J. Ashenden, Morgan Kaufman, 2008, 3rd edition, ISBN: 978-8131218556
- Verilog HDL-A guide to digital design and synthesis by Samir Palnitkar, 2nd Edition, Prentice Hall Publisher, 2003, ISBN-13: 978-0132599702

EE-350 Control Engineering

Prerequisites: Signal and Systems

Course Outline: System modeling, modeling of electrical, mechanical, thermal, hydraulic and biological systems, transfer functions, open- and closed-loop control systems, block diagrams, block-diagram reduction, signal flow graphs, continuous-time system response of 1st , 2nd and higher order systems, response components,

stability, poles and zeroes, Routh-Hurwitz test, performance specifications, type number, system sensitivity, Step and impulse response, analysis and design with the root-locus method, Frequency domain analysis and design, Nyquist criterion, gain and phase margins, PID controller implementation and tuning, introduction to State-space method, state equations, state transformations and diagonalization, time response from state equations, industrial applications of control systems, basic concept of PLC.

Text Book:

- Feedback Control Systems, 3rd edition, by Stefani, Savant, et. al., 4th Edition, Oxford University Press.
- Feedback control of dynamic systems by Franklin and Powel, 5th edition, Pearson.
- Modern Control Engineering by K. Ogata, 4th edition, Prentice Hall.

EC-390 Digital Signal Processing (3+1)

Prerequisites: Signal and Systems

Course Objectives: This course aims to develop mathematical and analytical skills necessary to analyze digital signals both in time and frequency domains. This course will provide the student with an intuitive and practical understanding of the fundamental concepts of discrete-time signal processing. From the system's perspective, the objective is to incorporate extensive design skills in the students enabling them to develop relevant prototypes with the desired level of accuracy.

Course Outline: Applications of DSP, digital signals, systems and convolution. Flip and Slide Convolution & Frequency Response, Fourier transform and frequency response, discrete time Fourier transform, symmetry properties, sampling theorem & D/A reconstruction, DFT and FFT algorithms, DFT properties & Circular Convolution (spectrum analysis & windowing), FFT algorithms and high speed (block) convolution, Z-transform and its properties with inverse, FIR and IIR filters and their implementations, FIR filter design methods, IIR filter design methods, resolution & side lobes, spectrum analysis, power spectrum for random signals, porting of DSP algorithms on embedded systems especially on DSP chips including fixed point programming.

Recommended Books:

- Digital Signal Processing by J. P. Proakis and D. G. Manolakis, Prentice Hall, 2006, 4th Edition, ISBN: 978-0131873742
- Digital Signal Processing: A Practical Approach by Emanual C. Ifeachor, 2nd edition, Prentice Hall, 2001, ISBN: 978-0201596199

EC-442 Embedded Systems (2+1)

Prerequisites: Microprocessor and Interfacing Techniques

Course Objectives: Introduce the trends and challenges in the design of embedded systems and teach chip technologies and design tools needed for these systems.

Course Outline: Introduction to embedded systems; components, tools and platforms; The C2M embedded design process; sensors and actuators; embedded system software, mixing C and assembly, HW/SW co-design; fundamentals of real-time operating systems, concurrent software and multi-tasking, scheduling, inter-task communication & synchronization, case studies using examples of embedded systems.

Recommended Books:

- Embedded Systems Design: An Introduction to Processes, Tools, and Techniques by Arnold S. Berger, 1st edition, CMP Books, 2001, ISBN: 978-1578200733
- Fundamentals of Embedded Software: where C and Assembly meet by Daniel Lewis, 1st edition, Pearson Education, 2001, ISBN: 978-0130615893
- Microc OS II-The Real Time Kernel by Jean J. Labrosse, 2nd edition, CMP Books, 2002, ISBN-13: 978-1578201037

EC-444 Parallel and Distributed Computing (2+1)

Prerequisites: Computer Architecture and Organization, Operating Systems

Course Objectives:

- To strengthen the student understanding of fundamental concepts of distributed computing
- To learn fundamental concepts that are used in and applicable to a variety of distributed computing applications,
- To realize fundamental concepts in four programming assignments: a chat server, a parallel-computing application, a mobile agent, and a distributed file system.

Course Outline: Shared-Memory Multiprocessor Architecture: Symmetric Multi-Processor (SMP), CC-NUMA, and Distributed Shared Memory (DSM), Message-Passing Multicomputer Clusters: PC clusters, workstation clusters, server farms, cluster of SMPs, availability support, single-system image, job management in clusters, Grid Computing Infrastructure and Technologies: Grid technologies, major Grid Projects, Globus, GridSim. Condor-G, Nimrod, GridSec, etc. Parallel Programming Models and Software Tools: Shared-variable, message-passing, support for collective communication, Fast MPI, LAM, OpenMP, MPI, PVM, Condor, LSF, middleware, etc., Latency Tolerance and Multiprocessing Techniques: Data pre-fetching, distributed coherent caches, latency hiding, Thread-level parallelism (TLP), etc., Cluster and Grid Computing Techniques and Applications: SMP clusters, storage-area networks, distributed Supercomputing, e-Science, Business Grids, etc., Emerging New Technologies and Research Frontiers: Grid and P2P Services, Wireless Grids, Network Security, Selfish Grids, and Trusted Computing, etc.

Recommended Books:

- Grid Computing: Making The Global Infrastructure a Reality by F. Berman, G. Fox, and T. Hey, John Wiley and Sons, 2003, ISBN: 0-470-85319-0
- The GRID 2: Blueprint for New Computing Infrastructure by Foster and C. Kesselman, Morgan Kaufmann, 2nd edition, 2004, ISBN: 1-55860-933-4
- An Introduction to Parallel Programming by Peter Pacheco, Morgan Kaufmann, 1st edition, 2011, ISBN: 978-0123742605
- Fundamentals of Parallel Computing Hardcover by Sanjay Razdan, Alpha Science International Ltd, 2014, ISBN: 978-1842658802

EC-445 System Programming (2+1)

Prerequisites: Microprocessor and Interfacing Techniques, Operating Systems

Course Objectives: To introduce the basics of writing device drivers for typical operating systems.

Course Outline: Introduction to System Program, Linux Architecture: Overview & Basics, Programs, Processes & Threads, File and Directory structure, I/O Processes, I/O Efficiency, Error Handling, User Identification, File Sharing, Atomic Operations, File Types, File Access Permissions, UNIX Special Files, Pipes, Terminal Control & Queues, Login Accounting, System Identification, Time and Date Routines, Signals & Timers, Signal Concepts, signal Function, Interrupted System Calls, POSIX Threads, Thread Limits, Thread Attributes, Synchronization Attributes, Reentrancy, Thread Synchronization.

Recommended Books:

- Windows System Programming by Johnson M. Hart, 4th edition, Addison-Wesley Professional, 2015, ISBN: 978-0134382258
- The Windows NT Device driver book by Art Baker, 2nd edition, Prentice Hall

EC-448 Robotics (2+1)

Prerequisites: Control Engineering

Course Objectives: To introduce the basic terminology of robotics, and derive mathematical models for simple robotic systems.

Course Outline: Introduction, components and subsystems, object localization, spatial description and transformations, kinematics (manipulator position / motion), statics, dynamics, mobile robots, task planning, sensors measurement and perception, control, programming.

Recommended Books:

- Introduction to Robotics: Mechanics and Control by John J. Craig, Pearson, 2013, ISBN: 978-8131718360
- Introduction to Robotics by Phillip John Mckerrow, Introduction to Robotics by Phillip John Mckerrow, 1991, ISBN: 978-0201182408

EC-465 Software Project Management (2+1)

Prerequisites: Software Engineering

Course Objectives: To develop ability to plan and manage software development projects successfully, maximizing the return from each stage of the software development life cycle.

Course Outline: Introduction to project management, Principals of project management, integrated software engineering project Planning (Project infrastructure, characteristics, Activities (Work Breakdown Structure), Iterative planning, Size, resource, cost and schedule estimation). Project Activity Planning (Network), Resource Requirements, Scheduling, and Allocation, Monitoring and Controlling Progress, Project organization and staffing, Risk analysis and management; Client Management, Project direction and control, Project progress visibility: matrices and measurement, Configuration Management.

Recommended Books:

- Project Management Handbook by K. Pinto Editor, Jossey-Bass Publishers, 1998, ISBN 0-7879-4013-5
- Software Engineering - A Practitioner's Approach by Pressman R.S., 8th edition, McGraw-Hill Education, 2014, ISBN: 978-0078022128
- Practical Software Metrics for Project Management and Process Improvement by R. B. Grady, Prentice-Hall, Englewood Cliffs, NJ 07632, 1992, ISBN 0-13-720384-5
- Effective Project Management, by Wisocki, Beck and Crane, John Wiley and Sons Inc., 1995, ISBN 0-471-11521-5
- Project Management, Strategic Design and Implementation, 3rd edition, by David I. Cleland, McGraw-Hill, 1999, ISBN 0-07-012020-X
- Bob Hughes and Mike Cotterel, Software Project management, 2005 McGraw Hill Higher Education

EC-467 Mobile Application Development (2+1)

Prerequisites: Nil

Course Objectives:

- To design and develop Web applications using HTML5.
- To design and develop software architectures for mobile applications for various platforms.

- To practice and use mobile application development tools such as Visual Studio, Android Studio, and Xcode in order to gain mobile application programming skills.
- To develop a medium sized mobile application as a term project working in a team.

Course Outline: Introduction to Mobile Computing, Development Environment, Factors in Developing Mobile Applications, HTML5 for Mobiles, Frameworks, User-interface, Text-to-Speech Techniques, Intents and Services, Storing and Retrieving Data, Communications Via Network and the Web, Telephony, Notifications and Alarms, Graphics, Multimedia, Location, Hardware Sensors, Developers and App store license agreements, Security and Hacking, Platforms Issue.

Recommended Books:

- iOS Programming: The Big Nerd Ranch Guide, 4th edition, Joe Conway, Aaron Hillegass and Christian Keur, Big Nerd Ranch Guides, 2014
- Android Programming: The Big Nerd Ranch Guides, 1st edition, Bill Phillips and Brian Hardy, Big Nerd Ranch Guides, 2014
- Professional Android 4 Application Development, 3rd Edition, Reto Meier, Wrox professional press, 2012

EC-481 Wireless and Mobile Networks (3+0)

Prerequisites: Computer Communication Networks

Course Objectives: To present the wireless and mobile network architectures, technologies and protocols.

Course Outline: Introduction to Wireless Communication, Wired vs. Wireless Communication, Electromagnetic Spectrum, Design Challenges, Wireless Transmission, Evolution of Wireless Networks, Channel Planning for Wireless System, Issues, QoS, Security, Multimedia Services and Applications, WLANS, WiMAX, Wireless PAN, CDMA One/IS-95, Wireless CDMA Design Considerations, Walsh Codes, IS-95 Reverse Link, EDGE, WCDMA/ UMTS, Transport and Physical Channels, Signaling, Physical Layer Procedures, Compressed Mode Measurements, Handover Measurements, CDMA-2000, Mobile Ad Hoc, Security, WEP Protocol, Mobile IP, Introduction to Wireless Mesh Networks, Characteristics, WSN, High Rate WPAN , ZigBee, OFDM, OFDMA, Fundamentals of Cellular Concepts, 1G/2G/2.5G/3G Cellular Networks, Trunking and Grade of Service, Measuring Traffic Intensity, Trunked Systems, Erlang Charts, Improving Coverage and Capacity, GSM Specifications, Call Routing in GSM, GPRS, EDGE, Limitation of 3G, 4G Objectives, 4G Overview, Mobility Management, Handoff types, QoS Considerations.

Recommended Books:

- Handbook of Wireless Networks and Mobile Computing, Edited by Ivan Stojmenovic, John Wiley & Sons, Inc., 2002
- Aftab Ahmad, "Wireless and Mobile Data Networks", John Wiley & Sons, 2005
- W. Stallings, "Wireless Communications and Networks", Prentice Hall, 2002.
- K. Pahlavan & P Krishnamurthy, "Principles of Wireless Networks", Prentice Hall, 2002
- K. Daniel Wong, "Wireless Internet Telecommunications", Artech House, Inc 2005
- Yi-Bang Lin, "Wireless and Mobile Network Architectures", John Wiley & Sons, 2001

EC-482 Network Security and Cryptography (3+0)

Prerequisites: Computer Communication Networks

Course Objectives:

- Develop an understanding of information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
- Gain familiarity with prevalent network and distributed system attacks, defenses against them, and forensics to investigate the aftermath.
- Develop a basic understanding of cryptography, how it has evolved, and some key encryption techniques used today.
- Develop an understanding of security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

Course Outline:

Introduction, computer security concepts, OSI security architecture, classical encryption techniques, Block Ciphers and Stream cypher, Passive attacks, active attacks, Symmetric Encryption, RC4, Public key cryptography DES, Triple DES, AES, Key distribution and user authentication, cryptographic hash functions MD5, Digital signatures, Key management and distribution, User authentication protocols, TLS, Malicious software, Firewall, HTTPS, S/MIME, Security Attacks, DoS attacks, Spoofing, Spams, Session Hijacking, Wireless security, Internet Security, Antiviruses, Digital Immune System.

Recommended Books:

- William Stallings, "Cryptography and Network Security", 5th edition, Pearson Prentice Hall
- Behrouz A. Forouzan, "Cryptography and Network Security", 2nd edition, McGraw Hill
- William Stallings, "Network Security Essentials: Applications and Standards", 4th edition, Pearson Prentice Hall
- Nader Badawy, "Cryptography and Network Security", 4th edition

EC-483 Fault Tolerant Computing (3+0)

Prerequisites:

Computer Architecture and Organization, Data Structures & Algorithms

Course Objectives:

To discuss various aspects of designing reliable and testable digital systems including fault modeling, simulation, test pattern generation, built-in self-test, testing random access memories, and reliability testing.

Course Outline:

Introduction to digital system testing, Economics of testing, fault models, Test generation at gate level and switch level, random test generation, BIST for Memories, fault diagnosis and reconfiguration, Simulation based test generation, design for testability.

Recommended Books:

- Essentials of Electronic Testing for Digital, Memory & Mixed Signal VLSI Circuits by M. L. Bushnell, and V. D. Agrawal, Springer.