HITEC UNIVERSITY

Taxila Cantt



SELF ASSESSMENT REPORT

BS Computer Engineering

Faculty of Engineering and Technology

Heavy Industries Taxila Education City (HITEC) University

May 2023

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Executive Summary

This self-assessment report is being prepared for BS Computer Engineering 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 Computer Engineering 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. 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 stakeholders 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 stakeholders. 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 Computer Engineering 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 four intakes of the BS Computer Engineering Program starting from 2014.

•	BS Computer Engineering	2019
•	BS Computer Engineering	2020
•	BS Computer Engineering	2021
•	BS Computer Engineering	2022

Program Selected

HITEC University has selected the BS Computer Engineering Program for Self-Assessment Report (SAR) under the directives of Higher Education Commission (HEC). It was initially under the umbrella of EE department, but a separate setup was launched in 2014.

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 honour, 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 honourable life as citizens of Pakistan.

Mission of the HITEC University, Taxila

HITEC University will be a centre 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 computer engineer 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 computer engineering 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			
		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 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	University Vision:				
career in industry, academia, R&D organizations	• Intellectual flourishment				
or in a self-initiated entrepreneurial undertaking.	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				

Program Educational Objectives	Keywords
	Creating innovative solution
PEO 2: Our graduates will be able to analyze	University Vision:
problems and create sustainable solutions using	Intellectual flourishment
their domain knowledge and modern IT tools.	Nurturing thought
Also they will have the ability to adapt to the	• Creativity
changes in technology and the needs of society	University Mission:
enanges in teemiology and the needs of society.	• Center of excellence in teaching, learning and research
	• Strong linkages with industry
	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
	Creating innovative solution
PEO 3: Our graduates will continue to seek	University Vision:
knowledge for professional advancement and	Confidence and fortitude
enhanced awareness about computing practices	Character grooming
and societal concerns.	• Intellectual flourishment
	• Creativity University Mission:
	• Unge for acciel 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	University Vision:
projects as individuals or as a part of an	• Character building and grooming
interdisciplinary team. They will be effective	• Adherence to moral and social values
communicators and will conduct themselves with	University Mission:
integrity, upholding the principles of ethics and	• Urge for social responsibility
social responsibility.	Faculty of Computer Engineering Vision:
	• Perpetuate truth Faculty of Computer Engineering Mission:

Program Educational Objectives	Keywords			
	• 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 a computer engineer.

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%.

Program Educational Objectives Assessment

The first batch of CE program has been graduated in July/August 2018. However, the Batch-2016 will be the first batch with complete OBE-based results. Furthermore, the true assessment of PEOs will be on the basis of the indirect feedback data collected from CE graduates after 4-5 years of their graduation. The extent of achievement of the PEOs is evaluated through number of important assessment activities including gathering of Alumni Survey and Employer's Feedback of alumni. The Quality Assurance and Collaboration (QA&C) department of the university conducts surveys; Alumni and Employers, which will be used to assess PEOs.

The data collected in the assessment will be analyzed and evaluated against the KPIs which are defined in the table below.

Assessment of Program Educational Outcomes				
PEOs	PEOs Strategy Key Performance Indictor			
PEO 1	Employer Survey [Q1] Alumni Record	 Employer Feedback should be above 60%. 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. 	Once in academic year	
PEO 2	Employer Survey [Q2] Alumni Survey [Q3, 8] Alumni Record	 Employer Feedback should be above 60%. Alumni Feedback Should be above 60%. At least 10% of the students should go for higher studies. 	Once in academic year	
PEO 3	Employer Survey [Q4, 6, 7] Alumni Survey [Q9] Alumni Record	 Employer Feedback should be above 60%. Alumni Feedback should be above 60%. At least 10% of the students should manage self- initiated business activities. 	Once in academic year	
PEO 4	Employer Survey [Q3, 5] Alumni Survey [Q6, 7]	Employer Feedback should be above 60%.Alumni Feedback should be above 60%.	Once in academic year	

 Table 1-2. Program Learning Assessment KPIs

Program Stakeholders

To accomplish the PEOs, the program's stakeholders are identified, and a review process is in place for the continuous improvement of the curriculum and the extent to which the objectives are being met. The following are identified as the stakeholders: -

Students as Alumni

An updated database of graduated students containing their employment information and professional engagements is being maintained. The Exit Survey is taken from the graduate students. In addition, Alumni Survey is taken after the graduation.

Employers

The employers of our alumni and the relevant industry at large are important stakeholders of our program. The employers' input is obtained through Employer Survey. Industrial linkages and feedback in open houses and project exhibitions are also important sources for program improvements.

Faculty

Our teachers are the most important stakeholders. Their input and feedback are continuously incorporated for program improvement and achievement of objectives through Course Evaluation Reports and Curriculum Review Committees. Faculty's exposure to research, industry-related projects, technical conferences and training courses assists in improving their contribution towards CQI of the program.

Alumni Survey

Summary of the alumni conducted for Batch- 2016, 2017 and 2018 is shown below:

Alumni Survey Results Summary

Summary of the alumni survey conducted for Batch- 2016, 2017 and 2018 is shown below:

2016

Department	Total	Job Holders	Higher Studies	Unemployed	Own Business	Internship	Total
Computer Engineering	17	13	0	3	1	0	17
Total	17	13	0	3	1	0	17
%age							
Computer Engineering 76% 0% 18% 6% 1						100%	
Threshold accor KPIs	ding to	60%	10%	20%	10%		100%



Figure 1.1: Alumni Survey Results of Batch 2016



Figure 1.2: Alumni Survey Results of Batch 2017

Department Total		Job Holders	Higher Studies	Unemployed	Own Business	Internship	
Computer Engineering	25	4	8	5	8	0	
Total 25		4	8	5	8	0	
	%age						
Computer Engine	16%	32%	20%	32%			
Threshold according to KPIs		60%	10%	20%	10%		



Figure 1.3: Alumni Survey Results of Batch 2018

The table below presents the mapping of Alumni Survey questions with attainment of PEOs.

Table 1-3. Alumni Survey Questions Mapping with PEOs

Alumni Survey – Questions Mapping with PEOs				
PEO / Question	PEO 1	PEO 2	PEO 3	PEO 4
Alumni Record	\checkmark	\checkmark	√	
Q-1				
Q-2				
Q-3		\checkmark		
Q-4				
Q-5				
Q-6				\checkmark
Q-7				\checkmark
Q-8		\checkmark		
Q-9			\checkmark	
Q-10				
Q-11				

Standard 1-3 The results of Program's assessment and the extent to which they are used to improve the program must be documented.

Alumni Survey Corrective Actions (CQI)

Latest survey shows that for the Computer Engineering Department, 16 percent of the responders are employed, 32 percent have opted for higher studies while 32 percent have started their own business and 20 percent are unemployed. Comparing with the thresholds set by the department, higher studies and own business are well above the set limit, unemployed is almost on the

borderline whereas job holders is much below the set limit. The issue has been forwarded to the senior management committee for necessary actions.

Employer Survey

Currently, there are five batches 2014, 2015, 2016, 2017 and 2018 have been graduated. A process has been developed to assess the level of attainment of the program objectives to evaluate effectiveness of the BSCE academic program. Directorate of QA&C conducts the employer survey from several corporate where our graduates were employed. A variety of questions focusing on the OBE system will be asked. The form has been developed and the template of the form is presented in Employer Feedback Form. The PEOs and employer survey question mapping is shown below:

Table 1-4. Employer Survey Questions Mapping with PEOs

Employer Survey – Questions Mapping with PEOs				
PEO / Question	PEO 1	PEO 2	PEO 3	PEO 4
Q-1	\checkmark			
Q-2		\checkmark		
Q-3				\checkmark
Q-4			\checkmark	
Q-5				\checkmark
Q-6			\checkmark	
Q-7			\checkmark	
Q-8				

Employer Feedback Summary

The Summary of PEO achievement through employer survey conducted for batch 2016, 2017 & 2018 is shown below:



Figure 1.4: Employer's Survey Results of Batch 2016, 2017 and 2018

Process of Revision of PEOs

The PEOs have been determined specifically to ensure that the Department of Computer Engineering meets the needs of its constituencies. Through the survey tools, these constituencies also have an opportunity to recommend changes to each of the PEOs to align them with their needs. The process of revision of PEOs is shown in Figure 2.5. The revision in PEOs recommended by the directorate of QA&C is first reviewed by the departmental CRC. This Committee then forwards its recommendation to the BoS



Figure 1.5: Process of PEOs Revision

Industrial Advisory Board

The institute is conscious of the fact that despite all the idealism one may have, new institutions tend to regress towards the existing models, and fail to live up to the ideals which inspired their creation. It, therefore, took care to build monitoring mechanisms to maintain the Institute's standards in education and research. One such mechanism is the Industrial Advisory Board consisting of leading scientists, engineers, and academicians. The board sets up international standards for the Institute in terms of the quality of education and research, the caliber of faculty, revision and review of the curricula, and the adequacy of the laboratory and library facilities. It also reviews the development programs of the Institute and provides guidelines for its growth in the future. The present Advisory Board comprises the following members:

Table 1.5: List of Industrial Advisory Board

Sr. No.	Name	Designation	Industry
1	Mr. Amir Nawaz	DCM	AWC
2	Mr. Zahid Mehmood	General Manager	NESCOM
3	Mr. Ammar Waqar	Product Manager, Chief Tech. Officer	iEngineering Ltd, Transconomy LLC
4	Mr. Aqdas bin Tahir	General Manager	Beyond Koncept
5	AWM Osama Maqsood Janjua	Research Officer	ARDIC, Heavy Industry Taxila
6	Maj. Muhammad Ahsan Munir	Senior Research Officer	ARDIC, Heavy Industry Taxila
7	Christian Herter	Managing Director	Xtendtum Services
8	Mr. Asad Ullah Shabbir	Director	Wurfel IT (Pvt.) Ltd
9	Mr. Adnan Noor	Manager	Mercurial Minds
10	Dr. M. Faisal Nadeem	Principal Engineer	Informatics Complex
11	Mr. Muhammad Hammad	Senior Software Developer	MTBC, Islamabad
12	Dr. Wazir Zada Khan	Professor	University of Wah
13	Dr. Aamer Nadeem	Professor	CUST, Islamabad
14	Dr. Laiq Hasan	Professor	UET Peshawar
15	Dr. Mukhtar Ullah	Professor	NUCES, FAST
16	Dr. Tallha Akram	Associate Professor	Comsats Wah
17	Mr. Nasir Mehmood Bhatti	Chief Scientist	PAEC Nilore
18	Mr. Muhammad Ali Rana	DCM	NESCOM
19	Mrs. Iram Ali Rana	Teacher	The City School
20	Engr. Usman Zahid	Lecturer	Foundation University

21	Engr. Rafiullah Khan	Service Engineer	Modern Equipment and Services
22	Engr. Yahya Waqar	DOC Engineer	Huawei
23	Dr. Raza Ali Shah	Associate Professor	HITEC University
24	Dr. Imran Ashraf	Assistant Professor	HITEC University
25	Dr. Muhammad Bilal	Assistant Professor	HITEC University

Criterion 2: Curriculum Design and Organization

The curriculum of the Computer Engineering Program adhered to the PEC/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 Computer Engineering

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

Following is the list of courses taught in the selected program. Section 4.5 shows the details about

these courses including pre-requisites.

Sem.	Course	Commo Title	Credit
No.	Code	Course The	Hours
	BS-101	Engineering Physics	3+0
	HS-101	English	3+0
1	MT-101	Calculus & Analytical Geometry	3+0
	EE-102	Electric Circuit Analysis	3+1
	HS-102	Pakistan Studies	2+0
	EC-110	Computing Fundamentals	2+1
	EE-101	Engineering Workshop	0+1
	HS-103	Communication Skills	3+0
2	EC-111	Programming Fundamentals	3+1
	EE-205	Electronic Devices and Circuits	3+1
	EC-225	Discrete Structures	3+0

	MT-303	Applied Linear Algebra	2+0
	MT-103	Differential Equations	3+0
	EC-121	Digital Logic Design	3+1
3	HS-201	Technical Report Writing	3+0
	IS-211	Islamic Studies	2+0
	ME-211	Computer Aided Engineering Design	0+1
	EC-230	Object Oriented Programming	3+1
	MT-201	Complex Variables and Transforms	3+0
	EC-231	Operating Systems	3+1
4	EC-222	Data Structures & Algorithms	3+1
	EC-223	Signals and Systems	3+1
	EC-228	Computer Architecture and Organization	3+1
	MT-202	Numerical Methods	2+1
	CS-204	Software Engineering	3+0
5	EC-332	Computer Communication Networks	3+1
	EC-333	Microprocessor and Interfacing Techniques	3+1
	EC-334	Database Systems	3+1
	EC-201	Engineering Project Management	3+0
6	MT-302	Probability and Statistics	3+0
	EC-341	Digital System Design	3+1
	EC-390	Digital Signal Processing	3+1

	XX-XXX	EC Depth Elective – I	2+1
	HS-401	Professional Values & Ethics	2+0
	MS-403	Management and Entrepreneurship	3+0
7	HS-404	Foreign Language	2+0
	XX-XXX	EC Depth Elective – II	2+1
	XX-XXX	IDEE – I	2+1
	HS-402	Economics	2+0
	HS-405	Health Safety and Environment	1+0
8	XX-XXX	EC Depth Elective – III	2+1
0	XX-XXX	EC Depth Elective – IV	2+1
	XX-XXX	IDEE – II	2+1
	EC-499	Final Year Project	0+6
	EC-350	Control Engineering	3+1
	EC-442	Embedded Systems	2+1
	EC-444	Parallel and Distributed Computing	2+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
	CS-406	Digital Image Processing	2+1
	EE-304	Communication Systems	3+0

Curriculum Breakdown

Semester-1

Course Code	Course Title	Credit Hours
CE-101	Computer Fundamentals	2+1
EE-102	Electric Circuits	3+1
MT-101	Calculus & Analytical Geometry	3+0
IS-211	Islamic Studies	3+0
HS-101	English	3+0

Total Credits: 19

Semester-2

Course Code	Course Title	Credit Hours
CE-106	Computer Application in Engineering	2+1
CE-107	Computer-Aided Engineering Drawing	0+1
CE-108	Programming Fundamentals	3+1
EE-201	Basic Electronics	3+1
HS-103	Communication Skills	3+0
MT-103	Differential Equations	3+0

Total Credits: 18

Semester-3

Course Code	Course Title	Credit Hours
CE-201	Data Structures and Algorithms	3+1
CE-202	Digital Logic Design	3+1
CE-203	Discrete Structures	3+0
EE-103	Network Analysis	3+1
MT-201	Complex Variables and Transforms	3+0
CE-201	Data Structures and Algorithms	3+1

Total Credits: 18

Semester-4

Course Code	Course Title	Credit Hours
CE-206	Computer Organization and Assembly Language	3+1
CE-207	Object Oriented Programming	3+1
CE-208	Database Systems	3+1
MT-203	Linear Algebra	3+0
HS-201	Technical Report Writing	3+0

Total Credits: 18

Semester-5

Course Code	Course Title	Credit Hours
CE-301	Microprocessor & Interfacing Techniques	3+1
CE-302	Signals & Systems	3+1
CE-3xx	CE Elective-I	3+1
CS-311	Digital Image Processing	3+1
MT-202	Numerical Methods	3+0

Total Credits: 19

Semester-6

Course Code	Course Title	Credit Hours
CE-306	Operating Systems	3+0
CE-307	Computer Communication Networks	3+1
CE-3xx	CE Elective-II	3+0
CE-3xx	CE Elective-III	3+1
MT-302	Probability and Statistics	3+0
HS-102	Pakistan Studies	3+1

Total Credits: 19

Semester-7

Course Code	Course Title	Credit Hours
CS-401	Final Year Project-I	0+3
CE-402	Digital System Design	3+1
CS-41x	CE Elective-IV	2+1
MS-201	Engineering Economics	2+0
MS-401	Engineering Management	3+0

Total Credits: 15

Semester-8

Course Code	Course Title	Credit Hours
CS-401	Final Year Project-II	0+3
CS-406	Artificial Intelligence	2+1
CS-43x	CE Elective-V	3+0
IS-411	Professional Ethics	2+0
MS-410	Technology Entrepreneurship	2+0

Total Credits: 14

Table 6: Curriculum Course Requirements (table 4.3)

Elective courses

Sr. #	Course Name	Course Code	Credit Hours
1	Embedded Systems	CE-310	3+1
2	Digital Signal Processing	CE-312	3+1
3	Computer Architecture	CE-314	3+0
4	Embedded Software Development	CE-316	3+1
5	Embedded Operating Systems	CE-318	3+0
6	Telecommunication Systems	CE-320	3+0
7	Software Engineering	CE-322	3+0
8	Wireless and Mobile Networks	CE-410	3+0

9	Data and Network Security	CE-412	3+0
10	Parallel & Distributed Computing	CE-414	3+1
11	Neural Networks and Fuzzy Logic	CE-416	3+0
12	Mobile Application Development	CE-418	3+1
13	Computer Graphics	CE-420	3+1
14	System Programming	CE-422	3+1

Table 7: Elective Courses and their respective Credit Hours

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: Mathematic	s Courses	
Calculus & Analytical C	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	
Enginee	ering Economics	MS-201
Enginee	ering Management	MS-401
Technol	ogy Entrepreneurship	MS-410

Group 6:	Courses of Computer Engineering I	Domain
Compute	er Fundamentals	CE-101
Compute	r Application in Engineering	CE-106
Compute	er-Aided Engineering Drawing	CE-107
Program	ming Fundamentals	CE-108
Data Stru	actures and Algorithms	CE-201
Digital L	ogic Design	CE-202
Discrete	Structures	CE-203
Compute	er Organization and Assembly Language	CE-206
Object O	riented Programming	CE-207
Database	Systems	CE-208
Micropro	ocessor & Interfacing Techniques	CE-301
Signals &	k Systems	CE-302
Digital I	nage Processing	CS-311
Operatin	g Systems	CE-306
Compute	r Communication Networks	CE-307
Digital S	ystem Design	CE-402
Artificial	intelligence	CS-406

Table 4.3:	Curriculum	Course Re	equirements	

Domoin	Knowledge Area	PEC Recom	mended	BSCE Breakup	Program	
Domani	Kilowledge Area	Total Credits	Overall (%)	Total Credits	Overall (%)	
Non- Engineering	Humanities	15		19	32.85%	
	Management Sciences	5	29.63%	6		
	Natural Sciences	20		20		
	Sub Total	40	29.63%	45	32.85%	
Engineering	Computing	10	70 27%	10	67 150/	
	Engineering Foundation	29	10.3170	30	07.1370	

	CE Core	27		27	
	CE Depth	16		12	
	Inter-Disciplinary Engineering Breath (Electives)	7		7	
	Senior Design Project	6		6	
	Sub Total	95	70.37%	92	67.15%
Total:		135	100%	137	100%

Table 4.4: courses versus Program Learning Outcomes

Sem.	Sem. Course Course Title		Credit		PLOs										
No.	Code		Hours	1	2	3	4	5	6	7	8	9	10	11	12
1	BS-101	Engineering Physics	3+0	1											
	HS- 101	English	3+0										1		
	MT- 101	Calculus & Analytical Geometry	3+0	1											
	EE-102	Electric Circuit Analysis	3+1	1											
	HS- 102	Pakistan Studies	2+0						1						
	EC- 110	Computing Fundamentals	2+1	1	1			1							
2	EE-101	Engineering Workshop	0+1	1				1							
	HS- 103	Communication Skills	3+0								1				
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	EC- 111	Programming Fundamentals	3+1	1	1		1								
	EE-205	Electronic Devices and Circuits	3+1	1											
	EC- 225	Discrete Structures	3+0	1	1										
	MT- 303	Applied Linear Algebra	2+0	1											
	MT- 103	Differential Equations	3+0	1											
	EC- 121	Digital Logic Design	3+1	1	1	1	1			1					
3	HS- 201	Technical Report Writing	3+0							1	1				
	IS-211	Islamic Studies	2+0					1	1						
	ME- 211	Computer Aided Engineering Design	0+1	1			1								
	EC- 230	Object Oriented Programming	3+1	1	1	1	1								
4	MT- 201	Complex Variables and Transforms	3+0	1	1										

	EC- 231	Operating Systems	3+1	1	1	1	1			1		
	EC- 222	Data Structures & Algorithms	3+1	1	1		1					
	EC- 223	Signals and Systems	3+1	1	1		1					
	EC- 228	Computer Architecture and Organization	3+1	1	1	1	1					
	MT- 202	Numerical Methods	2+1	1	1		1					
	CS-204	Software Engineering	3+0	1	1	1						
5	EC- 332	Computer Communication Networks	3+1	1	1		1					
	EC- 333	Microprocessor and Interfacing Techniques	3+1	1		1	1			1		
	EC- 334	Database Systems	3+1	1	1	1	1					
6	EC- 201	Engineering Project Management	3+0					1			1	1
	MT- 302	Probability and Statistics	3+0	1	1							

	EC- 341	Digital System Design	3+1		1	1	1	1				1			
	EC- 390	Digital Signal Processing	3+1	1	1	1		1				1			
	XX-XXX	EC Depth Elective – I	2+1			Pro	ovideo	d unde	er List	of Ele	ective	Cours	ses.		
	HS- 401	Professional Values & Ethics	2+0							1	1				
7	MS- 403	Management and Entrepreneurship	3+0										1	1	1
7 -	HS- 404	Foreign Language	2+0												1
	XX-XXX	EC Depth Elective – II	2+1	Provided under List of Elective Courses.											
	XX-XXX	IDEE – I	2+1	Provided under List of IDEE Elective Courses.											
	HS- 402	Economics	2+0		1										1
8	HS- 405	Health Safety and Environment	1+0						1	1					1
	XX-XXX	EC Depth Elective – III	2+1			Pro	ovide	d unde	er List	of Ele	ective	Cours	ses.		
	XX-XXX	EC Depth Elective – IV	2+1			Pro	ovide	d unde	er List	of Ele	ective	Cours	ses.		

	XX-XXX	IDEE – II	2+1	Provided under List of IDEE Elective Courses.											
	EC- 499	Final Year Project	0+6	1	1	1	1	1		1		1	1	1	1
List o	f Elective	Courses													
	EC- 350	Control Engineering	3+1	1		1	1	1				1			
	EC- 442	Embedded Systems	2+1		1	1	1	1				1			
	EC- 444	Parallel and Distributed Computing	2+1	1		1	1	1				1			
	EC- 445	System Programming	2+1	1		1	1	1				1			
	EC- 448	Introduction to Robotics	2+1	1	1			1				1			
	EC- 482	Network Security and Cryptography	3+0	1	1		1								
List o	f IDEE E	lective Courses													
	CS-302	Artificial Intelligence	2+1	1	1			1				1			
	CS-406	Digital Image Processing	2+1	1	1			1				1			
	EE-304	Communication Systems	3+0	1	1	1									

Total Count of each PLO	34	25	15	7	24	4	3	2	14	5	3	6
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Standard 2-2 Theoretical backgrounds, problem analysis and solution design must be stressed within the program's core material. Table 8: Standard 2-2 Requirement (table 4.5)

Elements	Courses	
Theoretical	CF-101	Computing Fundamentals
	CL-101	Computing Pundamentals
Background	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	CE-203	Discrete Structures
Analysis	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	CE-107	Computer-Aided Engineering Drawing
Design	MT-201	Complex Variables and Transforms
	HS-201	Technical Report Writing
	CE-307	Computer Communication Networks
	CS-406	Artificial Intelligence

Standard 2-3 The Curriculum must satisfy the core requirements for the program as specified by the respective accreditation body.

Domoin	Knowledge Area	PEC Reco	mmended	BSCE Program Breakup			
Domain	Knowledge Area	Total Credits	Overall (%)	Total Credits	Overall (%)		
	Humanities	15		19			
Non- Engineering	Management Sciences	5	29.63%	6	32.85%		
	Natural Sciences	20		20			
	Sub Total	40	29.63%	45	32.85%		
	Computing	10		10			
	Engineering Foundation	29		30			
	CE Core	27		27			
	CE Depth	16	70.37%	12	67.15%		
Engineering	Inter-Disciplinary Engineering Breath (Electives)	7		7	_		
	Senior Design Project	6		6	-		
	Sub Total	95	70.37%	92	67.15%		
Total:		135	100%	137	100%		

Standard 2-4 The curriculum must satisfy the major requirements for the program as specified by the respective accreditation body.

Domoin	Knowledge Area	PEC Recon	nmended	BSCE Program Breakup		
Domani	Knowledge Area	Total Credits	Overall (%)	Total Credits	Overall (%)	
	Humanities	15		19		
Non- Engineering	Management Sciences	5 29.63%		6	32.85%	
	Natural Sciences	20		20		
	Sub Total	40	29.63%	45	32.85%	
	Computing	10		10		
	Engineering Foundation	29		30		
	CE Core	27		27		
	CE Depth	16	70.37%	12	67.15%	
Engineering	Inter-Disciplinary Engineering Breath (Electives)	7		7		
	Senior Design Project	6		6		
	Sub Total	95	70.37%	92	67.15%	
Total:		135	100%	137	100%	

Standard 2-5 The curriculum must satisfy general education, arts and professional and other discipline requirements for the program as specified by the respective accreditation body.

Domoin	Knowledge Area	PEC Recom	mended	BSCE Breakup	Program	
Domani	Kliowiedge Area	Total Credits	Overall (%)	Total Credits	Overall (%)	
	Humanities	15		19		
Non-	Management Sciences	5	29.63%	6	32.85%	
Engineering	Natural Sciences	20		20		
	Sub Total	40	29.63%	45	32.85%	
Engineering	Computing	10	70 27%	10	67 150/	
	Engineering Foundation	29	10.3170	30	07.1370	

	CE Core	27		27	
	CE Depth	16		12	
	Inter-Disciplinary Engineering Breath (Electives)	7		7	
	Senior Design Project	6		6	
	Sub Total	95	70.37%	92	67.15%
Total:		135	100%	137	100%

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.

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

Following are the courses that are related to IT.

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 N o.	Name of Laboratory	Locati on and area	Objectives	Adequa cy for instructi on	Lab(s) of Course(s) Conducted in the Lab	Softwar e availabl e	Type(s) of Workstatio ns (No. of each Type)	Safety Regulati ons
Dec	licated 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 programmin g tools. For students to develop	All required instructi on material and charts are displaye d in the lab at appropri ate places for use by faculty, students	EC-110 Computing Fundamenta ls [Fall19] EC-111 Programmin g Fundamenta ls [Sp20]	Matlab 2020 Cisco Packet Tracer Pycharm / python Microsof t Visio Net Beans Wamp server	HP Compaq Dx 7400, Core 2 Duo (47 Units), Dell OptiPlex 360, Core 2 Duo (10 Units)	Safety regulatio ns are being strictly followed and displayed in each lab.

			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 like programmin g,	and support staff.				
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 instructi on material and charts are displaye d in the lab at appropri ate places for use by faculty, students and support staff.	EC-230 Object Oriented Programmin g [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 Codeblo cks Dev C Cisco Packet Tracer Microsof t 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 administratio n, 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 instructi on material and charts are displaye d in the lab at appropri ate 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) 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,	All required instructi on material and charts are displaye d in the lab at appropri ate places for use	CS-302 Artificial Intelligence [Fall19] CS-406 Digital Image Processing [Fall19] EC-231 Operating Systems [Sp20] EC-445 Systems	Matlab 2016 Jupiter anacond a Visual Studio Dec C	Dell OptiPlex 9020, Core i5 (50 Units), Dell Gx-620 (10 Units)	

			and faculty members can perform experiments, analyze data, and create new AI technologies in the lab. The lab can assist with AI-related 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 implementin	by faculty, students and support staff.	Programmin g [Sp20]			
5	Data Communica tion and Networks Lab	Israr Block (2nd floor)	g AI systems. This laboratory is utilized to facilitate hands-on experiments for communicati on courses in the fields of wired and wireless communicati ons. It would help in	All required instructi on material and charts are displaye d in the lab at appropri ate places for use	EC-334 Computer Communica tion 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	Dell OptiPlex 9020, Core i5 (50 Units), Dell OptiPlex 620, Core 2 Duo (9 Units), Dell OptiPlex 755, Core 2 Duo (1 Unit)	

			orasnino	hv		Codeblo		
			theoretical	faculty		cks		
			concepts and	students		Dev C		
			visualization	and		Cisco		
			of how data	support		Packet		
			in terms of	staff.		Tracer		
			bits and bytes			Microsof		
			gets			t Visio		
			transmitted.			2013		
			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					
			understandin					
			g and					
			practical					
			expose to					
			communicati					
			on					
			technologies					
		-						
		Israr	This lab	All	EC-333		Workbench	
		Block	provides	required	Microproces		es $(1/)$,	
		(2110 floor)	end other	on	SOI and		Troiper	
		11001)	and other	011 motorial	Toobniquos		Poordo	
			resources	and	[Fall10]		MTS_51	
	Embedded		that are	charts	FC-442		Microproce	
6	Systems Lab		required to	are	Embedded		ssor Trainer	
	~ 500000 140		design.	displaye	Systems		Boards.	
			analyze and	d in the	[Fall19]		Power	
			implement	lab at	EC-228		Supplies,	
			embedded	appropri	Computer		Digital	
			systems. In	ate	Architecture		Multi-meter	
			addition, the	places	and		and	

			lab also has a number of analog and digital equipment required for experimentat ion and project building at both junior and senior level of undergraduat e studies.	for use by faculty, students and support staff.	Organizatio n [Sp20] EC-341 Digital System Design [Sp20]	associated electric components	
Sha	red Labs	Ŧ		4.11			
7	Digital Systems Lab (Shared)	Israr Block (1st floor)		All required instructi on material and charts are displaye d in the lab at appropri ate places for use by faculty, students and support staff.	EE-102 Electric Circuit Analysis [Fall19] EC-121 Digital Logic Design [Fall19]	Workbench es (16), Digital Logic Trainer board, Adv. Digital Logic Trainer, Micro- controller 8051 based, Embedded Trainer	Safety regulatio ns are being strictly followed and displayed in each lab.
8	Electronics Lab (Shared)	Israr Block (1st floor)		All required instructi on material and charts are	EE-205 Electronic Devices and Circuits [Sp20]	Workbench es (16), Signal Generator, Oscilloscop e, Multi- meter, DC Power	

	1					
		Israr	displaye d in the lab at appropri ate places for use by faculty, students and support staff. All		Supply, Electricity Trainer Module	
9	Workshop Lab (Shared)	Israr Block (1st floor)	required instructi on material and charts are displaye d in the lab at appropri ate places for use by faculty, students and support staff.	EE-101 Engineering Workshop [Sp20]	Power supply, Signal generator, Oscilloscop e, Multimeters , Wiring Trainer, Soldering Iron, Project Board	

Table 9: 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 program at Department of Computer Engineering

- F Sc/A Level or equivalent with Physics, Chemistry/ Computer Science and Mathematics.
- Diploma of Associate Engineers with same/RelevantTechnology/Disciplines approved by PEC.
- Minimum 60 % 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.

Migration and transfer of credits

Migration and transfer 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.

- Only the course(s) with '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/

University, 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 Departmental 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	Computing Fundamentals	EC-110	1	-
4	Programming Fundamentals	EC-111	1	-
5	Data Structures and Algorithms	EC-222	1	-
6	Digital Logic Design	EC-121	-	1
7	Discrete Structures	EC-225	1	-
8	Computer Architecture and Organization and	EC-228	-	1
9	Object Oriented Programming	EC-230	-	1
10	Database Systems	EC-334	1	-
11	Microprocessor & Interfacing Techniques	EC-333	-	1

12	Signals & Systems	EC-223	-	1
13	Operating Systems	EC-231	1	-
14	Computer Communication Networks	EC-332	1	1
15	Digital System Design	EC-341	-	1
16	Digital Signal Processing	EC-390	-	1
17	Engineering Project Management	EC-201	1	1

 Table 10: 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. The number of graduate students during the last three years is 19 with no research assistants and 5 Ph. D students.

Faculty to graduate student's ratio for the last three years remained in the range of 1:11 to 1:12.875.

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

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
		I	Grand Total	96

Faculty Publications

Appendix – B-1

Faculty Resume

Name:	Dr. Raza Ali Shah
Education:	PhD (ICT) Asian Institute of Technology, Pathumthani, Thailand
	(January 2015)

	Thesis Topic: <i>Performance analysis of dual-hop OFDM relay system</i> 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: <i>Analysis of power efficiency in channel estimation for joint ZP-</i>	
	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)	
	Contact Address:	
	House 1210, St. 21, Block C-1, Multi-garden, B-17,	
Personal:	Islamadau, Fakistan	
	Tel (home): +92-51-7069657	
	Tel (Mohile): +92-344-3037466	
	Email: raza.ali.shah@hitecuni.edu.nk	

	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
Experience	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)
	Membershin: IEEEP Communication Society Pakistan
Memberships	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	
	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,
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	al. "Enhancing System Performance through Objective Feature
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	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.
Publications	4. Rehman, Mubashir, Shah, R.A. et al. Contactless Small-Scale Movement Monitoring System Using Software Defined Radio
	for Early Diagnosis of COVID-19. IEEE Sensors Journal (2021).
	5. Rehman, Mubashir, Shah, R.A. et al. RF Sensing Based
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	Intelligent Real-Time Multiperson Respiratory Illnesses Sensing
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	7. Khan, M. B. Rehman, M., Mustafa, A., Shah, R. A., Yang, X.
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10(13), 1558.
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Nakagami-m fading. IEICE Transactions on Communications,
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10 Zahid Muhammad and Raza Ali Shah "BER Analysis for
two hop Co operativeNep orthogonal multiple access (CNOMA)
two-nop Co-operative Non-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 OEDM amplify-and-forward relay system with
subcarrier mapping in Payleigh fading EUPASID Journal on
Windows Comm. and Naturating Day 2014
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 Man Wireless Personal Communications 99 no. 1
(2018) · 95.02
(2018). 83-93.
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 ICEE AS'22 Tavila Deliston
ILLE INFERS 25, Taxila, Pakistali.

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,
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cooperative networks. IEEE ECTI-CON 2010.
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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
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, manand, pp 1-11, 2012
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Demo". LifeWAY TM , Thailand, pp 1-16, 2012
Raza Ai Shah, "Operational Manual Reel-to-Reel Machine UHF
scan". LifeWAY TM , pp 1-11, Thailand, 2012

Name:	Dr. Imran Ashraf
	PhD Computer Engineering, 2011 - 2016
	TU Delft, The Netherlands
Education:	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)
	1. Efficient decomposition of unitary matrices in quantum circuit
	compilers, 2022, Anna Maria Krol, Aritra Sarkar, Imran Ashraf,
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	Quantum Accelerators, 2022, N. Khammassi, I. Ashraf, J. v.
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	A.419126%3A1371
	4. Quantum Computing from NISQ to PISQ, 2021, Koen
	Bertels, Aritra Sarkar, Imran Ashraf, IEEE Micro, Impact
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	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
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	Retinopathy Image Classification, 2021, Farrukh Zia, Isma Irum,
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and Robust Features Selection: A Machine Learning Application
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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
	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
	2020-2022
	1.1.1.4 UET Taxila, Software Engineering Department
Experience	PhD Scholar / Lecturer
1	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	 Conveyor Industrial Outreach Committee (IOC), HITEC University, Taxila

	2. Head Quality Assurance Cell (QAC), HITEC University
	 Member Curriculum Review Committee (CRC), HITEC University 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
	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. <i>Arabian Journal for Science and Engineering</i> , <i>45</i> (4), 2975-2992. 2.334 (ISSN 2191-4281) https://doi.org/10.1007/s13369-019-04238-2
Publications	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. <i>Australian Journal of Forensic Sciences</i> , <i>53</i> (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. <i>Journal of Ambient Intelligence and Humanized</i> <i>Computing</i> , <i>12</i> (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. <i>Journal of Intelligent & Fuzzy Systems</i>, 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

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	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
Education:	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
	• OBE Head 2019 - 2022.
Service Activity	• DQAC Head 2021 - 2022
	• Deputy Superintendent 2020 - 2021
	• Exam Superintendent 2021 - 2022
	1. HRNetO:Human Action Recognition Using Unified Deep
	Features Optimization Framework; Tehseen Ahsan, ,Sohail
Publications	Khalid1 Shaheryar Najam, Muhammad Attique
	Khan, YeJin Kim and Byoungchol Chang.

Name:	Sara Tehseen
	PhD Computer Engineering (2018 to Present)
	National University of Sciences and Technology, Islamabad
Education:	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
	 Conveyor Outcome Based Education (OBE), HITEC University, Taxila
Service Activity	2. Head Final Year Projects, HITEC University
	3. Deputy Superintendent of Exam(DCE), HITEC University
Publications	 Tehsin, Sara, et al. "Self-organizing hierarchical particle swarm optimization of correlation filters for object recognition." IEEE Access 5 (2017): 24495-24502. 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. 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. 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. 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. Asfia, Yame, Tehsin, Sara, et al. "Visual Person Identification Device using Raspberry Pi." Proc. of 25th

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minimum average correlation energy filter for object
recognition in cluttered and occluded environments."
Pattern Recognition and Tracking XXVIII, vol. 10203, p.
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2017.
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logarithmic mapped optimal trade-off correlation filter."
Pattern Recognition and Tracking XXVIII, vol. 10203, p.
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2017.
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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.

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
	• Lecturer (CED) Feb 2023 - to date
	 TEVTA Taxila
	• 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

	1.	A. Niaz et al., "Inhomogeneous Image Segmentation Using
Publications		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.

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
	House: A-244 Gulistan Colony, Wah Cantt
Personal:	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	 Convener Lab Management Committee, DCE HITEC University, Taxila Member Industrial Outreach Committee (IOC), DCE HITEC University, Taxila Member PEC/OBE Committee, DCE HITEC University, Taxila
Publications	 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) Low power 4×4 bit multiplier design using dadda algorithm and optimized full adder(IEEE Xplore, DOI: 10.1109/IBCAST.2018.8312254)

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

	HITEC University, Taxila, Computer Engineering
	Department
	Lab Engineer
Experience	Sep 2022 - to date
	Swarm Robotics Lab UET Taxila
	Research Assistant
	Oct 2020 - Sep 2022
Memberships	PEC
Service Activity	 Member PEC/OBE Committee, DCE HITEC University, Taxila Member Lab Management Committee, DCE HITEC University, Taxila Member of Departmental Maintenance committee, DCE HITEC University, Taxila
Publications	10 international Conference/Journal Publications

Name:	Bushra Fiaz
	MS Computer Engineering (In Progress)
	HITEC University, Taxila
Education:	BS Computer Engineering 2022
	HITEC University, Taxila
	House: Shahzeb House Faisal Town Street No 5 HMC Road
Personal:	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	 Member PEC/OBE Committee, DCE HITEC University, Taxila Member of FYP & AEM committee, DCE HITEC University, Taxila Member Lab Management Committee, DCE HITEC University, Taxila Member of Alumina Interaction and career counseling committee, DCE HITEC University, Taxila
Publications	no

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

	HITEC University, Taxila, Computer Engineering Department Lab Engineer
Experience	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

	Details of	Qualification	ons		
Name	Degree	Year	Institution	Specialization	Experience (Years)
	MS	<u>2022</u>	UET Taxila		
Engr. Ali Raza	BS	2020	HITEC Taxila	Computer Vsion AI on the edge	2.5
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 unsatifi ed	Unsat isfied	Uncertai n	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 unsatifi ed	Unsat isfie d	Uncertai n	Satisfie d	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	

1	2	3	4	5	
1	2	3	4	5	
	1	2	3		
	1	1 2 1 2		$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$

Learning Resources	Highly unsatifi ed	Unsa tisfie d	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 unsatifi ed	Unsat isfied	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						

Highly unsatifi ed	Unsat isfied	Uncertain	Satisfied	Highly satisfied	Score
1	2	3	4	5	
1	2	3	4	5	
1	2	3	4	5	
	Highly unsatifi ed 1 1	Highly Unsat unsatifi isfied ed 1 2 1 2 1 2 1 2	Highly Unsat Uncertain unsatifi isfied ed 1 2 3 1 2 3 1 2 3 1 2 3	Highly Unsat Uncertain Satisfied unsatifi isfied ed 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4	Highly unsatifiUncertain isfiedSatisfiedHighly satisfieded123451234512345

Additional Core Questions

Instructor / Teaching Assistant Evaluation	Highly unsatifi ed	Unsat isfied	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	1	2	3	4	5	
course?						
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 O

No O

32. Domicile:			
33.Gender:		Male O	Female O
34. Age Group:	less than 22 \bigcirc	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..

Departm				Facu	ulty Member			
ent:					Name:			
Course		Cour	se					
Code:		Title	e:					
Session:	ion: Semester:		Fall O		Spring	0		
Credit	3-0	Leve	el:		PG	Prerequ	isites:	
Hours:								
Name of		No. of		Lectu	res			
Course		Students						
Instructor		Contact						
:		Hours						
Assessmen	t Methods:	Ouizz	Ass	signm	Course	Mid	Final	Total
give precise details (no &		es	e	ents	Projects	Semester	Exams	
length of assignments, exams, weightings etc)		(Numb er & percent age)	Numb (Num er & & percent perce age) e)		(Percentag e)	Exam (Length & percentage)	(Length & percentage)	

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

Post-	Initiall	Above	Betwe	Betwe	Betw	Les	Withdraw	Tota
Graduate	у	85% (or	en	en	een	S	al	1
	Enroll	А, А-	70% &	55% &	50%	Tha		
	ed	Grade)	84.99	69.99	&	n		
			%(B+,	%(C+,	54.99	50		
			B, B-)	C, C-)	%(D)	%		
						(F)		
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:	(Course Instructor)	Date:	
Name:	(Head of Department)	Date:	

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: Unsatisfied	C: Uncertain	D:
Satisfied	E: Highly Satisfied			

S/#	Attributes	A	B	С	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			
X7TT	Alumni Information			

VII. Alumni Information:

1. Name (Optional)

2. Name of Organization

- 3. Position in Organization
- 4. Year of graduation



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: Unsatisfied C: Uncertain D:

Satisfied E: Highly Satisfied

S/#	Attributes	Α	B	С	D	Е
	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 97					

Appendix – A-5

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 in place to help them progress and excel in their profession. We seek your help in comple this survey and the information provided will be kept in confidence. Indicate how satisfied are you each of the following aspects at your department ?

Satisf	ied E: Highly Sat	isfied					
	A: Highly unsatisfied	1	B:	Unsatisfied	C:	Uncertain	D:
•	Departmetn	:					
•	Designation	:					
•	Name	:					

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

17. Any other suggestions:

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

S/#	Attributes	Α	B	С	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.					

Appendix –

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.			

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.

Introduction to numbers systems, CPU, memory, input/output **Course Outline:** 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
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- **Course Objectives:** To provide theoretical and practical understanding of Signals, Systems and Transform.
- **Course Outline:** Linear Time-invariant systems, convolution integral for continuoustime 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 discretetime 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	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 Arch	nitecture 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 Syste	ems (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
 - 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 LanguageCourse 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, FPGAbased 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, 1 st edition, CMP Books, 2001, ISBN: 978-1578200733
	• Fundamentals of Embedded Software: where C and Assembly meet by Daniel Lewis, 1 st edition, Pearson Education, 2001, ISBN: 978- 0130615893
	• Microc OS II-The Real Time Kernel by Jean J. Labrosse, 2 nd edition, CMP Books, 2002, ISBN-13: 978-1578201037
EC-444 Parallel and Dis	stributed 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)

Prereg	uisites:	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, Fundamentals of Cellular OFDM, OFDMA, 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.