



COMPUTER ENGINEERING

The Department of Computer Engineering at Bahria University is home to multidisciplinary research and academic units that address issues and recent advances in Computer Engineering. The department provides research areas and cutting edge facilities in Computer engineering. Our Goal has been, and continues to be, to provide a high degree quality program in Computer and Software Engineering, a program that prepares students for lifelong learning as they take on professional careers in computing.

- Bachelor in Computer Engineering BCE

Available Campuses

Islamabad, Karachi

Regular Program Duration

4 Years
8 Semesters

Available Specialization

None

Program Timing

Morning

Entry Requirements

Passed intermediate examination or its equivalent with a minimum of 60% marks in Pre-Engineering Group, or with Mathematics, Physics and Computer Studies.

Objectives of the Degree Program

Graduates of Computer Engineering Program are expected to achieve the following Program Educational Objectives for BCE program.

PEO 1: Attain an ability to identify and solve challenging problems in their professions by applying theory, principles and modern tools learnt during degree program.

PEO 2: Demonstrate effective communication as an individual or team player with strong managerial and entrepreneurial skills.

PEO 3: Maintain highest ethical and professional standards in pursuing their careers.

PEO 4: Engage in life-long learning to continually polish their professional capabilities for their personal growth and the betterment of society.

Learning outcome of the Degree Program

The Computer Engineering program prepares students to attain the program educational objectives by ensuring that students demonstrate achievement of the following graduate attributes.

PLO 1: Engineering Knowledge: An ability to apply knowledge of mathematics, computer engineering fundamentals and computer engineering specialization to the solution of complex engineering problems.

PLO 2: Problem Analysis: An ability to identify, formulate, research literature and analyze complex computer engineering problems reaching substantiated conclusions using engineering and natural sciences principles.

PLO 3: Design/Development of Solutions: An ability to design solutions for complex computer engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health & safety, cultural, societal, and environmental considerations.

PLO 4: Investigation: An ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO 5: Modern Tool Usage: An ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.



PLO 6: The Engineer and Society: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO 7: Environment and Sustainability: An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.

PLO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO 9: Individual and Team Work: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PLO 10: Communication: Ability to communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PLO 11: Project Management: Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

PLO 12: Lifelong Learning: Ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

Why choose BU for the Stated Degree Program?

- Federally Chartered
- HEC Recognized
- Engineering program accredited by PEC
- Easily Accessible Location
- Highly Qualified Faculty
- Good Student and Faculty Ratio
- Classroom and Research Based Teachings
- Secure and Disciplined Environment
- Scholarships on Merit/Need Basis
- Two percent seats are available for disable persons
- Internship Opportunities
- Career Office
- State of the Art Laboratories
- Well-Stocked Library
- Medical Cover For Students/Staff/Faculty

Rode Map

SEMESTER BY SEMESTER DISTRIBUTION

Semester 1

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
None	GSC-110	Applied Calculus & Analytical Geometry	3	0	3
None	ISL-101 /HSS-116	Islamic Studies / Ethics	2	0	2
None	CSC-110	Computing Fundamentals	2	1	3
None	GSC-113	Applied Physics	3	1	4
None	ENG-105	Functional English	3	0	3
None	EEL-112	Workshop Practices	0	1	1
Total					13+3=16

Semester 2

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
GSC-110	GSC-211	Multivariable Calculus	3	0	3
None	GSC-211	Circuit Analysis	3	1	4
None	CSC-110	Computer Programming	3	1	4
None	GSC-113	Communication Skills	3	0	3
None	ENG-105	Digital Logic Design	3	1	4
Total					15+3=18

Semester 3

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
	GSC-221	Discrete Mathematics	3	0	3
	EEN-224	Electronic Devices and Circuits	3	1	4
	CSC-210	Object Oriented Programming	3	1	4
	PAK-101	Pakistan Studies	2	0	2
	GSC-210	Differential Equations	3	0	3
	EEL-121	Engineering Drawing & CAD	0	1	1
Total					14+3=17

Semester 4

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
	GSC-121	Linear Algebra	3	0	3
	EEN-224	Electronic Devices and Circuits	3	1	4
	CSC-210	GE/Management Electives-I	3	0	3
	PAK-101	Signals & Systems	3	1	4
	GSC-210	Computer Architecture and Organization	3	1	4
Total					15+3 = 18

Semester 5

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
	EEN-226	Probability Methods in Engineering	3	0	3
	CEN-321	Microprocessors and Interfacing	3	1	4
	CEN-222	Data Communication & Networking	3	1	4
	CSC-220	Database Management Systems	3	1	4
	HSS-320	Technical Writing and Presentation Skills	3	0	3
Total					15+3 = 18

Semester 6

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
None	EEN-325	Digital Signal Processing	3	1	4
CSC-221	SEN-220	Software Engineering	3	0	3
CEN-221	CSC-320	Operating Systems	3	1	4
CSC-210	CSC-220	CE-Depth Elective -I	2	1	3
CEN-221	CEN-442	Digital System Design	3	1	4
Total					14+4 = 18

Semester 7

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
		IDEE-I	2	1	3
	HSS-422	Engineering Ethics	3	0	3
	CSC-320	CE Depth Elective-II	3	0	3
		CE Depth Elective-III	2	1	3
	ESC-498	Project -I	0	3	3
Total					10+5 = 15

Semester 8

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
		GE/Management Elective-II	3	0	3
		IDEE-II	3	0	3
		CE Depth Elective -IV	2	1	3
		GE/Social Science Elective	3	0	3
	ESC-499	Project-II	0	3	3
Total					11+4 = 14

Bachelor in Computer Engineering BCE

Department of Computer Engineering

CE Depth Electives (15 Credit Hours)

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
None	SEN-448	Software Applications for Mobile Devices	2	1	3
None	CSC-411	Artificial Intelligence	2	1	3
CEN-222	CEN-470	Wireless and Mobile Networks	2	1	3
EEN-313	CEN-445	Digital Image Processing	2	1	3
None	CSC-455	Data Mining and Warehousing	2	1	3
CSC-320	CEN-456	Parallel & Distributed Computing	2	1	3
CEN-321	CEN-439	Embedded System Design	2	1	3
CEN-120	CEN-446	FPGA Based System Design	2	1	3
CEN-120	CEN-457	VLSI Design	2	1	3
CSC-320	CEN-459	Real Time Systems	2	1	3
GSC-210	GSC-320	Numerical Analysis	3	0	3
SEN-220	SEN-410	Software Project Management	3	0	3
None	SEN-420	Software Quality Assurance	3	0	3
None	CEN-451	Data Encryption and Security	3	0	3

List of General Electives (6 Credit Hours)

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
None	HSS 202	Introduction to Sociology	3	0	3
None	PSY 101	Introduction to Psychology	3	0	3
None	HSS 111	Introduction to International Relations	3	0	3
None	HSS 459	Foreign Language (Arabic, French etc.)	3	0	3
None	MGT 111	Principles of Management	3	0	3
None	HSS 453	Human Resource Management	3	0	3
None	HSS 411	Engineering Economics & Management	3	0	3
None	HSS 461	Accounting & Finance	3	0	3
None	HSS 456	Organizational Behaviour	3	0	3
None	HSS 115	Introduction to Media Studies	3	0	3
None	HSS 201	Introduction to Anthropology	3	0	3
None	HSS 421	Entrepreneurship & Leadership	3	0	3

Inter Disciplinary Engineering Electives (6 Credit Hours)

Pre-Req	Course Code	Course Title	Theory	Lab	Total Credit Hours
CEN-222	CEN-468	Introduction to Communication Systems	2	1	3
CEN-120	CEN-438	Fault Tolerant Systems	2	1	3
EEN-313	CEN-463	Robotics	2	1	3
CSC-320	CEN-449	System Programming	2	1	3
None	CSC-444	Computer Graphics	2	1	3
None	SEN-493	Multimedia Systems	2	1	3
CSC-411	CSC-449	Neural Networks and Fuzzy Logic	3	0	3
CSC-221	CSC-321	Design Analysis of Algorithms	3	0	3
None	EEN-466	Nanotechnology	3	0	3
EEN-313	EEN-467	Control Engineering	3	0	3
None	SEN-320	Human Computer Interaction	3	0	3
None	SEN-452	Cloud Computing	3	0	3
None	SEN-332	Big Data Analytics	3	0	3
None	ENV-105	Introduction to Environmental Sciences	3	0	3
None	ENV-425	Occupational Health and Safety	3	0	3

Bachelor in Computer Engineering BCE

Department of Computer Engineering

Contents	Complex Numbers, DeMoivre's Theorem and its Applications, Simple Cartesian Curves, Functions and Graphs, Symmetrical Properties, Curve Tracing, Limit and Continuity, Differentiation of Functions. Derivative as Slope of Tangent to a Curve and as Rate of Change, Application to Tangent and Normal, Linearization, Maxima/Minima and Point of Inflection, Taylor and Maclaurin Expansions and their convergence. Integral as Antiderivative, Indefinite Integration of Simple Functions, Methods of Integration: Integration by Substitution, by Parts, and by Partial Fractions, Definite Integral as Limit of a Sum, Application to Area, Arc Length, Volume and Surface of Revolution.
Course Title	Islamic Studies / Ethics
Course Code	ISL-101 /HSS-116
Credit Hours	2+0
Pre-Requisite	None
Course Objectives	This course aims at refreshing the fundamentals of the religion Islam so that students can benefit in both the present life and life of hereafter.
Contents	Introduction to Quranic Studies Study of Selected Text of Holy Quran-I Study of Selected Text of Holy Quran-II Seerat of Holy Prophet (S.A.W) I Seerat of Holy Prophet (S.A.W) II Introduction to Sunnah Introduction to Islamic Islamic Culture & Civilization Islam & Science Islamic Economic System NonPolitical System of Islam Islamic History Social System of Islam
Course Title	Computing Fundamentals
Course Code	CSC-110
Credit Hours	2+1
Course Objectives	This course provides introduction to computer components and operating systems, Number systems, Problems solving techniques: flow chart and algorithm development, and Computer programming fundamentals

Contents	<p>Number Systems History computer system Basic machine organization Von Neumann Architecture Overview of Operating Systems Introduction to Information Technology Algorithm definition and design Programming paradigms and languages</p>
Contents	Applied Physics
Course Code	GSC-113
Credit Hours	3+1
Pre-Requisite	None
Course Objectives	Objective of this course is to give students the basic ideas/concepts of physical sciences which would help them in better understanding of the applications of these sciences in Engineering and technology
Contents	<p>Electricity & Magnetism Engineering Mechanics Statics and Dynamics Engineering Thermodynamics Modern Physics KCL & KVL</p>
Course Title	Functional English
Course Code	ENG-105
Credit Hours	3+0
Pre-Requisite	None
Pre-Requisite	<ul style="list-style-type: none"> ● The importance of English language cannot be denied. It enriches our thought and culture and provides us with the most important international vehicle of expression. It has opened for us several doors of knowledge for it is the lingua franca of the world and also the language of science, technology, commerce and diplomacy. ● The main objective of this course is to enhance English language skills of the students and develop their critical thinking.

Contents	<ul style="list-style-type: none"> ● Public Speaking Confidence Building. Body language and eye contact. ● The Art of Creating a Power Point Presentation. Rules. Audience. ● Interacting with the Opposite Gender Teamwork and respecting the opposite gender and understanding their personal space. Ice breaking exercises. ● Classroom Etiquettes and Teachers' Expectations Importance of formal decorum. Meeting the teacher's expectations. ● Articles: Indefinite and Definite Exercises. ● Prepositions. Location, direction and time. Exercises THAN vs THEN THEIR vs THEY'RE vs THEIR Exercises. Punctuation <p>Tenses in English Grammar● Formal Letter WritingVarious formats used for writing letters in formal capacityBusiness letter, application, statement of proposal and cover letterSummary writingStudents learn to write technically and concise.Organizing and planning your writingMind map OutlineSensory Perception in writing.Using your five senses in writing descriptions.Descriptive essay writingCritical thinking:Thinking out of the box and critical analysis.Using video, "Instruction Manual for Life" by Theremin Trees.● Final term project:Group project, based on a short film made by th e group to assess their :TeamworkTime managementBody language.</p>
Contents	Workshop Practices
Course Code	EEL-112
Credit Hours	0+1
Pre-Requisite	None
Course Objectives	To develop practical skills in the use of workshop tools and equipment.

Contents	<p>Introduction to various technical facilities in the workshop including mechanical and electrical equipment.</p> <p>Concepts in electrical safety, safety regulations, earthing concepts, electric shocks and treatment.</p> <p>Use of tools used by electricians</p> <p>Wiring regulations, types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc.</p> <p>Symbols for electrical wiring schematics e.g. switches, lamps, sockets etc.</p> <p>Drawing and practice in simple house wiring and testing methods, wiring schemes of two-way and three-way circuits and ringing circuits</p> <p>Voltage and current measurements.</p> <p>Electric soldering and soldering tools; soldering methods and skills, PCB designing, transferring a circuit to PCB, etching, drilling and soldering component on PCB testing.</p>
Course Title	Multivariable Calculus
Course Code	GSC-211
Credit Hours	3+0
Pre-Requisite	GSC-110
Course Objectives	The goals are to develop the skills to have ground knowledge of multivariate calculus and appreciation for their further Engineering courses.
Contents	Functions of Several Variables and Partial Differentiation. Multiple Integrals, spherical, cylindrical coordinates, vector fields, gradients, line and surface integrals. Green's and Stoke's Theorem.
Course Title	Circuit Analysis
Course Code	CEN-121
Credit Hours	3+1
Pre-Requisite	GSC-113
Course Objectives	To introduce transient and steady state analysis of DC and AC circuits
Contents	Differential and integral forms of circuit equations, consideration of initial conditions, analysis of first and second order circuits, network response to sinusoidal driving functions, \ concept of phasors, power consideration and complex power. Series and parallel RC, RL and RLC circuits. AC fundamentals; nodal analysis, loop analysis, linearity and superposition, source transformation, circuit theorems

Bachelor in Computer Engineering BCE

Department of Computer Engineering

Course Title	Computer Programming
Course Code	CSC-113
Credit Hours	3+1
Pre-Requisite	None
Course Objectives	The course is designed to familiarize students with the basic structured programming skills. It emphasizes upon problem analysis, algorithm designing, and programs development and testing.
Contents	Introduction to Computer Programs Basic Data Manipulation Using Program Logic Structures Using Procedures and Functions Collection Data Types String Processing File Management Memory Management
Course Title	Communication Skills
Course Code	HSS-120
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	The objective of this course is to enable students to acquire good English speaking capabilities.
Contents	Study Skills Oral Communication Advanced Reading Comprehension Precis writing Writing for a purpose Applied Grammar Presentation Skills
Course Title	Digital Logic Design
Course Code	CEN-120
Credit Hours	3+1

Pre-Requisite	None
Course Objectives	This is an introductory course in Digital Logic Design, concerned with the analysis and design of digital systems.
Contents	Number Systems and Binary Codes Boolean Algebra and Logic Gates Combinational Logic and MSI Circuits Sequential Logic Circuits Memories and Programmable Logic Devices (PLDs) Registers & Counters
Course Title	Discrete Mathematics
Course Code	GSC-221
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	This course introduces the students with elements of logic, mathematics, and philosophy under-standing the reasoning behind computational structures and Processes
Contents	Logic Relations and Functional Number Theory Graph Theory Languages and finite State Machines
Course Title	Electronic Devices and Circuits
Course Code	EEN-224
Credit Hours	3+1
Pre-Requisite	GSC-113
Course Objectives	To introduce large signal analysis and design of diode circuits and transistor based amplifiers.
Contents	PN junction diodes, Forward and reverse characteristics of diode, Ideal diode, Practical diode, Equivalent circuits of diode, current equation of diode, diode as a switch. Schottky diode, Zener diode, Tunnel diode, Varactor diode. LED, Laser diode and their applications. Bipolar junction transistor Operation (NPN and PNP), DC circuit analysis, Load line BJT biasing, bias stability. Design and analysis of common emitter, common base and common collector amplifiers. FET biasing, design of common source, common drain and common gate amplifiers. Hybrid parameters, ac gain and frequency analysis of single/multi stage amplifiers. Classes of amplifiers, power amplifiers, differential amplifiers, operational amplifiers and applications.

Course Title	Object Oriented Programming
Course Code	CSC-210
Credit Hours	3+1
Pre-Requisite	CSC-113
Course Objectives	3+0
Pre-Requisite	OOP is more than learning a new language; it requires a new way of thinking. The idea is not primarily concentrate on the cornerstones of procedural languages, data structures and algorithms but instead thinking in terms of objects. This course covers C++ language features in the context of object oriented paradigm, so that student learns not only C++ language syntax but how to apply C++ effectively in data abstraction and object oriented design. Language features, essential programming techniques and design guidelines are presented as a unified whole.
Contents	Programming BasicsIntroduction to Object Oriented ProgrammingInheritance and PolymorphismAbstraction RelationshipsExceptionsIntroduction to Data Structures StacksQueuesLink Lists
Course Title	Pakistan Studies
Course Code	PAK-101
Credit Hours	2+0
Pre-Requisite	None
Course Objectives	The course 'Pakistan Studies' is aimed to impart knowledge about the reason of development, vision and history of Pakistan to the students. It will cover the era ranging from pre-development to the post-development of Pakistan and also highlight the great sacrifices made by the leaders of the Islamic State Pakistan. This course will help students develop a sense of patriotism as well as an urge for creative reconstruction. It will seek to cover Pakistan's Cultural Heritage since ancient times, Muslim Political Thought over the centuries, Constitutional Development since 1947, Political Systems and their functioning, Public Policies and Reforms, Agro-Industrial Projects, Urbanization, Social change and Transformation, Political Development.

<p>Course Contents</p>	<ul style="list-style-type: none"> ● History of subcontinent Ancient Civilization of the region comprising Pakistan. The Indus Valley Civilization. Colonial Rule in the subcontinent: The colonial legacy. Creation of Pakistan & Ideology of Pakistan ● Forefathers of Pakistan Shah Wali Ullah Sir Syed Ahmed Khan Quaid Azam Muhammad Ali Jinnah Dr. Allama Muhammad Iqbal ● Political and Constitutional development of Pakistan Delay in Constitution making Constitution 1956 Constitution 1962 Constitution 1973 ● Pakistan in search of a viable political order and the contemporary issues that need our attention. ● Ranging from the social issues, environmental issues, economics disparity to the attention required at the current global issues like global warming. <p>Land and People of Pakistan. Physical Features. Climate Social Institution: Culture and Languages Strategic Importance of Pakistan</p>
<p>Course Contents</p>	<ul style="list-style-type: none"> ● Human Rights. What are Human Rights? Islamic Concept of Human Rights. Western Concept of Human Rights. UN System for protection of Human Rights.
<p>Course Title</p>	<p>Differential Equations</p>
<p>Course Code</p>	<p>GSC-210</p>
<p>Credit Hours</p>	<p>3+0</p>

Pre-Requisite	GSC-110
Course Objectives	This course will mainly focus on the theory and applications of (ODEs).The students will be introduced to derive differential equations from physical systems / situations of the nature in to mathematical models, and their solutions, in the context of physical sciences and engineering problems.
Contents	First Order Ordinary Differential Equations. Linear Second Order Homogeneous and Non-Homogeneous Differential Equations Higher Order Linear Differential Equations Laplace Transforms Introduction to Simple Linear PDEs (If Possible)
Course Title	Engineering Drawing & CAD
Course Code	EEL-121
Credit Hours	0+1
Pre-Requisite	None
Course Objectives	To equip the students with the basic knowledge and skills of engineering drawing and its application in practical scenarios. The students will also be introduced to a CAD package.
Contents	Types of lines and usage, dimensioning, lettering, orthographic first angle projection, sheet planning, orthographic third angle projection, introduction to computer aided drawing, isometric projection, sectional drawing and assembly drawing. Drawing sheets will be prepared on drawing board as well as CAD package.
Course Title	Linear Algebra
Course Code	GSC-121
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	This introductory course on linear algebra will provide an opportunity to the students to become familiar with the fundamental patterns and structures of mathematical reasoning used in mathematics, science and engineering. The student will be made to understand how proper mathematical definitions are stated and used in mathematical work, how abstract axiomatic systems are developed and applied.

Contents	Systems of Linear Homogeneous and Non-Homogeneous Equations Vector Spaces: Real and Complex Linear Transformations Eigen Value Problems for Linear Operators Normed and Inner Product Spaces
Course Title	Data Structures and Algorithms
Course Code	CSC-221
Credit Hours	3+1
Pre-Requisite	CSC-210
Course Objectives	The objective of this course is to introduce the analysis and designing of data structures using various standard algorithms. A portion of this course comprises on C# programming to understand the basic concepts behind various data structures. This course also introduces students to the analysis and design of computer algorithms.
Contents	Introduction of Data Structures Arrays Searching Techniques Sorting Techniques Stacks, Recursion Queues Linked Lists Trees Graphs Introduction to Algorithm Time Complexity Growth of Functions Analysis and comparison of sorting algorithms Recursion Heap Sort Analysis Priority Queues Dynamic Programming Binary Search Tree Analysis and Comparison of Greedy Design Algorithms Hashing Pattern Matching Algorithms and Analysis Amortized Analysis
Course Title	Signals & Systems
Course Code	EEN-313
Credit Hours	3+1
Pre-Requisite	GSC-220
Course Objectives	This course provides the fundamentals of signals, system and transforms to students. The course objective is to equip the students with the concepts and techniques of performing analysis of signals and systems (of both continuous- and discrete-time types). This course builds foundation for the later course of 'Digital Signal Processing

Contents	Fundamentals of Signals System Modeling and Response Frequency Domain Analysis of Signals and Systems Filter Design Laplace Transform and its Applications Z Transform and its Applications DT & CT Convolution
Course Title	Computer Architecture and Organization
Course Code	CEN-221
Credit Hours	3+1
Pre-Requisite	CEN-120
Course Objectives	The objective is to introduce the internal working and organization of various building blocks of a digital computer as well as simple assembly language programming techniques.
Contents	Introduction to Computers Metrics for Performance Evaluation, Instruction Sets and Addressing Modes Arithmetic Functions RTL, CPU Structure, Stack Operations, Main Memory Organization and Technologies RAID Systems I/O Interfacing
Course Title	Probability Methods in Engineering
Course Code	EEN-226
Credit Hours	3+0
Pre-Requisite	None
Contents	Set theory, basic concepts of probability, conditional probability, independent events, Baye's Theorem, discrete and continuous random variables, distributions and density functions, probability distributions (binomial, Poisson, hyper geometric, normal, uniform and exponential), mean, variance, standard deviations, moments and moment generating functions, linear regression and curve fitting, limits theorems and applications.
Course Title	Microprocessors and Interfacing
Course Code	CEN-321
Credit Hours	CEN-221
Pre-Requisite	3+1

Course Objectives	Objective of this course is to introduce the architecture, programming and interfacing of microprocessor and microcontroller based systems. A portion of this course comprises on C and assembly language programming to understand the relation of software and hardware in microprocessor and microcontroller based systems.
Contents	Architecture and Instruction Set Memory Interfacing IO Interfacing and Programmable IOs Interrupts Structure Microprocessor based Data Acquisition and Control Microcontrollers Based Systems Introduction to Digital Signal Processors
Course Title	Data Communication & Networking
Course Code	CEN-222
Credit Hours	3+1
Pre-Requisite	None
Course Objectives	This is an introductory course in Data Communications and networking. It familiarizes the students with the basics of data communications, OSI model and techniques, applications and control of modern data communications networks. Topics included are network models, digital and analog transmission, multiplexing, circuit and packet switching. This course will mainly focus to develop engineering skills in troubleshooting and designing data networks.
Contents	Data Communication and Protocol Architecture Data Transmission Signal Encoding Techniques Digital Data Communication Techniques Error Detection and Correction Techniques Data Link Control Protocols Multiplexing Circuit Switching and Packet Switching LAN Architecture IP Addressing
Course Title	Database Management Systems
Course Code	CSC-220
Credit Hours	3+1
Pre-Requisite	CSC-210

Course Objectives	The main objective of this course is to provide students with the background to design, implement, and use database management systems. After the completion of this course students will be able to Model and design Database, write Structured Queries and optimize them, Implement Constraints and Triggers, Use and develop semi structured databases.
Contents	<p>Introduction</p> <p>Entity-Relationship Data Model</p> <p>Relational Data Model</p> <p>Other Data Models</p> <p>Relational Algebra</p> <p>The Database Language – SQL</p> <p>Constraints and Triggers</p> <p>System Aspects of SQL</p> <p>Object-Orientation in Query Language</p> <p>Logical Query Languages</p>
Course Title	Technical Writing and Presentation Skills
Course Code	HSS-320
Credit Hours	3+0
Pre-Requisite	None
Contents	An Introduction to Technical Writing Producing the Product Objectives In Technical Writing Audience Recognition And Involvement Course Objectives Research The Summary Reports Proposals Oral Communication The Job Search Technical Description Instructions and User Manuals
Course Title	Digital Signal Processing
Course Code	EEN-325
Credit Hours	3+1
Pre-Requisite	EEN-313
Course Objectives	This course deals with the breadth and depth of the area of digital signal processing (DSP), building upon the foundation laid in its pre-requisite course 'Signals & Systems'. The objective is to equip the students with the knowledge of FIR & IIR systems, DFT & FFT, sampling theorem, Analogue-to-Digital & Digital-to-Analogue conversion, and practical implementation of DSP. Other course objective is to develop the students' ability to analyze discrete-time signals and systems in both time- and frequency-domains and to perform Matlab-based DSP tasks including digital filter design.

Contents	<ul style="list-style-type: none"> ● Discrete Time Signal and System ● Z Transform, Inverse Z transform ● Properties of Z transform ● Introduction to Sampling, Discrete time processing of Continuous time signals ● Changing the sampling rate using discrete time processing, Multirate Signal Processing, ● Poly Phase ● Frequency response of LTI systems, Frequency response of rational systems, Inverse systems Relationship between phase and magnitude, All pass systems ● Linear system with generalize linear phase ● Minimum phase system, ● Basic Structures for IIR systems, Basic Structures for FIR systems ● Filter Design Techniques, Impulse invariance ● Bilinear transformation, Design of FIR filters by windowing ● Introduction to DFS, Properties of DFS, Periodic Convolution ● Introduction to DFT, Properties of DFT ● Circular Convolution, Linear Convolution using DFT
Course Title	Software Engineering
Course Code	SEN-220
Credit Hours	3+0
Pre-Requisite	CSC-221
Course Objectives	This course aims to develop the students' knowledge of basic software terminologies, software life cycle activities, software process models and information systems. The students will also be familiarized with the UML to model software development.
Contents	<ul style="list-style-type: none"> ● Software Engineering. Software Development Life Cycle. ● Software Process Models. ● Software prototyping. ● Software design using UML. ● System analysis. ● Software project management. ● Introduction to Software Requirements Engineering
Course Title	Operating Systems
Course Code	CSC-320
Credit Hours	3+1
Pre-Requisite	CEN-221

Course Objectives	This course will introduce you to modern operating systems. We will focus on UNIX-based operating systems, though we will also learn about alternative operating systems, including Windows. The course will begin with an overview of the structure of modern operating systems. Over the course of the subsequent units, we will discuss the history of modern computers, analyze in detail each of the major components of an operating system (from processes to threads, synchronization, deadlocks and memory management), and explore more advanced topics in the field, including memory management and file input/output. The class will conclude with a discussion of various system-related security issues.
Contents	<ul style="list-style-type: none"> Operating System Introduction Basic Concepts Process Concept Scheduling and Scheduling Algorithms Concurrent Processing Threads Deadlocks Memory Management Paging File Concepts I/O System Disk Management Tertiary Storage Structure
Course Title	Digital System Design
Course Code	CEN-442
Credit Hours	3+1
Pre-Requisite	CEN-221
Course Objectives	On completion of this course the students will be able to design and test a blocks of a digital circuit, be able to implement a logic circuits into a combination of microcontrollers and FPGAs.

Contents	High-Level Digital Design Methodology using Verilog, Design, Implementation, and Verification Application Requiring HW Implementation, Floating-Point to Fixed-Point Conversion Architectures for Basic Building Blocks, Adder, Compression Trees, and Multipliers Transformation for High Speed using Pipelining, Retiming, and Parallel Processing Dedicated Fully Parallel Architecture Time Shared Architecture Hardwired State Machine Based Design Micro Program State Machine Based Design FPGA-Based Design And Logic Synthesis
Course Title	Engineering Ethics
Course Code	HSS-422
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	The objective of this course is to develop engineering ethics in the students.
Contents	Introduction to Ethical Concepts Ethics and Professionalism Moral Reasoning and Codes of Ethics Moral Frame Works Engineering as Social Experimentation Commitment to Safety Risk and Liability in Engineering Workplace Responsibilities and Rights Honesty Integrity and Reliability Engineers as Employees Environmental Ethics Global Issues Engineers and Technological Progress Responsibility For Research Integrity Fair Credit in Research and Publication Credit and Intellectual Property in Engineering Practice Making a Life in Engineering and Science Case Studies on Professional Behavior.

Bachelor in Computer Engineering BCE

Department of Computer Engineering

Course Title	Software Applications for Mobile Devices
Course Code	SEN-448
Credit Hours	2+1
Pre-Requisite	None
Course Objectives	Objective of this course is to teach the Platform, Tools, and Technologies, Application Design Considerations, Overview of the NET Compact Framework.
Contents	Mobile Enterprise Application Architecture, Client Application Requirements and Performance. NET Compact Framework Smart Device Extensions in Development of Mobile Device Applications Compact NET Framework and Full NET Framework Server and Client Tools in a Mobile Application Development Environment Pocket PC 2002 Emulator
Course Title	Artificial Intelligence
Course Code	CSC-411
Credit Hours	2+1
Pre-Requisite	None
Course Objectives	The course will covers different topics of AI such that, search, game, planning, logic, machine learning, uncertainty, robotics, neural network and fuzzy logic and advance AI. Further more programming languages of artificial intelligence, lisp and prolog will be covered in this course. The main focus is on the established methods of these areas. Recent advances from research are also included.
Contents	Introduction Search Informed Search CSP Game Playing Logic Planning Expert System Knowledge Representation LISP Prolog
Course Title	Wireless and Mobile Networks
Course Code	CEN-470
Credit Hours	2+1
Pre-Requisite	CEN-222
Course Objectives	

Contents	<p>Introduction to Wireless Communication, Wired vs. Wireless Communication, Electromagnetic Spectrum, Design Challenges, Wireless Transmission, Evolution of Wireless Networks , 1G Cellular Networks, 2G Cellular Networks, 2.5G Cellular Networks, 3G Cellular Networks, Limitation of 3G, 4G Objectives, Issues, QoS, Security, Multimedia Services and Applications, Tariff management, WLANS(IEEE802.11), WiMAX (IEEE802.16), Wireless PAN(IEEE802.15)), Fundamentals of Cellular Concepts(Cellular Concept, AMPS Architecture, Frequency Reuse, Locating co-channel cells, Channel Assignment Strategies, Handoff Strategies, Prioritizing Handoff, Practical Handoff Considerations, Co-channel Interference and Capacity, Adjacent Channel Interference and Capacity, Channel Planning for Wireless System, Trunking and Grade of Service, Measuring Traffic Intensity, Trunked Systems, Erlang Charts, Improving Coverage and Capacity, Cell Splitting, Sectoring, Repeaters for Range Extension, Microcell Zone Concept), Analog Mobile Phone System (Introduction, Architecture, System Overview, Call Handling, Air Interface, Supervisory Signals, N-AMPS), GSM Specifications, Identifiers in GSM Network, Call Routing in GSM, GPRS, EDGE, CDMA One / IS-95, Mobile Wireless CDMA Design Considerations, Walsh Codes, IS-95 Reverse Link, EDGE, WCDMA / UMTS, Logical Channels in WCDMA, Spreading and Scrambling, Transport and Physical Channels, Signaling, Physical Layer Procedures, Compressed Mode measurements, Handover Measurements, WCDMA , CDMA 2000 Mobile Ad Hoc, 802.11 Security, WEP Protocol, EDCF, HCF, Mobile IP, Introduction to wireless Mesh Networks, Characteristics, MANET, WSN, High Rate WPAN , ZigBee, WiMax/IEEE 802.16, OFDM, OFDMA, 4G Overview, Issues, Mobility Management, Handoff types, QoS Considerations</p>
Course Title	Digital Image Processing
Course Code	CEN-445
Credit Hours	2+1
Pre-Requisite	EEN-313
Course Objectives	To introduce underlying concepts involved in processing digital images

Contents	Image Formation Process Types of Images (Infrared, Thermal and Video Etc) Image Acquisition Techniques Digitization Acquisition Flaws Image Storage Compression Techniques Image Transformation (Translation, Scaling, Rotation, Stereo) Image Enhancement Image Histogram Contrast Enhancement Histogram Manipulation Thresh-Holding Binarization Grey Scale and Color Images Smoothing Sharpening Edge Detection Image Restoration Morphological Operators (Erosion, Dilation, Opening, Closing) Image Segmentation, (Hough Transform, Skeletonization, Thinning).
Course Title	Data Mining and Warehousing
Course Code	CSC-457
Credit Hours	2+1
Pre-Requisite	None
Course Objectives	Objective of this course is to teach students concepts related to data warehousing and data mining.

Contents	<p>Concepts of Data mining and Data Warehousing Data Preparation Techniques: outlier and missing data analysis Data Reduction Techniques Learning methods in Data mining Statistical Methods in Data Mining Cluster Analysis Hierarchal, agglomerative and Naive Bayesian methods Decision Trees and Decision Rules Association Rules Other Soft Computing Approaches in Data Mining Artificial Neural Networks Fuzzy Logic and Fuzzy Set Theory Genetic Algorithm Evolutionary algorithms</p>
Course Title	Embedded System Design
Course Code	CEN-439
Credit Hours	2+1
Pre-Requisite	CEN-321
Course Objectives	To develop an understanding of various embedded systems.
Contents	<p>Trends and Challenges in Embedded System Design Introduction to the Design and Use of Single-Purpose Processors (Hardware) and General-Purpose Processors Memories and Buses Hardware/Software Tradeoffs Advanced Computation Models Control Systems Chip Technologies Modern Design Tools Embedded Processor Selection Hardware/Firmware Partitioning Glue Logic Circuit Design Circuit Layout Circuit Debugging Development Tools Firmware Architecture Firmware Design and Firmware Debugging Study Of Intel 8051 Microcontroller Architecture and Instruction Set</p>

Course Title	FPGA Based System Design
Course Code	CEN-446
Credit Hours	2+1
Pre-Requisite	CEN-120
Course Objectives	Teach the design of digital electronic circuits with field programmable gate arrays.
Contents	<p>Introduction to digital design and FPGA FPGA architectures SRAM-based FPGAs Permanently-programmed FPGAs Circuit FPGA-based system design Logic design process Combinational network delay Power and energy optimization Arithmetic and logic elements Logic implementation using FPGAs FSM design ASM design Physical design (PnR) for FPGAs Synthesis process Sequential design using FPGAs Sequential machine design Sequential design style.</p>
Course Title	VLSI Design
Course Code	CEN-457
Credit Hours	2+1
Pre-Requisite	CEN-120
Course Objectives	This course is the terminal course in the line of digital design courses such as digital logic design, digital electronics, and digital design using HDLs. It describes how digital ASIC circuits are designed, simulated and analyzed. Course contents include designing of high speed adders, wires, memories, pipelined datapaths and other advanced topics in the area of VLSI. Extensive laboratory work gives students hands-on experience on advanced VLSI tools available.

Contents	History of VLSI Fabrication Circuit Characterization & Performance Estimation Adders Combinational Circuit Design Sequential Circuit Design Testing Case Studies
Course Title	Numerical Analysis
Course Code	GSC-320
Credit Hours	3+0
Pre-Requisite	GSC-210
Course Objectives	The main purpose of this course is to introduce the fundamental computational techniques and algorithms for solving mathematical problems that arise in different scientific and engineering problem situations.
Contents	Error analysis and IEEE standards of floating point representation of Real Numbers Analysis and Implementation of Algorithms for Solutions of Non-Linear Equations Interpolation and Extrapolation of Scientific Data Curve Fitting Algorithms Numerical Integration Algorithms Computational Algorithms for ODEs: Ordinary Differential Equations Dynamical Systems and Chaotic Dynamics
Course Title	Software Project Management
Course Code	SEN-410
Credit Hours	3+0
Pre-Requisite	SEN-220
Course Objectives	This course provides an introduction to managing software projects. It discusses various evaluation models for software development process. This course enables students to acquire practical software project management skills as a result of which students can readily be employed in field.

Contents	Introduction to Project Management Project evaluation Selection of an appropriate project approach Software effort estimation Activity planning Risk Management Resource allocation Monitoring and Control Managing People and Organization Software Quality Generics Sequential Systems.
Course Title	Software Quality Assurance
Course Code	SEN-420
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	Develop a good quality assurance plan and standards for large, small and fast-track projects and Understanding of how to use quality management tools effectively.
Contents	Introduction to software quality assurance Fundamentals of software quality assurance practice Software quality control processes Software quality verification Software quality measurement Supporting tools for software quality control The SEI Capability Maturity Model for Software ISO 9000 for Software Software Testing Techniques Software Testing Strategies Formal Methods Software quality certification
Course Title	Fault Tolerant Systems
Course Code	CEN-438

Credit Hours	2+1
Pre-Requisite	CEN-120
Course Objectives	This course offers a unique opportunity for engineering managers and software designers to learn about fault tolerance - about systems surviving failure. It is about maintaining systems despite the failure of some of their parts.
Contents	Fault, Error and Failure. Types of faults (Hard Faults, Soft Faults) Hardware Redundancy techniques Gate Level Testing Fault Analysis Test Pattern Generation Circuit Verification Introduction to Error Control Coding Fundamental of Information Theory
Course Title	Robotics
Course Code	CEN-463
Credit Hours	2+1
Pre-Requisite	EEN-313
Course Objectives	This course is the terminal course in the line of control system courses. It describes how robotic systems can be analyzed with respect to design, simulation and application. Robotic system stability is the main focus of this course.
Contents	Introduction to Robotics Spatial Description and Transformation of Robots Manipulator Kinematics of Robots AI and Path Planning of Robots
Course Title	System Programming
Course Code	CEN-449
Credit Hours	2+1
Pre-Requisite	CSC-320

Course Objectives	In this course, the student will learn to write efficient, well-documented programs in IBM PC assembly language. In this course students understand the relation of software and hardware and learn how to get command and control on computer hardware through assembly language programming.
Contents	System Organization and Number Representation Assembly Language Structure Processor Status and Flag Registers Flow Control Instructions Logic, Shift, Rotate Instructions and Multiplication, Division instructions Procedures Arrays & Addressing Modes and String Instructions Structure and Macros Advanced Arithmetic Disk and File Operations Display and Keyboard Programming BIOS and DOS Interrupts
Course Title	Computer Graphics
Course Code	CSC-444
Credit Hours	2+1
Pre-Requisite	None
Course Objectives	The objectives of this course is to provide students with hands-on experience in developing interactive, real-time rendering applications using OpenGL.
Contents	2D and 3D graphics Animation sequences Colors, shading, ray tracing Spline curves, radiosity, warping and morphing Two dimensional graphics Projection and transformation Animation Sequences Analysis of Three Dimensional Scenes Texture Mapping Modeling Fire Non-Photorealistic Rendering

Course Title	Computer Graphics
Course Code	CSC-444
Credit Hours	2+1
Pre-Requisite	None
Course Objectives	The objectives of this course is to provide students with hands-on experience in developing interactive, real-time rendering applications using OpenGL.
Contents	2D and 3D graphics Animation sequences Colors, shading, ray tracing Spline curves, radiosity, warping and morphing Two dimensional graphics Projection and transformation Animation Sequences Analysis of Three Dimensional Scenes Texture Mapping Modeling Fire Non-Photorealistic Rendering
Course Title	Neural Networks and Fuzzy Logic
Course Code	CSC-449
Credit Hours	3+0
Pre-Requisite	CSC-411
Course Objectives	This course covers topics from following main areas of neural network and fuzzy logic
Contents	Introduction to Soft Computing. Fuzzy Cognitive Maps. Fuzzy Logic Systems. Applications of Fuzzy Logic Control Regression and Optimization Neural Networks Applications of NNBack Propagation Recurrent Network
Course Title	Introduction to Nanotechnology
Course Code	EEN-466
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	The objective of this course is to provide interesting emerging nanotechnologies by discussing scientific and engineering knowledge necessary to understand fundamental physical differences at the nanoscale.

Contents	Introduction Nanoscale phenomena Nanoparticles Carbon nanostructures Nanowires Nanostructured materials Self assembly Surface probe microscopy Other nanoscale characterization Nanolithography Nanoscale devices and Systems Applications of nanotechnology
Course Title	Control Engineering
Course Code	EEN-467
Credit Hours	3+0
Pre-Requisite	EEN-313
Course Objectives	Purpose of this course is to create the understanding and strong basic concepts in the field of control theory.
Contents	Introduction to Control Systems Mathematical Modeling of Dynamic Systems Block Diagram and State Flow Graph System Characteristics Transient Response Analysis Routh's Stability Criterion Steady State Error and the Types of the System Root Locus Analysis Basic Control Action and Response of Control System Control System Design by Root Locus Control System Design by Frequency Response State Space Analysis of Control System Design of Linear and Nonlinear Control Systems in State Space

Course Title	Human Computer Interaction
Course Code	EEN-466
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	The objective of this course is to make students understand basic HCI concepts and definitions, understand the role of modeling, study and design graphic interfaces. Study user centered design, task analysis, GOMS, and other key HCI methods.
Contents	Usability User-Centered Design UI software architecture Human Capabilities Output Models Conceptual Models and Metaphors Input Models Design Principles Paper Prototyping Constraints and Layout Graphic Design Computer Prototyping Toolkits Heuristic Evaluation User Testing
Course Title	Cloud Computing
Course Code	SEN-452
Credit Hours	3+0
Pre-Requisite	None
Pre-Requisite	The objective of this course is to provide students knowledge of Datacenter Architectures, Cloud Stack, Technology Trends, Consistency, Availability, Partitions, Cluster File Systems, Data-flow Computation Frameworks.

Contents	Key-Value Store and Interactive Query Systems Big Data in the Clouds Geographic distributed Storage Programming Languages for the Cloud Databases in the Cloud In-Memory Frameworks Google file system Hadoop file system MapReduce OSes and Clouds Networking: topologies, Traffic Management, Transport Protocol Improvements, Security, Scheduling and Resource Management in Clouds Service Level Agreement Cloud Computing Trends and Issues
Course Title	Engineering Economics & Management
Course Code	HSS-411
Credit Hours	3+0
Pre-Requisite	None
Pre-Requisite	Objective of the course is to create awareness amongst the students about the economic and managerial considerations involved in engineering.
Contents	Introduction to Economics Economic Environment Elementary Financial Analysis Break Even Analysis Selection Between Alternatives Investment philosophy Value Analysis/Value Engineering Linear Programming Capital Financing & Allocation Introduction to Management

Course Title	Entrepreneurship & Leadership
Course Code	HSS-421
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	Purpose of this course is to introduce the importance of entrepreneurship, in particular in the areas of leadership, decision making and negotiation.
Contents	Leadership Styles Group and Organizational Leadership Values and Ethics Management vs. Leadership Entrepreneurship Individual, Group and Organizational Leadership Principles Human Behavior and Motivation In Performance Values and Ethics in Leadership and Decision Making Nature of Entrepreneurial Work - Risks, Rewards, Challenges

Course Title	
Course Title	Applied Calculus & Analytical Geomatic
Course Code	GSC-110
Credit Hours	3+0
Pre-Requisite	None
Course Objectives	This freshmen level course has been designed to introduce the ideas and concepts of calculus that would serve as a foundation for subsequent computer engineering courses. The primary objective is to endow the knowledge of basic concepts of calculus and geometry. Purpose of this course is to build the students knowledge of differential/integral calculus and analytic geometry of functions of one independent variable, at the intermediate level.