

CHITTAGONG INDEPENDENT UNIVERSITY (CIU)
UNDERGRADUATE CURRICULUM
SCHOOL OF ENGINEERING AND COMPUTER SCIENCE

In order to obtain a B.Sc. in **Computer Engineering**, a student must complete a minimum of **140** credits of coursework. This includes 32 credits of Foundation Studies. The minimum requirement for the major is **93** credit hours including **6** credit hours of internship / senior project and Minor **15** credits.

Foundation Courses		32 Credits
Communication Skills		6
ENG 101	Listening and Speaking Skills	3
ENG 105	Business English	3
ENG 106	Advanced English Skills	3
Computer Skills		3
CSC 101	Introduction to Computer Science	3
Numeracy		6
MAT 102	Linear Algebra & Coordinate Geometry	3
MAT 212	Probability & Statistics for Sc. & Engr.	3
Natural Sciences		8
PHY 101	Physics-I	3
PHY 101L	Physics-I Lab	1
CHEM 101	Chemistry	3
CHEM 101L	Chemistry Lab	1
PHY 102	Physics-II	3
PHY 102L	Physics-II Lab	1
Social Sciences		3
SOC 101	Introduction to Sociology	3
HEA 101	Health and Society	3
ECN 200	Introduction to Economics	3
Humanities		3
FRN 101	Elementary French	3
HST 103	History and Civilization	3
ACN 201	Principles of Accounting	3
Live-in-Field Experience		3
LFE 201	Live-in-Field Experience	3

Course Descriptions of Foundation Courses

ENG 101 Listening and Speaking Skills (3 credits)

Listening for main ideas and specific information, getting meaning from context, identifying stressed words and reductions, listening for advice, directions, understanding instructions, guessing meaning, inferring, predicting, listening to lectures and note taking, listening to narratives and amusing anecdotes. Speaking as social interaction, to obtain and give information, telephone conversations, introductions, greetings, partings, giving instructions, making complaints, apologies, giving directions, opinions and suggestions, expressing feelings and moods, attitudes and opinions. Classroom interaction, asking for clarification and giving explanations, descriptions, comparisons, analysis, and evaluations. Speeches, presentations, debates and discussions at seminars and conferences. Pronunciation with emphasis on intonation, stress patterns, paralinguistic, features.

ENG 105 Business English (3 credits)

The role of communication in business organization, a model of the communication process, perception and reality, the filter of the mind, some malfunctions of communication, principles of clear business writing, qualities of effective business correspondence, the direct approach letters, the indirect approach, persuasive requests and collection letters, sales letters, job applications and resume writing, office memorandums, the problems and organization of a report, determination of a report make-up, techniques of writing a report, visual aspects in a report, public speaking and oral communication.

ENG 106 Advanced English Skills (3 credits)

Advanced skills in reading- Critical reading and responding, analysis and evaluation of texts styles, comparing different purposes and registers, writing critiques of articles, text books and reviews, reading scientific and technical articles, journals and research papers. Writing in response to reading, notes, summaries, term papers, seminar and workshop presentations, collaborative writing on wider topics. Speeches and debates. Writing in narrative and expository modes. Writing research papers, abstracts, formulating thesis questions and statements, making bibliographic surveys, writing research questions for surveys and interviews, gathering and presentation of data, drawing conclusions, abbreviations and numbers, quotations, footnotes and references, bibliographies, tables, illustrations, editing and proofreading. Term paper mandatory.

CSC 101 Introduction to Computer Science (3 credits)

Introduction to Desktop personal computers. Hardware and software. Basic idea of the working of microprocessors. Storage devices. System components: Variation. Basic concepts of BIOS. Diskette Operating System. Internal and external commands. Function keys. Line editors and screen editors. Batch files. BASIC programming

language Variable and constants. Mathematical operations. Conditional branching. Looping and arrays. Dimensioning arrays. Subprograms. ho operations. Word Processing: On-and practice wit one of the word processors: Word, WordPerfect or WordStar. Will cover: Basic editing, formatting, pagination, margin control, spell checking, searching and sorting.

MAT 102 Linear Algebra & Coordinate Geometry (3 credits)

Linear algebra:

Introduction to systems of linear equations. Gaussian elimination. Definition of matrices. Algebra of matrices. Transpose of a matrix. Factorization, Determinants. Quadratic forms. Matrix polynomials. Euclidean n -space. Linear transformation from \mathbb{R}^n to \mathbb{R}^m . Real vector spaces and subspaces. Basis and dimension. Rank and nullity. Inner product spaces Gram-Schmidt process and QR-decomposition. Eigen values and Eigen vectors. Diagonalization. Linear transformations, Kernel and range. Application of linear algebra to electric networks.

Coordinate Geometry:

Coordinate Geometry of 2-dimension-change of axis, Transformation of coordinates. Simplification of equations of curves, Coordinate geometry of 3-dimension system of coordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.

MAT 212 Probability & Statistics for Sc. & Engr. (3 credits)

Discrete and continuous random variables; probability concepts; discrete and continuous distributions; Binominal, Poisson, Normal, Exponential distributions; moments and moment generating functions; joint probability distributions; sampling distributions; confidence intervals; least-square regression; hypothesis testing; analysis of variance; Markov process, Monte-Carlo simulation.

PHY 101 Physics - 1 (3 credits)

Waves and Oscillations: Simple harmonic motion, Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillation, spring mass system, torsion pendulum, two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, vibrations of membranes and columns, progressive and stationary wave, group and phase velocities, sound waves-Doppler effect, Sabine's formula, architected acoustics.

Optics: Defects of images: Spherical aberration, astigmatism, coma, distortion, curvature, chromatic aberration, theories of light, Haygen's principle; Interference of light: young's double slit experiment, displacement of fringes and its uses, Fresnel bi-prism, interference in thin film, Newton's rings, interferometers, Differentiation: Diffraction by single slit, Diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating, Polarization: production and analysis of polarized light, Brewster's law, Malu's law, polarization by double refraction, Nicol prism, optical activity, polarimeters, optics of crystal optical effect in crystal, laser, nonlinear optics.

Thermal Physics: Heat and work, Zeroth law of thermodynamics, thermometer, thermocouple, the first law of thermodynamics and its applications, Kinetic theory of gases- kinetic interpretation of temperature, specific heats of ideal gases, equipartition of energy, mean free path, work done by gas, isothermal and adiabatic relations, van der Waals' equation of state, Maxwell's distribution of molecular speeds, reversible and irreversible processes, Carnot's cycle, second law thermodynamics, Carnot's theorem, entropy, thermodynamics functions, Maxwell relations, Clausius and Clapeyron equation.

PHY 101L Lab work based on PHY1 (1 credit)

PHY 102 Physics II (3 credits)

Atomic Structure: Rutherford scattering, atomic structure (Bohr model, Thomson model, Rutherford model), Zeeman Effect.

Structure of Matter: Classification of solids, crystal structure of solids, Bragg's law, Distinction between metal, insulator and semiconductor.

Modern Physics: Galilean relativity and Einstein's special theory of relativity, Lorentz transformation equations, Length contraction, time dilation and mass-energy relation, photoelectric effect, Compton Effect, De Broglie matter waves.

Nuclear Physics: Constituent of atomic nucleus, nuclear binding energy, different types of radioactivity, radioactive decay law, Nuclear reactions, nuclear fission, nuclear fusion.

Mechanics: Linear momentum of a particle, linear momentum of a system of particles, conservation of linear momentum, some applications of a system particles, Kepler's law of planetary motion, the law of Universal Gravitation, the motion of planets and satellites.

Introductory Quantum Mechanics: Wave function, uncertainty principle, postulates, Schrodinger time independent equation, expectation value, probability, particle in a Zero potential, calculation of energy.

PHY102L Lab work based on PHY2 (1 credit)

CHEM 101 Chemistry (3 credits)

Matter and energy. Modern concept of the structure of atom. Concept of the Periodic Table of elements. Concept of chemical bonds. Concept of mole, chemical reactions and ideal gas laws. Modern concept of acids and bases. Energetic and chemical equilibrium. Chemical kinetics: rate, order, rate constant and Arrhenius equation. Concepts of catalysis and photochemical reactions. Organic chemistry: concepts of saturated hydrocarbons, unsaturated hydrocarbons, alcohols, fatty acids and aromatic hydrocarbons. Concept of chemical industries in Bangladesh: case studies: chemical fertilizer, paper, sugar and leather.

CHEM 101L Lab work based on CHEM1 (1 credit)

SOC 101 Introduction to Sociology (3 credits)

Introductory Sociology is designed to acquaint the beginning students with the major concepts and theories. With a brief discussion of its history and contributions of the major sociologists the course introduces the students to the methodology of social research. The course then looks at the major concepts, like culture, groups, socialization, deviance and social control. The next section deals with social inequality in terms of social stratification, global inequality, and inequalities among ethnic groups, gender and of age. It then moves to the different institutions like, family, religion, education, economy, and government and politics. The next section deals with population, environment, urbanization and finally with collective behavior and social movements and social change.

HEA 101 Health and Society (3 credits)

This course aims to introduce students to an understanding of key sociological approaches to the analysis and understanding of health and society. The course covers concepts of health and disease, patterns of health and the social construction of disease. Special attention is given to develop knowledge on theories central to the notion of health, including the social, cultural and institutional forces and context that play a role on health and health related practices. The purpose is to help establish a perspective that will enable the students to better understand the relationship between health and society as well as to provide skills and knowledge for research experiences. The course also provides an overview of the basic concepts of population studies that will help students develop their own demographic perspective, enabling them to understand some of the most important issues confronting the world. The course will use a combination of methods, such as lectures, debates, preparation of assignments by reviewing journal articles and presentation.

ECN 200 Introduction to Economics (3 credits)

Basic concepts of economics. Distinction between Micro and Macro Economics. General view of price system: Demand and Supply. Elasticity of demand and supply. Consumer's behavior: Utility analysis, Inferior good and Giffen good. Market structures: Perfect competition, Monopoly, Monopolistic competition and Oligopoly. Factors of production: labor, land, capital and entrepreneur. Basic concepts of Macroeconomics. Circular flow of income, mixed economy, private and public sector economic interactions. Measuring domestic output: national income and the price level. Aggregate Expenditures Model. The Multiplier, net exports, and government. Aggregate demand and aggregate supply of money. Money market equilibrium.

Credit creation by banking system. Monetary policy. Some concepts of international Trade, exchange rate determination and economic development.

HST 103 History & Civilization (3 credits)

Meaning, Growth and Spread of civilization The Ancient Near East: Mesopotamia- Egypt- The Hebrews- The Hittites Canaanites - Philistine - Phoenicians - Crete - Mycenae _ The Classical World the Greeks and the Romans - The Medieval Age: Christianity, Barbarian invasions, Feudalism, Manorial System, Growth of towns and Universities - Byzantine civilization and the formation of Russia - Early Culture in America: The Mayas, the Aztecs, the Incas - The Renaissance and the Reformation - Government and Societies in the Age of Absolutism - The Age of Explorations – The formation of Latin American - the Scientific and Industrial Revolutions – Consolidation of Europe's Global dominance - World War I - The Bolshevik Revolution in Russia.

FRN 101 Elementary French I (3 credits)

Letters of alphabet. Accents and their pronunciation. Definite and indefinite articles (feminine/masculine, singular/plural). Personal pronouns. Auxiliaries "to be" and "to have", verbs ending with '-er', in the present tense. Interrogative, negative form. Simple adjectives (descriptive, colors). Presenting oneself.

ACN 201 Principles of Accounting (3 credits)

An introduction. The recording Process. Adjusting the Accounting and Preparing the Statements. Completion of the Accounting Cycle. Accounting for Merchandizing operation. Special journals. Preparation of Income Statement and Balance sheet for companies. (According to Company Act 1994). Introduction to Accounting Principles.

Live-in-Field Experience

LFE 201: Live-in-Field Experience (3 credits)

The course is intended to expose CIU students to experience life in the cross-cultural situation obtained in the country, and to the practice of the field survey method. It is usually offered during the semester break in the winter.

Core Courses			40 Credits
CCR 201	Discrete Mathematics	3	
CCR 203	Algorithm and Data Structure	3	
CCR 203L	Lab work based on CCR203	1	
CCR 204	Computer Hardware & Digital Logic	3	
CCR 204L	Computer Hardware & Digital Logic Lab	1	
CCR 205	Structured Programming Language	3	
CCR 205L	Lab work based on CCC 205	1	
CCR 212	Microprocessor & Assembly Language	3	
CCR 212L	Lab work based on CCR 212	1	
CCR 250	Numerical Methods for Engineering	3	
CCR 250L	Lab work based on CCR 250	1	
CCR 305	Object Oriented Programming -I	3	
CCR 305L	Object Oriented Programming Lab	1	
CCR 311	Computer Organization & Architecture	3	
CCR 401	Database Management	3	
CCR 401L	Lab work based on CCR 401	1	
CCR 413	Operating System	3	
CCR 435	Computer Graphics	3	
Concentration			38 Credits
CEN 210	Electronics Devices & Circuits	3	
CEN 210L	Lab work based on CEN 210	1	
CEN 312	Peripherals and Interfaces	3	
CEN 312L	Lab work based on CEN 312	1	
CEN 330	Data Communication	3	
CEN 330L	Lab work based on CEN 330	1	
CEN 405	MIS & System Analysis	3	
CEN 405L	Lab work based on CEN 405	1	
CEN 412	Wireless Networking & Mobile Computing	3	
CEN 420	Image Processing and Pattern Recognition	3	
CEN 425	Artificial Intelligence	3	
CEN 430	Computer Networks	3	
CEN 430L	Computer Networks Lab	1	
CEN 440	Computer Simulation and Modeling	3	
CEN 460	Multimedia Systems	3	
CEN 466	Cyber and Intellectual Property Laws	3	
Optional Courses (Any three)			9 Credits

ECR 101	Introduction to Electrical Engineering	3
CEN 404	Embedded Systems	3
CEN 432	Electrical Drives & Instrumentation	3
CEN 445	Software Engineering	3
CEN 450	Computer and Network Security	3
CEN 455	Web Application & Internet	3
CEN 465	E-commerce & Web Database	3
CEN 475	VLSI Design & Testing	3
CEN 480	Computer Vision	3
CEN 490	Special Topics in Computer Science & Engineering	3
Internship Program or Senior Project		6 Credits
CEN 498	Senior project	6
CEN 499	Internship Program	6

Course Description of Major in Computer Science & Engineering

Core courses

CCR 201 Discrete Mathematics (3 credits): Advanced counting techniques: generating functions of sequences, recurrence relations, solving recurrence relations by substitution and generating functions, method of characteristic roots, solution of inhomogeneous recurrence relations. Algebraic structures: semigroups and monoids, groups, subgroups and homomorphisms, cosets and Lagrange's theorem, normal subgroups, rings and fields, lattices and Boolean algebra. Coding and channels: optimal coding, Huffman's algorithm for constructing an optimal code. Faneaux algorithm. Introduction to graphs.

CCR 203 Algorithm & Data Structures (3 credits):

Introduction:

Role of Algorithm in Computing, Growth of functions, Asymptotic Notation, Standard notation & common functions, Introduction to Recurrences, Substitution method, master method, Randomizing Algorithms.

Divide and Conquer:

Performance analysis of Binary Search, Merge sort, Quick sort, Selection sort.

Greedy Algorithms:

Elements of Greedy Strategy, Activity Selection Problem, Knapsack problem, Single source Shortcut paths problem, Minimum Spanning tree problem and analysis of these problem.

Dynamic Programming:

Elements of Dynamic programming, Assembly-line scheduling problem, Matrix-chain multiplication, Multistage Graph, All pairs Shortest paths, Longest common subsequence, 0/1 Knap Sack.

Back Tracking:

General method, 8 queen's problem, Graph coloring, 0/1 Knap Sack Problem.

NP-Completeness:

Polynomial Time, polynomial-time verification, NP-completeness & reducibility, NP-complete problems.

Elementary data objects; elementary data structures, internal data representation, abstract data types, recursive data structures, arrays, lists, stacks, queues, graphs, trees.

CCR 203L Lab work based on CCR 203 (1 credit)

CCR 204 Computer Hardware and Digital Logic (3 credits):

Introduction:

Representation of Logic, Logic Variables, Boolean Algebra, Boolean Expressions and minimization of Boolean using K-Map, Review of Logic Gates & Flip-flops, Design and

Implementation of Adder, Subtractor, Multiplexer, Demultiplexer, Encoder, Decoder, ROM, Digital Comparators, Code Converters.

Number System Code:

Decimal Binary, Hexadecimal, Octal's complement, 2's complement, addition and subtraction, weighted binary codes, Error detecting codes, Error correcting codes, Alphanumeric codes.

Counters and Shift Register:

Ripple Counters, Design of Method-N ripple counter, Up-Down counter, design of synchronous counters with and without lockout conditions, design of shift registers with shift-left, shift-right &, parallel load, facilities, universal shift registers.

Data Converters:

Sample & Hold switch, D/A converters: Weighted type, R-2r ladder type; A/D Converters; Counter-Ramp' type. Dual Slope Type, Successive approximation type, flash type; Specifications of ADC & ,DAC.

Digital Logic Families:

Characteristics of digital circuits: Fan in, fan out, power dissipation, propagation delay, noise margin, Transistor-transistor Logic (TTL), TIL, NAND Gate with active Pull Up, its input and output Characteristics, Types of TTL Gates (Schottky, standard, low power, high speed). Emitter Coupled Logic (ECL), ECL gate, its transfer characteristics, level translation in ECL & TTL, MOS Gates, MOS inverter, CMOS Inverter, Rise & Fall time of MOS & CMOS gates, interfacing TIL & CMOS Circuits, Comparison of Characteristics of TTL, ECL, MOS & CMOS logic circuits, Tristate Logic & its applications.

Semiconductor Memories & Programmable Logic:

RQM, PROM, EPROM, EEPROM, RAM, Static RAM, Typical Memory Cell, Memory Organization, Dynamic RAM cell, Reading Writing Operation in RAM, PLA, PAL" FPGA

CCR 204L Lab work based on CCR 204 (1 credit)

CCR 205 Structured Programming Language (3 credits):

Introduction: Programming languages, basic concepts of compiler, interpreter, algorithm and flowchart.

Simple C: Program structure in C, program creating, debugging and running, basic I/O functions, identifiers and keywords, primitive data types, variables, constants, operators, bitwise operators, comments, decision making statements with if and switch case; looping structures with for, while, do-while, goto;

Compound Data Types: Array, structures, union, pointers, strings, dynamic allocation, static, global, external and register, user defined data types

Functions: C functions and user defined functions, function types, function and pointers, parameters, prototypes, recursive function.

File Handling: Concepts, character and file I/O, basics of file I/O, ANSI Standard Libraries.

Others: Pre-processors with define, include, macro, ifdef, uses of graphics functions and project management with user-defined header files.

CCR 205L Lab work based on CCR 203 and CCR 205 (1 credit)

CCR 212 Microprocessor and Assembly Language (3 credits): Organization of a computer; introduction to 80X86 family of microprocessors; jump instruction; address and instructions, assembling, linking and running programs; debugging programs; controlling program development; addressing models; instructions encoding and assemblers; I/O programming; interrupts, interrupt controllers, device drivers. Overview of Pentium processors. Assembly language fundamentals: symbolic constants, arithmetic instructions, jump and looping, conditional jumps, macro techniques, stack and subroutines, Conditional Call and Return. Interrupt, Interfacing Data Converters, Interrupt Controller, Direct Memory Access (DMA).

CCR 212L Lab work based on CCR 212 (1 credit)

CCR 250 Numerical Methods for Engineering (3 credits)

Introduction:

Motivation and errors in numerical techniques, Taylor series.

Finite Difference Calculus:

Forward, backward, divided, and central difference and difference of polynomial.

Interpolation and Extrapolation:

Iteration, bisection, false position. Raphson, Secant and Muller's methods.

Simultaneous Linear Algebra Equations:

Cramer's rule, Inversion of matrices, Gauss elimination, Gauss-Jordon method, factorization and Gauss-Siedel iteration methods.

Curve fitting:

Linear and polynomial regression, fitting power, exponential and trigonometric functions, ordinary differential equations, initial value problem, Taylor's series method, Picard's methods of successive approximation, Euler's method and RungeKutta method, Boundary value problems.

Numerical Integration:

General quadratic formula, trapezoidal rule and Simpson's rule, numerical differentiation.

CCR 250L Numerical Methods for Engineering Lab: (1 credit)

Laboratory experiments based on theory and concepts learnt in CCR 250

CCR 305 Object-Oriented Programming I (3 credits): Objects and classes; class specifiers and definition of objects; constructors and destructor. Abstract Data Structures, Friend functions; function and operator overloading; inheritance, reusability, virtual functions polymorphism; exception handling. Object oriented Programming Languages C++, Java.

CCR 305L Lab work based on CCR 305 (1 credit)

CCR 311 Computer Organization and Architecture (3 credits): Computer system: computer structures, components, functions, memory, I/O devices, modules, programmed and interrupt driven I/O, I/O channels and processors, interfaces, central processing unit: arithmetic/logic unit, instruction-sets, addressing modes, CPU, processor and register organizations, control units and parallel organizations, ; interrupts, interrupt controllers, device drivers.

CCR 401 Database Management (3 credits): Conventional and database approaches. Basic concepts. Hierarchical, network and relational data models. Entity–relationship modeling. Relational database designing: decomposition and normalization; functional dependencies. Relational algebra and calculus. structured query language (SQL). Query optimisation. Database programming with SQL and PL/SQL. Database security and administration. Distributed databases. Object-oriented data modeling. Specific database systems: Oracle, Access.

CEN 401L Lab work based on CEN 401 (1 credit)

CCR 413 Operating Systems (3 credits): Evolution of operating systems. Components and structure of operating systems. Process management: interrupt processing, scheduler, context switching, scheduling algorithm, process synchronization, semaphores, inter process communication, signals and pipes, deadlocks, threading. Memory management: memory allocation, addressing, swapping, paging, segmentation, virtual memory organization, demand paging. File system, structures and access methods: directory structure, file protection. I/O management, buffering. Distributed systems. Protection and security problems. Case studies: UNIX, MS-DOS, Windows.

CCR 435 Computer Graphics (3 credits): Graphics devices; graphics coordinate systems; programming tools for graphics; lines and curves; turtle graphics; elementary clipping: Cohen–Sutherland algorithm; generating curves in two dimension; elementary ray-tracing; drawing objects in two dimension; transformation of pictures; affine transformation; elementary three-dimensional object modeling; orthographic and perspective projections.

Concentration:

38 Credits

CEN 210 Electronic Devices and Circuits (3 credits): Semiconductors: Junction diode characteristics; Operation and small signal models of diodes; Circuit application of diodes. Bipolar transistor: Characteristics; BJT biasing and thermal stabilization; CE, CB, CC configurations; Small signal low frequency h-parameter models and hybrid-p model. Amplifiers: voltage and current amplifiers; Operational amplifiers; Off-set null adjustments; Differential

input and output impedance, frequency response and noise. Oscillators: Hartley, Colpitts & Wine-Bridge oscillators. Introduction to JFET, MOSFET, PMOS, NMOS and CMOS: Biasing and application in switching circuits. Silicon controlled rectifier (SCR), TRIAC, DIAC, UJT: Characteristics and application. Introduction to rectifiers, active filters, regulated power supply. Introduction to IC fabrication techniques.

CEN 210L Lab work based on CEN 210 (1 credit)

CEN 312 Peripheral and interfaces (3 credits):

The Memory Element:

RAM, Linea select Memory Organization, Decoders, Dimensions of Memory access, connecting Memory chips to a computer bus, static RAM, Dynamic RAM, ROM, Digital recording techniques.

System Resources:

Interrupt, DMA Channel, I/O Port Address and resolving and resolving the conflict of resources, I/O buses-ISA, PCI, SCSI, EISA, Local bus, VESA Local bus, PCI bus, PCI Express, Accelerated graphics port bus.

Video Hardware:

Introduction to Multimedia Kit, Multimedia building blocks, Video display technologies, DVI Digital Signals for CRT Monitor, LCD Panels, Video adapter types, Integrated Video/Motherboard chipset, Video RAM, Video driver and multiple Monitor, Graphics accelerators, Advanced Techniques.

Input/ Output Driver software aspects:

Role of device driver, DOS and UNIX/ LINUX device drivers.

Design & Integration of Peripheral devices to a computer system as Case Study.

CEN 312L Lab work based on CEN 312 (1 credit)

CEN 330 Data Communication (3 credits): Data: representation, signal encoding, signal analysis; Data Transmission Channel: channel capacity, transmission line characteristics, Baseband and Broadband transmission; Transmission media: guided and unguided; Transmission networks; Transmission modulation techniques, modems and interfaces; Multiplexing techniques; Error handling; Switching techniques; Introduction to advanced data communication technologies and Internet.

CEN 330L Lab work based on CEN 330 (1 credit)

CEN 405 MIS and Systems Analysis (3 credits): Information attributes. Management Information System: subsystems. Information system components and design factors. Systems and models; Systems analysis: systems development life cycle models. Feasibility analysis, Structured analysis; systems prototyping. Tools for determining system requirements; data flow diagrams; decision table and decision trees;. system design and implementation: application architecture, user interface design. Front-end and backend, database design, software

management and hardware selection. Object oriented analysis: use-case modeling, Unified Modeling Language. Case Studies of Information Systems.

CEN 405L Lab work based on CEN 405 (1 credit)

CEN 412 Wireless Networking & Mobile Computing (3 credits): Several topics related to wireless networking and mobile computing will be covered in this course. The topics include: cellular networks, multiple access protocols, channel assignment and resource allocation, mobility and location management, handoffs, routing, authentication, call admission control and QoS provisioning, network layer issues, wireless data networking (WAP, GSM, GPRS, CDMA, WCDMA), mobile ad hoc networks.

CEN 420 Image Processing and Pattern Recognition (3 credits): Digital image representation: acquisition, storage and display systems; sampling and quantization: uniform and non-uniform sampling; image geometry: perspective transformation, synthetic camera approach, stereo imaging; image transforms: fast Fourier transform, discrete Fourier transform, sine/cosine transform; image enhancement; spatial and frequency domains; smoothing and sharpening; gray-level binary images: thresholding, half-toning; image restoration: degradation model; constrained and unconstrained restoration; inverse filtering; Wiener filtering; image compression: source encoding/decoding, channel encoding/decoding.

CEN 425 Artificial Intelligence (3 credits): Principal ideas and development of artificial intelligence; theorem proving; problem solving methods; search space; best first search, A* search, Mean End Analysis, Min-Max Search, generation pruning and searching; knowledge representation techniques; Forward vs. Backward Reasoning, matching, Conflict Resolution, Fuzzy Logic, Semantic nets, frame, conceptual dependency, scripts, heuristic search; puzzle solvers; learning: forms of learning, inductive learning, decision trees, statistical learning, expert system and data processing; simulative and cognitive process; natural language analysis and synthesis; representation design and design knowledge;

CEN 430 Computer Networks (3 credits): Introduction to International Standards Organization open System Interconnection (ISO-OSI) reference model, design issues and protocols in the physical layer, data link layer and network layer; architectures and control algorithms of local area networks, point-to-point networks and satellite networks; standards in network access protocols; models of network interconnection, and overview of networking and communication software.

CEN 430L Lab work based on CEN 430 (1 credit)

CEN 440 Computer Simulation and Modeling (3 credits): Statistical background for simulation; system reliability; mathematical description of general dynamic systems; discrete event; discrete time and continuous time; queuing models; effects of queue disciplines; factors affecting queue systems; implementation and management of models; performance evaluation of models; simulation languages; SLAM.

CEN 460 Multimedia System Design (3 credits):

Introduction:

Multimedia and its types, Introduction to hyper media, Hyper Text, Multimedia Systems and their characteristics, Challenges, Desirable features, Components and Applications.

Multimedia Technology:

Multimedia hardware devices, multimedia software development tools, multimedia authoring tools, multimedia standards for document architecture, SGML, ODA, MHEG etc.

Storage Media:

Magnetic and Optical Media, RAID and its levels, Compact Disc and its standards, DVD and its standards, Multimedia Servers.

Audio:

Basics of Digital Audio, Application of Digital Audio, Digitization of sound, Introduction to MIDI (Musical Instrument Digital Interface), Components of a MIDI system, Hardware aspects of MIDI, MIDI messages.

Image, Graphics and Video:

Graphic/Image file format, Graphic/Image data, Color in Image and Video, Colour Image and Video Representations, Basics of Video, Types of Color, Video Signals, Analog Video, Digital Video, TV standards.

Video and Audio Compression:

Classifying Compression Algorithms, Lossless Compression Algorithms, Entropy Encoding, Run-length Encoding, Pattern Substitution, Basics of Information theory, Huffman Encoding, Huffman Coding of Images, Adaptive Huffman Coding, Arithmetic Coding, Lempel-ZIW-Welch (LZW), Source Coding Techniques, Transform Coding, JPEG Compression, Video Compression

CEN 466 Cyber and Intellectual Property Laws (3 credits)

Basics of Computer & Internet Technology

Internet, ISP & domain name, Network Security; Encryption techniques and Algorithms; Digital Signatures.

Introduction to Cyber World

Introduction to Cyberspace and Cyber Law, Different Components of cyber Laws, Cyber Law and Netizens.

E-Commerce

Introduction to E-Commerce, Different E-Commerce Models, E-Commerce Trends and Prospects; E-Commerce and Taxation, Legal Aspects of E-Commerce.

Intellectual Property Rights

IPR Regime in the Digital Society, Copyright and Patents, International Treaties and Conventions, Business Software Patents, Domain Name Disputes and Resolution.

IT Act, 2000

Aims and objectives, Overview of the Act, Jurisdiction, Role of certifying Authority, Regulators under IT Act, Cyber Crimes-Offences and Contraventions Grey Areas of IT Act.

Optional Courses (any three)

9 Credits

ECR 101 Introduction to Electrical Engineering: (3 credits)

Electrical Circuit Concepts & Units- Voltage, Current, Power & Energy, Resistance & Conductance, Ohms Law, KVL, KCL, Series & Parallel dc Circuits & networks.

Methods of Analysis- Branch-Current Analysis, Node & Mesh Analysis, Bridge Networks, Y- Δ transformation.

Network Theorems- Superposition, Thevenin's, Norton's, Maximum Power Transfer Theorem & Reciprocity Theorem.

Energy Storage Elements- Inductors & Capacitors & Their Characteristics, Series-Parallel Combination of Inductors & Capacitors.

Responses of RL & RC Circuits- Natural & Step Responses.

Magnetic Quantities & Variables- Flux Permeability & Reluctance, Magnetic Field Strength, Magnetic Potential, Flux Density Magnetization Curve.

Laws in Magnetic Circuits- Ohm's Law, Ampere's Circuit Law, Series & Parallel Magnetic Circuits.

CEN 404 Embedded Systems (3 credits): Provides a detailed overview of the important topics in the field. Typical examples of embedded systems; real time and safety critical issues; constraint driven design; systems integration; hardware-software partitioning and time-to-market considerations will be addressed. The subject will examine programmable devices, micro-controllers, application specific standard processors: importance of interrupts; re-configurable logic; system-on-a-chip; finite state machines; dataflow architectures; and distributed embedded systems. Software for embedded systems, including: programming languages and software architectures; interrupt servicing; multi-tasking; task communications and scheduling; verification: hardware-software co-simulation; and real-time operating systems will be introduced.

CEN 432 Electrical Drives and Instrumentation (3 credits): Single phase transformers; Principles of operation of DC, Induction and Stepper motors; Thyristor and microprocessor based speed control of motors. Introduction to amplifiers; Basic differential amplifiers; logarithmic amplifiers; Temperature compensation of Logarithmic amplifiers; Antilog amplifier; Chopper stabilized amplifier. Frequency and voltage measurements using digital techniques:

Digital frequency meter, digital voltmeter. Recorders and display devices: Oscilloscope, Spectrum analyzers and logic analyzers. Data acquisition system and interfacing to microprocessor based systems. Transducers: terminology, types, principles and application of piezoelectric, photovoltaic, thermoelectric, variable reactance and opto-electronic transducers. Noise reduction in instrumentation.

CEN 445 Software Engineering (3 credits): Introduction to the principles of software engineering. Software as product and process. Project management and planning; tracking and scheduling; risk analysis and quality assurance techniques.; configuration management. Project and process metrics, size and function oriented metrics. Software testing techniques: black box and white box techniques. Testing strategy: unit, integration and system testing.. Concepts of object-oriented, event-driven and network programming, client-server architecture, web engineering. The course focuses on taking a group development project from beginning to end.

CEN 450 Computer & Network Security (3 Credits): Introduction; nature and types of security attacks, model for network security, Fiestel cipher structure; conventional encryption algorithms, DES and triple DES, public key cryptography, message authentication, hash function, RSA and Diffie-Hellman algorithms, digital signature, digital certificate, key distribution, system security, intrusion and password protection, intrusion detection system, viruses, worms and anti-virus techniques, firewall architecture and design, trusted system, network security, Kerberos, X.50g, e-mail security, PGP and S/MIME, IP Security architecture, secure socket layer, secure electronic transaction, network management security and SNMP, JAVA security, CGI security, security features of windows NT, UNIX and LINUX.

CEN 455 Web Applications & Internet (3 credits): Web Technology – OSI & TCP/IP architecture, Internet Routing, IP addressing & Domain Name System. World Wide Web – overview of popular browsers; Anatomy of Web presentations. Designing HTML files- Mark up tags, hypertext linking, Images & graphics, Tables, Forms, Multimedia. Scripting languages- JavaScript, CGI. DHTML: Cascading Style Sheet, scripting. Web Servers – IIS, PWS, Apache. Understanding HTTP, Client and Server side scripts. Concept of designing dynamic Web pages: ASP, PHP, with MS Access, SQL server. Working with remote data services - using ASP, PHP technologies with MySQL and Oracle database. Web security: Cryptography, Digital signature, Digital Certificate, Authentication & Firewall.

CEN 465: E-Commerce and Web database (3 credits): Electronic Commerce environment - Modes of Web based business. Networking overview, Intranet, Extranet, VPN, and VAN. Security and authentication. Cryptography and key management. Digital Signature and Digital certificate. Electronic Cash and Electronic Payment schemas: EDI, EFT, payment and purchase order process, online electronic cash, Cyber Cash, Ecash. Master/visa Secure Electronic Transaction. Internet architecture and services- ISP connectivity methodologies, Web applications, Web servers and Web browsers, Overview of Web database design development and management. Three-tier client-server Web DBMS architecture, Integrating database with Internet, Web database security and access controls

CEN 475 VLSI Design and Testing (3 credits): VLSI Technology: MOS transistor and inverter characteristics, complex CMOS gates and functional circuits. Design and operation of large fan-out and fan-in circuits; Clocking methodologies; Techniques for data path and data control design. VLSI layout partitioning, placement routine, and writing in VLSI Reliability aspects and testing of VLSI.

CEN 480 Computer Vision (3 credits): Introduction, 2D image, 3D vision, stereo vision; edge detection, image segmentation, boundary features, shape features, spatial moments, texture analysis, and mathematical morphology; Marr's paradigm, active vision; 3D vision, Marr's paradigm, active and purposive vision; applications, autonomous vehicles, augmented reality environments, CAD modeling, games and movies; rigid body transformations, calibration problems, correspondence and flow, epipolar geometry, structure from stereo, and structure from motion.

CEN 490 Special Topic in Computer Engineering (3 credits): Selected advanced topic from the field of computer engineering and its applications. It may vary from time to time.

CEN 498 Senior Project (6 credits)

CEN 499 Internship (6 credits)

Minor in Engineering Mathematics			15 Credits
Students majoring in Electrical & Electronics Engineering must take engineering mathematics as their minor. Students taking this minor will be adequately trained in mathematics to understand its application in fields of Electrical and Electronics Engineering.			
Compulsory Courses			12 Credits
MAT 201	Calculus		3
MAT 251	Complex Variables & Vector Analysis		3
MAT 303	Differential Equations		3
MAT 305	Boundary Value Problems		3
Optional Courses – Anyone from the following			3 Credits
MAT 403	Introduction to Mathematical Modeling		3
MAT 405	Optimization Techniques		3

Description of Minor in Engineering **Mathematics**

MAT 201 Calculus (3 credits)

(Differential Calculus & Integral Calculus)

Differential Calculus:

Limits, continuity and differentiability, Successive differentiation of various types of functions, Leibnitz's theorem, Rolle's Theorem, Mean value theorem, Taylor's and Maclaurin's theorems in finite and infinite forms, Lagrange's form of reminders, Cauchy's form of reminders, Expansion of functions, evaluations of indeterminate forms of L'Hospital's rule, Partial differentiation, Euler's theorem, Tangent and normal, Subtangent and subnormal in Cartesian and polar co-ordinates, Determination of maximum and minimum values of functions, Curvature, Asymptotes, curve, tracing.

Integral Calculus:

Definition, integration by the method of substitution, integration by parts, Standard Integrals. Integration by successive reduction. Definite Integrals, its properties and use in summing series. Walli's formulae. Improper integrals. Beta function and Gamma function, Area under a plane, curve and area of a region enclosed by two curves in Cartesian and polar co-ordinates, Trapezoidal and Simpson's rule, Volumes and surface areas of solids of revolution.

MAT 251 Complex Variables and Vector Analysis (3 credits)

Complex Variables:

Complex number system. General functions of a complex variable. Limits and continuity of a function of complex variable and related theorems. Complex differentiation and the Cauchy-Riemann equations. Mapping by elementary functions. Infinite series. Convergence and uniform convergence. Line integral of a complex function. Cauchy's integral formula. Liouville's theorem. Taylor's and Laurent's theorem. Singular points, Residue, Cauchy's residue theorem. Contour integration, conformal mapping.

Vector Analysis:

Scalar and vectors, equality of vectors, addition and subtraction of vectors, geometrical interpretation. Multiple product of vectors. Linear dependence and independence of vectors. Differentiation and Integration of vectors together with elementary applications. Line, Surface and volume integrals. Gradient of a scalar functions, divergence and curl of a vector function, Various formulae. Integrals form of gradient, divergence and curl. Divergence theorem, Stoke's theorem, Green's theorem and Gauss's theorem.

MAT 303 Differential Equations (3 credits)**Ordinary differential equations:**

Degree and order of ordinary differential equations, formation of differential equations by various method, solution of first order differential equations. Solution of general linear equations of second and higher order with constant coefficients, applications. Solution of homogeneous linear equation of the higher order when the dependent or independent variables are absent. Solution of differential equations by the method based on the factorization of the operators. Frobenius method. Legendre and Bessel's function.

Partial Differential Equations:

Introduction linear and on-linear first order equations. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients. Wave equations. Particular solution with boundary and initial conditions.

MAT 305 Boundary Value Problems (3 credits): Bessel's functions; Legendre polynomials; Fourier series; half wave and full wave expansions; solutions of Laplace equation, Poisson's equation, wave equation and diffusion equation in orthogonal and non-orthogonal coordinate systems; Sturm-Liouville problem. Fourier and Laplace Transform in details.

MAT 403 Introduction to Mathematical Modeling (3 credits): An introduction to techniques of mathematical modeling involved in the analysis of meaningful and practical problems in many disciplines including mathematical sciences, operations research, engineering and the management and life sciences. Students will be encouraged to recognize and formulate problems in mathematical terms, solve the resulting mathematical problems and interpret the solution in real terms.

MAT 405 Optimization Techniques (3 credits): Discrete, deterministic models of interest to social sciences. Linear programming, duality, simplex method, sensitivity analysis, convex sets. Selections from assignment, transportation, network flow, nonlinear programming problems.