THE CURRICULUM

The details of course codes and titles organized in different levels and terms are as follows:

Level 1 (Freshman Year), Semester 1

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 1101	Structured Programming Language	3.00	4.00 – 0.00	
CSE 1102	Structured Programming Language Sessional	1.00	0.00 – 2.00	
ENG 1161	English	3.00	4.00 – 0.00	
MATH 1163	Differential and Integral Calculus	3.00	4.00 – 0.00	
PHY 1165	Physics	3.00	4.00 – 0.00	
ECO 1263	Engineering Economics	3.00	4.00 – 0.00	
EEE 1265	Electrical Circuit Analysis	3.00	4.00 – 0.00	
EEE 1266	Electrical Circuit Analysis Sessional	1.00	0.00 – 2.00	
	Total Credit Hour	20.00	24.00 – 4.00	

Level 1 (Freshman Year), Semester 2

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 1301	Discrete Mathematics	3.00	4.00 – 0.00	
CSE 1303	Data Structure and Algorithms I	3.00	4.00 – 0.00	CSE 1101
CSE 1304	Data Structure and Algorithms I Sessional	1.00	0.00 – 2.00	
EEE 1361	Electronics	3.00	4.00 – 0.00	EEE 1265
EEE 1362	Electronics Sessional	1.00	0.00 – 2.00	
CSE 1201	Object Oriented Programming Language	3.00	4.00 – 0.00	CSE 1101
CSE 1202	Object Oriented Programming Language Sessional	1.00	0.00 – 2.00	
MATH 1261	Differential Equations and Coordinate Geometry	3.00	4.00 – 0.00	MATH 1163
CE 1364	Engineering Drawing and AutoCAD	1.00	0.00 – 2.00	
	Total Credit Hour	19.00	20.00 – 8.00	

Level 2 (Sophomore Year), Semester 1

Course Code	Course Title	Credit Hour	Contact Hour	Pre-Requisite
CSE 2101	Digital Logic Design	3.00	4.00 – 0.00	
CSE 2102	Digital Logic Design Sessional	1.00	0.00 – 2.00	
CSE 2103	Java and Socket Programming	3.00	4.00 – 0.00	CSE 1201
CSE 2104	Java and Socket Programming Sessional	1.00	0.00 – 2.00	
MATH 2161	Matrices and Vector Analysis	3.00	4.00 – 0.00	
BAN 2163*	Bangla Language and Literature	3.00	4.00 – 0.00	
CSE 2201	Numerical Analysis	3.00	4.00 – 0.00	
ACT 2261	Principles of Accounting	3.00	4.00 – 0.00	
	Total Credit Hour	20.00	24.00 – 4.00	

* For foreign students, this course will be titled “Elementary Bangla Language”.

Level 2 (Sophomore Year), Semester 2

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 2301	Microprocessor and Interfacing	3.00	4.00 – 0.00	CSE 2203
CSE 2302	Microprocessor and Interfacing Sessional	1.00	0.00 – 2.00	
CSE 2303	Theory of Computation	3.00	4.00 – 0.00	
CSE 2305	Database Management System	3.00	4.00 – 0.00	
CSE 2306	Database Management System Sessional	1.00	0.00 – 2.00	
MATH 2361	Complex Variable and Fourier Transformation	3.00	4.00 – 0.00	MATH 1163
CSE 2203	Computer Organization and Architecture	3.00	4.00 – 0.00	CSE 2101
CSE 2205	Data Structure and Algorithms II	3.00	4.00 – 0.00	CSE 1101
CSE 2206	Data Structure and Algorithms II Sessional	1.00	0.00 – 2.00	
CSE 2210	Assembly Language Programming	1.00	0.00 – 2.00	
	Total Credit Hour	22.00	24.00 – 8.00	

Level 3 (Junior Year), Semester 1

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 3101	System Analysis and Design	3.00	4.00 – 0.00	
CSE 3102	System Analysis and Design Sessional	1.00	0.00 – 2.00	
CSE 3103	Compiler	3.00	4.00 – 0.00	
CSE 3104	Compiler Sessional	1.00	0.00 – 2.00	
CSE 3105	Data Communication	3.00	4.00 – 0.00	
CSE 3107	Information System Management	3.00	4.00 – 0.00	
CSE 3205	Applied Statistics and Queuing Theory	3.00	4.00 – 0.00	
CSE 3207	Cyber Crime and Security	3.00	4.00 – 0.00	
	Total Credit Hour	20.00	24.00 – 4.00	

Level 3 (Junior Year), Semester 2

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 3301	Programming for Mobile Devices	3.00	4.00 – 0.00	
CSE 3302	Programming for Mobile Devices Sessional	1.00	0.00 – 2.00	
CSE 3303	Computer Graphics	3.00	4.00 – 0.00	
CSE 3304	Computer Graphics Sessional	1.00	0.00 – 2.00	
CSE 3305	Software Engineering	3.00	4.00 – 0.00	
CSE 3306	Software Engineering Sessional	1.00	0.00 – 2.00	
CSE 3201	Computer Network	3.00	4.00 – 0.00	
CSE 3202	Computer Network Sessional	1.00	0.00 – 2.00	
CSE 3203	Operating System	3.00	4.00 – 0.00	
CSE 3204	Operating System Sessional	1.00	0.00 – 2.00	
	Total Credit Hour	20.00	20.00 – 10.00	

Level 4 (Senior Year), Semester 1

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 4000	Project and Thesis*	2.00	0.00 – 4.00	
CSE 4l01	Artificial Intelligence	3.00	4.00 – 0.00	
CSE 4102	Artificial Intelligence Sessional	1.00	0.00 – 2.00	
CSE 44XY	Option – I	3.00	4.00 – 0.00	
CSE 45XO	Option – II	3.00	4.00 – 0.00	
CSE 45XE	Option – II Sessional	1.00	0.00 – 2.00	
CSE 4200	Web Based Software Development	2.00	0.00 – 4.00	
CSE 4202	Technical Writing	1.00	0.00 – 2.00	
	Total Credit Hour	16.00	12.00 – 14.00	

Level 4 (Senior Year), Semester 2

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 4203	Professionalism and Ethics	3.00	4.00 – 0.00	
CSE 4000	Project and Thesis*	4.00	0.00 – 8.00	
CSE 4300	Industrial Training**	2.00	0.00 – 4.00	
CSE 45XO	Option – II	3.00	4.00 – 0.00	
CSE 45XE	Option – II Sessional	1.00	0.00 – 2.00	
	Total Credit Hour	13.00	8.00 – 14.00	

*The student has to complete the course **CSE 4000: Project and Thesis** taking over the two semester in level 4 (Senior Year). The course shall be evaluated in each semester but the grade "X", i.e., continuation grade shall be awarded in Term 1 and Term 2 if the progress is satisfactory. Grade "I" shall be provided if the progress is not satisfactory. The final grade shall be awarded at the end of the Term 3 of level 4.

CSE 44XY: The values of digits "XY" shall depend on the theory courses to be offered. "X" and "Y" may be any digit.

CSE 45XO/45XE: The values of digits "XO" or "XE" shall depend on the theory or sessional courses to be offered. "X" may be any digit, "O" stands for an odd digit and "E" stands for an even digit.

** Each student has to submit an evaluation report at the end of the training. This report shall be endorsed by the respective industry and shall be evaluated by the supervisor to be incorporated in the tabulation sheet.

Optional/Elective Courses

A. Option -I

Course Code	Course Title	Credit Hour	Contact Hour	Pre-Requisite
CSE 4401	IT Entrepreneurship Development	3.00	4.00 – 0.00	
CSE 4403	E-Commerce and E-Governance	3.00	4.00 – 0.00	
CSE 4405	IT Laws, Regulations and Ethics	3.00	4.00 – 0.00	
CSE 4407	Software Testing and Quality Assurance	3.00	4.00 – 0.00	
CSE 4409	Software Project Management	3.00	4.00 – 0.00	
CSE 4411	Basic Graph Theory	3.00	4.00 – 0.00	
CSE 4413	Fault Tolerant System	3.00	4.00 – 0.00	
CSE 4415	Basic Multimedia Theory	3.00	4.00 – 0.00	
CSE 4417	Machine Learning	3.00	4.00 – 0.00	
CSE 4419	Bioinformatics	3.00	4.00 – 0.00	
CSE 4421	Robotics	3.00	4.00 – 0.00	
CSE 4425	Cloud Computing	3.00	4.00 – 0.00	

B. Option -II

Course Code	Course Title	Credit Hour	Contact Hour	Pre-requisite
CSE 4501	Digital Signal Processing	3.00	4.00 – 0.00	
CSE 4502	Digital Signal Processing Sessional	1.00	0.00 – 2.00	
CSE 4503	Data and Web Mining	3.00	4.00 – 0.00	
CSE 4504	Data and Web Mining Sessional	1.00	0.00 – 2.00	
CSE 4505	Wireless Network	3.00	4.00 – 0.00	
CSE 4506	Wireless Network Sessional	1.00	0.00 – 2.00	
CSE 4507	Software Architecture	3.00	4.00 – 0.00	
CSE 4508	Software Architecture Sessional	1.00	0.00 – 2.00	
CSE 4509	Distributed Database Management System	3.00	4.00 – 0.00	
CSE 4510	Distributed Database Management System Sessional	1.00	0.00 – 2.00	
CSE 4511	Digital Image Processing	3.00	4.00 – 0.00	
CSE 4512	Digital Image Processing Sessional	1.00	0.00 – 2.00	
CSE 4513	Simulation and Modeling	3.00	4.00 – 0.00	
CSE 4514	Simulation and Modeling Sessional	1.00	0.00 – 2.00	
CSE 4515	Pattern Recognition	3.00	4.00 – 0.00	
CSE 4516	Pattern Recognition Sessional	1.00	0.00 – 2.00	
CSE 4517	Communication Engineering	3.00	4.00 – 0.00	
CSE 4518	Communication Engineering Sessional	1.00	0.00 – 2.00	
CSE 4519	Internet Engineering	3.00	4.00 – 0.00	
CSE 4520	Internet Engineering Sessional	1.00	0.00 – 2.00	
CSE 4521	Deep Learning	3.00	4.00 – 0.00	
CSE 4522	Deep Learning Sessional	1.00	0.00 – 2.00	
CSE 4523	Human Machine Interaction	3.00	4.00 – 0.00	
CSE 4524	Human Machine Interaction Sessional	1.00	0.00 – 2.00	
CSE 4525	Switching and Routing	3.00	4.00 – 0.00	
CSE 4526	Switching and Routing Sessional	1.00	0.00 – 2.00	

Summary of Courses for B. Sc. in Computer Science and Engineering (CSE) Program:

A. Semester -wise Course Load Distribution:

Level and Semester	Hours/Week		Credits			No of Theory Courses
	Theory	Sessional	Theory	Sessional	Total	
Level 1 Semester 1	24	4	18	2	20	6
Level 1 Semester 2	20	8	15	4	19	5
Level 2 Semester 1	24	4	18	2	20	6
Level 2 Semester 2	24	8	18	4	22	6
Level 3 Semester 1	24	4	18	2	20	6
Level 3 Semester 2	20	10	5	5	20	5
Level 4 Semester 1	16	14	12	7	16	3
Level 4 Semester 2	4	14	3	7	13	2
Total	-	-	117	33	150	39

B. Area-specific Credit Hour Distribution:

Sl#	Course Group	Credit Hour
1.	Humanities/Social Science	9
2.	English	3
3.	Mathematics	12
4.	Physics	3
5.	Software and Information Technology	75
6.	Hardware and Networking	18
7.	Other Engineering	9
8.	Optional Courses	11
9.	Individual Activities	10
	Total	**150**

C. Total Formal Contact Hours:

Theory Contact Hour: 2028; Sessional Contact Hour: 598; Individual Contact Hour: 260
Total Contact Hour: 2886

Course Description

ENG 1161	English	3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

To illustrate the basics English writing principle along with correct English grammar with different ways of sentence construction and general essay and short story writing.

Outcome:

1. Displaying control of appropriate spelling, grammar, vocabulary, punctuation and capitalization;
2. Understanding the different ways in which grammar has been described;
3. Giving oral presentation using effective delivery strategies.

Contents:

English Phonetics: the places and manners of articulation of English sounds; Vocabulary: techniques of enriching stock of words; English Grammar: construction of sentences; common grammatical problems; Reading: techniques and strategies for improving comprehension skills; prose pieces by renowned authors; Writing: developing paragraphs as the building blocks of larger discourses; Business Correspondence: importance, classifications and structures; Report: types and layout of reports; Technical Writing: research paper; dissertation and thesis; technical proposals; instruction manual.

Reference Books:

1. P. C. Wren and H. Martin, *High School English Grammar and Composition*, published by S. Chand Publishing.
2. Leslie Cope Comford, *English Composition: A Manual of Theory and Practice*, published by Bastian Books.

MATH 1163	Differential and Integral Calculus	3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of the course is to provide insight into differential calculus and applications. This course will cover differentiation and integration of the elementary functions, with applications to physical and social sciences.

Outcome:

1. Understanding the meaning of differentiation and integration;
2. Applying various methods of calculating derivative of a function;
3. Applying techniques of definite and indefinite integration.

Contents:

Number system, sets and their applications, functions and their domain and range, sketch simple function, logarithmic and exponential functions; limits of functions, continuity and differentiability of functions; differentiation of varies types of functions and their applications; successive differentiation of functions, Leibnitz's theorem; Roll's theorem, mean value theorem; Taylor's theorem in finite and infinite form; Lagrange's and other form of reminder, expansion of function; evaluation of indeterminate forms by *L'hospital's* rule; partial differentiation and Euler's theorem for homogenous function; determination of maximum and minimum values of functions and point of inflexion of functions; tangent, normal, sub tangent and subnormal in Cartesian and polar co-ordinates; basic concept of integration, integration by method of substitution, integration by parts, standard integral; integration of rational fraction, integration of some special trigonometric function; definite integral, general properties of definite Integral, Walli's formula, beta function and gamma function; integration by method of successive reduction, finding values of definite integral by using reduction formula; improper integral; multiple integrals; area under plane curve in Cartesian and polar co-ordinate, area of the region enclosed by two curves in Cartesian and polar co-ordinate; rectification: finding arc length of curves in Cartesian and polar co-ordinate; volume of solids of revolutions, area of surfaces of revolutions.

Reference Books:

1) B. C. Das and B. N. Mukherjee, *Differential Calculus*, published by U. N. Dhur, 19th Edition,
2) A. K. Sharma, *Text Book of Differential Calculus*, published by Discovery Publishing House,.
3) B. C. Das and B. N. Mukherjee, *Integral Calculus: Including Differential Equations*, published by U. N. Dhur, 23rd Edition.
4) A. M. Agarwal, *Integral Calculus*, published by Arihant Publications, 1st Edition.

PHY 1165	**Physics**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of the course is give students basic exposure to Physics that will better prepare them for more rigorous courses that will be taken later on. The basics of thermodynamics, light, harmonic oscillation, polarization and introduction to fluid mechanics will be covered throughout the course.

Outcome:

1. Demonstrate a rigorous understanding of the core theories and principles of physics, which include mechanics, electromagnetism, thermodynamics, and quantum mechanics;
2. Apply critical reasoning skills to model and solve physics related problems;
3. Demonstrate proficiency in the collection, analysis and interpretation of data.

Contents:

Heat & thermodynamics; kinetic theory of gases; laws of thermodynamics; waves and oscillations: simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, damped oscillation, forced oscillation, resonance, reduced mass, progressive wave, power and intensity of wave motion, stationary wave, group velocity and phase velocity, architectural acoustics, reverberation and Sabine's formula; physical optics: theories of light; interference of light; Young's double slit experiment; displacements of fringes and its uses; Fresnel's Bi-prism, interference at wedge shaped films, Newton's rings and interferometers; diffraction of light; Fresnel and Fraunhoffer diffraction, single slit and N-slits grating; polarization: polarized light, Brewster's law, malus law, polarization by double refraction, retardation plates, Nicol prism, optical activity, polarimeters and polaroid; modern physics: theory of relativity, length contraction, time dilation,

relativity of mass, mass and energy relation, velocity addition theorem, twin paradox, massless particles. atomic structure and nuclear physics- electron orbits, atomic spectra, the Bohr atom, energy level and spectra, corresponding principle, atomic excitation, the laser, basic properties of nuclei, radioactivity, binding energy, meson, emergency particles; the solid state physics and statistical mechanics- crystalling and amorphous solids, ionic crystal, covalent crystal, van der walls bond, metallic bond, band theory of solids, semiconductor, superconductor.

Reference Books:

1. Resnick, Halliday and Krane, *Physics* (Vol. 1 & 2), published by Wiley Pvt Ltd, 5th Edition.
2. H. C. Verma, *Concepts of Physics* (Vol. 1 & 2), published by Bharati Bhavan.

CSE 1101	Structured Programming Language		3.00

Prerequisite: None Contact Hour: 4 hours/week.

Objective:

The main objective of this course is to introduce programming using C programming language. Its primary intention is to develop basic programming knowledge and be able to solve problems.

Outcome:

1. Apply fundamental programming concepts, using a structured language, to solve substantial problems;
2. Generate an innovative design to solve a problem containing a range of constraints;
3. Interpret verbal problem specifications into program code;
4. Enhance ability to approach problems systematically.

Contents:

Structured programming language: data types, operators, expressions, control structures; Functions and program structure: parameter passing conventions, recursion; Header files; Preprocessor; Pointers and arrays; Strings; Multidimensional array; User defined data types: structures, unions, enumerations; Input and Output: standard input and output, formatted input and output, file access; Variable length argument list; Error Handling; Linking; Library functions.

Reference Books:

1) B. S. Gottfried, *Shaum's Outline of Theory and Problems of Programming with C*, McGraw Hill, 3rd edition.
2) Herbert Schildt, *Teach Yourself C*, Published by Osborne, 3rd Edition.

CSE 1102	Structured Programming Language Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 1101 using C programming language.

MATH 1261	Differential Equation and Coordinate Geometry	3.00

Prerequisite: MATH 1163 Contact Hour: 4 hours/week.

Objective:
The students should understand what coordinate geometry and Equation are and how to apply them to real life situations for IT professionals.

Outcome:
1. Solve differential equations using graphical, numerical, and analytical methods;
2. Develop the ability to apply differential equations to significant applied and/or theoretical problems;
3. Classify and identify different problem types in coordinate geometry and select suitable problem solving techniques.

Contents:
Continuity and differentiability; Leibnitz's forms; Lagrange's form of remainders; Cauchy's form of remainder; Expansion of functions; Evaluation of indeterminate forms by L 'Hospitals rule; Partial differentiation; Euler's Theorem; Tangent and Normal; Sub-tangent and subnormal in Cartesian and polar coordinates; Maximum and minimum values of functions of single variable.

Transformation of coordinates axes and its uses; General equations of second degree and their reduction to standard forms; Pair of straight lines; System of circles; Coaxial circles and limiting points; Equations of parabola, ellipse and hyperbola in Cartesian coordinates; Tangents and normal; Pair of tangents; Chord of contact; Chord in terms of its middle point; Parametric coordinates; Conjugate diameters; Asymptotes.

Reference Books:
1. Sanay Mishra, *Fundamental Mathmatics- Coordinate Geometry*, published by Pearson Education, 1st Edition.
2. Luther Pfahler Eisenhart, *Coordinate Geometry*, published by Dover Publications Inc.,
3. F. G. Tricomi, *Differential Equations*, published by Dover Publications Inc.
4. Mark Krusemever, *Differential Equations*, published by MacMillan.

ECO 1263	Engineering Economics	3.00

Prerequisite: None Contact Hour: 4 hours/week.

Objective:
Economics is the study of how societies allocate scarce resources among competing uses. It is about the choices made by people, individually and collectively, in the production, exchange, distribution and consumption of goods and services. Central to economic analysis is the study of how people respond to incentives in a market economy, how these incentives may be modified by government intervention, and whether and how government intervention is warranted.

Outcome:
1. Explain the basic economic principles of wants, scarcity, choice, opportunity cost, etc. as applied to business organizations and engineering firms;
2. Understand the time value of money, and how to sketch the cashflow diagram;
3. Identify areas of conflicts between engineers and accountants;
4. Evaluate the profit of a firm, carry out the break even analysis and employ this tool to make production decision.

Contents:
Definition of economics; economics and engineering; principles of economics; micro-economics: the theory of demand and supply and their elasticity's; price determination; economic theory, economic theories for developing countries; indifference curve technique; marginal analysis; production and production function; types of productivity; rational region of production of an engineering firm; concept market and market structure; cost analysis and cost function; small scale production and large scale production; optimization; theory of distribution; macro-economics: savings, investment, and employment; national income analysis; inflation; monetary policy, fiscal policy and trade policy with reference to Bangladesh; economics of development and planning.

Reference Books:

1. Campbell McConnell, Stanley Brue and Sean Flynn, *Economics*, published by McGraw-Hill, 18th Edition.
2. N. Gregory Mankiw, *Principles of Economics*, published by Cengage Learning, 6th Edition.

EEE 1265	Electrical Circuit Analysis		3.00

Prerequisite: None Contact Hour: 4 hours/week.

Objective:
Electrical and electronics engineers design, plan, research, evaluate and test electrical and electronic equipment and systems. The basics of electrical circuits and designing along with different electrical devices mechanism will be covered in this course.

Outcome:
1. Use basic electrical DC concepts and theorems to analyze circuits;
2. Build and simulate electrical DC circuits and perform measurements with electronic test equipment;
3. Explain concepts in the mathematical model used for description of the circuits
4. Write technical reports using collected experiment data.

Contents:
Direct current: voltage, current, resistance and power; Laws of electrical circuits and methods of network analysis;

Introduction to filters: Passive and Active filters; Alternating current: Instantaneous and rms values of current, voltage and power, average power for various combination of R, L and C circuits, phasor representation of sinusoidal quantities; Balanced three phase circuit circuits; Ideal operational amplifier circuits.

Reference Books:
1) B. L. Theraja and A. K. Theraja, *A Textbook of Electrical Technology (Volume 1 – Basic Electrical Engineering)*, Published by S. Chand and Company Ltd, 1st Edition.
2) Robert L. Boylestad, *Introductory Circuit Analysis*, Published by Pearson, 12th Edition.

EEE 1266	Electrical Circuit Analysis Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on EEE 1265.

CSE 1201	Object Oriented Programming Language		3.00

Prerequisite: CSE 1101 Contact Hour: 4 hours/week.

Objective:

This course provides an introduction to object-oriented programming with C++ language, covering topics such as class design, inheritance, dynamic binding and static binding. Participants will be able to recognize features of object-oriented design such as encapsulation, polymorphism, inheritance and composition of systems based on object identity. Sections are also included on the implementation of core data structures such as lists, graphs, trees and hash tables.

Outcome:

1. Specify simple abstract data types and design implementations, using abstraction functions to document them;
2. Recognize features of object-oriented design sich as encapsulation, polymorphism, inheritance, and composition of systems based on object identity;
3. Name and apply some common object-oriented design patterns.

Contents:

Object Oriented Programming (OOP) principles; Techniques using C++; Encapsulation, classes and objects, access specifiers, static and non-static members; Constructors, destructors and copy constructors; Array of objects, object pointers, and object references; Inheritance: single and multiple inheritance; Polymorphism: overloading, abstract classes, virtual functions and overriding; Exceptions; Template functions and classes.

Reference Books:

1) Robert Lafore, Object Oriented Programming, Published by MacMillan Computer Publishing, 3rd Edition.
2) Herbert Schildt, *Teach Yourself C++*, Published by McGraw Hill, 3rd Edition.

CSE 1202	Object Oriented Programming Language Sessional	1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 1201 using C++ programming.

CSE 1301	Discrete Mathematics		3.00

Prerequisite: None Contact Hour: 4 hours/week.

Objective:

Simplify and evaluate basic logic statements. Use mathematically correct terminology and notation. Apply logical reasoning to solve problems. Demonstrate an understanding of relations and functions. Demonstrate different traversal methods for trees and graphs and model problems using graphs and trees.

Outcome:

1. Identify and apply basic concepts of set theory, arithmetic, logic, proof techniques, binary relations, graphs and trees;
2. Produce convincing arguments, conceive and/or analyze basic mathematical proofs and discriminate between valid and unreliable arguments;

3. Apply the knowledge and skills obtained to investigate and solve a variety of discrete mathematical problems.

Contents:

Set theory: sets, relations, and partial ordered sets; functions; Mathematical Logic: propositional logic; predicates and quantifiers. Mathematical reasoning and proof techniques; Counting: permutations, combinations, principles of inclusion and exclusion; Discrete Probability; Recurrence relations and recursive algorithms; Algorithms; Growth of functions; Graph Theory: graphs, paths, and trees.

Reference Books:

1) K. H. Rosen, *Discrete Mathematics and its Applications*, published by McGraw-Hill, 7th Edition.
2) R. Johnsonbaugh, *Discrete Mathematics*, published by Prentice Hall, 5th Edition.
3) Seymour Lipschutz and Marc Lipson, *Schaum's Outline of Discrete Mathematics*, Published by McGraw-Hill, 3rd Edition.

EEE 1361	**Electronics**		**3.00**

Prerequisite: EEE 1265. Contact Hour: 4 hours/week.

Objective:

Electronics engineers design, plan, research, evaluate and test electronic equipment and systems. The basics of electrical circuits and designing along with different Electronics devices mechanism will be covered in this course.

Outcome:

1. Develop the ability to analyze and design analog electronic circuits using discrete components;
2. Observe the amplitude and frequency responses of common amplification circuits;
3. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

Contents:

Semiconductor; junction diode characteristics; bipolar transistor: characteristics, small signal low frequency h-parameter model and hybrid-pi model; amplifiers: voltage and current amplifiers; oscillators; differential amplifiers, operational amplifiers (OPAMPs); linear applications of OPAMPs, input & output impedances, off-set null adjustments, frequency response and noise; 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.

Reference Books:

1) V. K. Mehta and Rohit Mehta, Principles of Electronics, Published by S. Chand and Company Ltd, 9th Edition.
2) Allen Mottershead, Electronic Devices and Circuits: An Introduction, Published by Prentice Hall of India Pvt Ltd, Illustrated Edition.
3) Ramakant A. Gayakward, Op-Amps and Linear Integrated Circuits, Published by Prentice Hall of India Pvt Ltd, 4th Edition.

EEE 1362	Electronics Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on EEE 1361.

CE 1364	Engineering Drawing and AutoCAD		1.00

Prerequisite: none. Contact Hour: 4 hours/week.

Objective:
The aims of this course includes to enable the students to learn sketching and taking field dimensions, to take data and transform it into graphic drawings, to learn basic engineering drawing formats, to learn basic AutoCad skills and to learn how to draw 2D drawings in AutoCad.

Outcome:
1. Describe various drawing instruments and conventions;
2. Use drawing instruments in making an engineering drawing;
3. Use AutoCAD to draw plane drawing;
4. Draw multiview projections, sectional views using AutoCAD;
5. Do dimensioning using AutoCAD.

Contents:
Introduction; Instruments and their uses; Third angle projection; Orthographic drawing; Isometric views; Sectional views; Introduction to computer graphic software: Computer aided drawing (CAD).

Reference Books:
1) K. Venugopal, Engineering Drawing and Graphics + AutoCAD, Published by New Age International Pvt Ltd, 2009.

CSE 1303	Data Structure and Algorithms I		3.00

Prerequisite: CSE 1101 Contact Hour: 4 hours/week.

Objective:
Impart the basic concepts of data structures and algorithms. Be familiar with the basic techniques of algorithmic analysis. Understand concepts of searching and sorting techniques. Be able to solve problems in a step by step process with the help of fundamental data structures.

Outcome:
1. Understand the major techniques for implementing the fundamental data types (linked lists, binary search trees, stacks, hashing, heaps, etc.) and implement several of them;
2. Define basic static and dynamic data structures and relevant standard algorithms for them;
3. Select basic data structures and algorithms for autonomous realization of simple programs or program parts.

Contents:
Internal data representation; Abstract data types; Elementary asymptotic analysis: growth of functions, O, Ω

and Θ notations; Elementary data structures: arrays, linked lists, stacks, queues, trees and tree traversals, graphs and graph representations, heaps, binary search trees; Data structures for set operations; Advanced data Structures: balanced binary search trees (AVL trees, red-black trees, splay trees, skip lists), advanced heaps (Fibonacci heaps, binomial heaps); Hashing.

Reference Books:

1) Nell Dale, *C++ Plus Data Structure*, Published by Jones and Bartlett Publishers Inc, 5th Edition.
2) Seymour Lipschutz, *Theory and Problems of Data Structure*, Published by McGraw Hill Inc.

CSE 1304	Data Structure and Algorithms I Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 1303.

CSE 2101	Digital Logic Design		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Have fundamental concepts of combinatorial and sequential circuits. Build simple logic circuits using basic gates and optimize those using Karnaugh Maps. Understand digital representation of information, digital logic, Boolean algebra.

Outcome:

1. Identify and explain fundamental concepts of digital logic design including basic and universal gates, number systems, binary coded systems, basic components of combinational and sequential circuits;
2. Demonstrate the acquired knowledge to apply techniques related to the design and analysis of digital electronic circuits including Boolean algebra and multi-variable Karnaugh map methods;
3. Analyze small scale combinational and sequential circuits.

Contents:

Digital logic: Boolean algebra, De Morgan's Theorems, logic gates and their truth tables, canonical forms, combinational logic circuits, minimization techniques; Arithmetic and data handling logic circuits, decoders and encoders, multiplexers and demultiplexers; Combinational circuit design; Flip-flops; race around problems; Counters: asynchronous and synchronous counters and their applications; Asynchronous and synchronous logic design: State diagram, Mealy and Moore machines; State minimizations and assignments; Pulse mode logic; Fundamental mode design; PLA design; Design using MSI and LSI components.

Reference Books:

1) Thomas L. Floyd, *Digital Fundamental*, Published Pearson, 10th Edition.
2) M. Morris Mano, *Digital Logic and Computer Design*, Published by Prentice Hall, New Edition.

CSE 2102	Digital Logic Design Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 2101.

MATH 2161	Matrices and Vector Analysis		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course provides the basics of different matrix operations and solution methods of different vector based practical problems.

Outcome:

1. Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion;
2. Carry out matrix operations, including inverses and determinants;
3. Apply principles of matrix algebra to linear transformations;
4. Describe and manipulate vector spaces, subspaces and their bases;
5. Determine the kernel, image space and matrix representation of a linear transformation.

Contents:

Solution of the linear System of equation; matrices: definition of matrix; different types of matrices; algebra of matrices adjoint and inverse of a matrix; elementary transformation of matrix; normal and canonical form of matrix; rank and nullity of matrix;

Multiple products of vectors; Differentiation and integration of vectors together with elementary applications; Gradient, divergence and curl of point functions; Various formulae; Definition of line, surface and volume integrals; Green's theorem; Gauss's theorem; Stoke's theorem.

Reference Books:

1) Biswas Suddhendu, *Textbook of Matrix*, published by PHI, 3rd Edition.
2) David A. Harville, *Matrix Algebra: Exercises and Solutions*, published by Springer.
3) Jerrold E. Marsden and Anthony Tromba, *Vector Calculus*, published by W. H. Freeman; 6th edition.
4) Thomas H. Barr, *Vector Calculus*, published by Pearson Education.

BAN 2163	Bangla Language and Literature		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course samples the rich tradition of Bangla literature. It includes both the formal study of literary devices and critical reading of select poems, plays, novels, and short stories. The objective is to underscore the uniqueness and immense varieties of Bangla literature as well as to explore if and how Bangla literature has been influenced by the western and English literature and philosophy.

Outcome:

By the end of this course the learner will be able to:

1. identify and critically analyze key ideas.
2. articulate orally and in writing an understanding of these key ideas and practices.
3. demonstrate an understanding of how theatre texts work in a physical space.
4. facilitate group discussions and demonstrations of the ideas discussed in lectures and critical readings.

Contents:

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Reference Books:

1. K.S. Murshid *(ed.)*, *Literature in Bangladesh: Contemporary Bengali Writing*
2. Dipti Tripathi, *Adhunik Bangla Kabya Parichay*
3. Sajoj Bandopadhaya, Bangla Uponnasher Kalantor

CSE 2103	Java and Socket Programming		3.00

Prerequisite: CSE 1201 Contact Hour: 4 hours/week.

Objective:

This course introduces advanced programming with Java. In this course students will gain an understanding of designing real world applications and use advanced level API's available in java correctly. Another primary objective of this course is to learn the core concepts of networking and techniques of socket based client server programming.

Outcome:

1. Discuss network programming with Java in general, including some of the history and features that Java brings to network programming;
2. Create original programs in Java that demonstrate key concepts of network programming;
3. Create Java network programs that fulfill specific deliverables and provide significant network capability as required to fulfill assignment objectives and deliverables.

Contents:

Inheritance; packages and interfaces; exception handling; multithreaded programming; enumerations, autoboxing and annotations; I/O, Applets and other topics; generics; java library: string handling, java.lang, java.util and java.io; networking; the applet class; event handling; introducing the AWT; AWT controls, layout managers and menus; images; the concurrency utilities; NIO regular expressions and other packages; java beans; introducing swing; exploring swing; Servlets; financial Applets and Servlets; creating a downloaded manager in Java.

Reference Books:

1) Paul Deitel and Harvey Deitel, *JavaTH How to program*, Published by Prentice Hall, 9th Edition.
2) Cay S. Horstmann and Gary Cornell, *Core Java, Volume* 1 & 2, Published by Prentice Hall, 9th Edition.

CSE 2104	Java and Socket Programming Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 2103 using Java Programming Language.

CSE 2201	Numerical Analysis		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of the course is to identify and classify the numerical problem to be solved, to choose the most appropriate numerical method for its solution based on characteristics of the problem and to understand the characteristics of the method to correctly interpret the results.

Outcome:

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems;
2. Apply numerical methods to obtain approximate solutions to mathematical problems;
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations;
4. Analyze and evaluate the accuracy of common numerical methods.

Contents:

Introduction; Solution of Non-linear Equations: Fixed Point Iteration, Bi-Section method, False Position method, Newton-Raphson method, Bairstow's Method; Solution of Linear equations: Triangular systems and back substitution, Gauss-Jordan elimination method, Pivoting, LU-factorization, Cholesky's method, Dolittle and Crout factoriza- tion; Interpolation and Approximation: Taylor's Series, Lagrangian interpolation, Divided differences formula, Newton's forward and backward interpolation, Spline interpolation; Differentiation: Numerical differentiation, Richardson's extrapolation; Integration: Newton's-Cote integration, Trapezoidal rule, Simpson's rule, Romberg's integration; Ordinary Differential Equations: Euler's method, Picard's method, Milne's method, Taylor's series method, Runge-Kutta method; Curve Fitting: Least squares lines, Least square polynomials, Non-linear curve fitting; Numerical Optimization: Golden Ratio search, Newton's search, Powell's method, Gradient search.

Reference Books:

1) Steven Chapra and Raymond Canale, *Numerical Methods for Engineers*, Published by McGraw Hill, 6th Edition.
2) Jaan Kiusalaas, *Numerical Methods in Engineering with Matlab*, Published by Cambridge University Press, 2nd Edition.
3) Santosh K Gupta, *Numerical Methods for Engineers*, Published by New Age International, 2nd Edition.

CSE 2203	Computer Organization and Architecture		3.00

Prerequisite: CSE 2101 Contact Hour: 4 hours/week.

Objective:

This course introduces students to the fundamental concepts underlying modern computer organization and architecture. Students will be familiarized with hardware design including logic design, various functional modules of the computer and how they interact. The objective is to tie the programmer's view of a computer system with the actual hardware and architecture of the underlying machine.

Outcome:

1. Understand the basics of computer hardware and how software interacts with computer hardware;
2. Analyze and evaluate computer performance;
3. Understand computer arithmetic and convert between different number systems;
4. Understand basics of Instruction Set Architecture (ISA) – MIPS;
5. Assemble a simple computer with hardware design including data format, instruction format, instruction set, addressing modes, bus structure, input/output, memory, Arithmetic/Logic unit, control unit, and data, instruction and address flow;
6. Use Boolean algebra as related to designing computer logic, through simple combinational and sequential logic circuits.

Contents:

Information representation; measuring performance; instruction and data access methods: operations and operands of computer hardware, representing instruction, addressing styles; arithmetic logic unit design: arithmetic and logical operations, floating-point operations; processor design: data paths-single cycle and multi cycle implementations; control unit design-hardwired and micro programmed; hazards; exceptions; memory organization: cache memory, virtual memory; channels; DMA and interrupts; buses; parallel processing: overview, importance, architecture, hardware and software issues, parallel programming and parallel algorithms; distributed processing: overview, impact, forms of distributed processing, strategies of distributed data processing, centralization vs. decentralization.

Reference Books:

1) David A Patterson and John L. Hennessy, *Computer Organization and Design – The hardware / software interface*, Published by Morgan Kaufmann, 3rd Edition.
2) William Stallings, *Computer Organization and Architecture Designing for Performance*, Published by Prentice Hall, 8th Edition.
3) John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach*, Published by Morgan Kaufmann, 4th Edition.

CSE 2205	Data Structure and Algorithms II		3.00

Prerequisite: CSE 1101 Contact Hour: 4 hours/week.

Objective:

To know the basics of analyzing the running time of different algorithms, designing and implementing efficient algorithms for solving different classical problems and finally getting an idea of complexity classes to deal with some hard computational problems.

Outcome:

1. Identify fundamental data structures and algorithms and summarize their typical uses, strengths, and weaknesses;
2. Analyze the complexity of algorithms;
3. Solve problems computationally through the application of fundamental data structures and algorithms.

Contents:

Introduction to algorithms; Correctness proof and techniques for analysis of algorithms; Master Theorem; Methods for the design of efficient algorithms: divide and conquer, greedy methods, dynamic programming; Sorting: heap sort, merge sort, quick sort; Graph algorithms: DFS, BFS, Applications of DFS and BFS, MST algorithms, shortest path algorithms, maximum flow and maximum bipartite matching; Lower bound theory; NP-completeness; NP-hard and NP-complete problems; Coping with hardness: backtracking, branch and bound, approximation algorithms; String matching algorithms; FFT and its applications.

Reference Books:

1) Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms*, Published by The MIT Press, 3rd Edition.
2) Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, *Fundamentals of Computer Algorithms*, Published by Galgotia Publications Pvt. Ltd, 2nd Edition.

CSE 2206	**Data Structure and Algorithms II Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 2205 using C/C++/Java programming.

CSE 2210	**Assembly Language Programming**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Objective:

Students will translate a number of small C/C++ programs into assembly language, and learn to trace and debug at the assembly level. They will extend the simple CPU implementation introduced in class to support additional instructions. The knowledge of how C/C++ constructs are translated to execute on hardware, simple hardware operations and interrupt handling are crucial building blocks for the Operating Systems and Computer Architecture courses.

Outcome:

1. Translate C/C++ code into assembly language;
2. Perform simple optimizations by hand;
3. Trace and debug at the assembly level;
4. Understand and extend simple CPU implementations;
5. Understand basic interrupt/exception handling;
6. Make simple performance estimates for assembly code.

Contents:
Instruction set, Instruction types and their formats; Assembly program format; Assembly process; Interrupts and system services; Addressing methods; High level control structure formation; Use of subroutines and macros; Numeric processing and string processing.

Reference Book:

1) Ytha Yu, Charles Marut, *Assembly Language Programming and Organization of the IBM PC*, Published By McGraw Hill International Edition
2) Kip R. Irvine, *Assembly Language for Intel-Based Computers*, Published by Prentice Hall.

ACT 2261	Principles of Accounting		3.00

Prerequisite: None Contact Hour: 4 hours/week.

Objective:
The objective of this course is to develop and understand the nature and purpose of financial statements, develop the ability to use the fundamental accounting equation to analyze the effect of business transactions on an organization's accounting records and financial statements and to be able to use accounting information to be able to solve various business problems.

Outcome:

1. Develop and understand the nature and purpose of financial statements in relationship to decision making;
2. Develop the ability to use the fundamental accounting equation to analyze the effect of business transactions on an organization's accounting records and financial statements;
3. Develop the ability to use a basic accounting system to create (record, classify, and summarize) the data needed to solve a variety of business problems;
4. Develop the ability to use accounting concepts, principles, and frameworks to analyze and effectively communicate information to a variety of audiences;

Contents:

Financial Accounting: Nature of business and accounting; Basic accounting concepts; Accounting as an information system; computerized accounting system; Conceptual framework of accounting; Double entry mechanism; Accounting equation; Introduction to journal accounting; Posting to ledger accounts; Preparing trial balance; Adjusting entries; Preparing an adjusted trial balance; Preparing financial statements; Financial statement analysis and interpretation.
Cost and Management Accounting: Cost concepts, Cost classifications and cost functions; Job order costing & prepare job cost sheet; Cost allocation; Cost volume profit analysis; Variable costing vs absorption costing; Short term investment decision: Relevant & Differential cost analysis; Long-term investment decision: Capital budgeting; Working capital management; Linear programming for management decision.
Reference Books:

1) Jerry J. Weygandt, Paul D. Kimmel and Donald E. Kieso, *Principles of accounting*.

CSE 2301	Microprocessor and Interfacing		3.00

Prerequisite: CSE 2203. Contact Hour: 4 hours/week.

Objective:

This course gives a practical training of interfacing the peripheral devices with the 8086 microprocessor. The course objective is to introduce the basic concepts of microprocessor and real time applications of microprocessor as well as microcontroller. Design of various types of digital and analog interfaces will be studied. The accompanying lab is designed to provide practical hands-on experience with microprocessor software applications and interfacing techniques.

Outcome:

1. Understanding of the Intel 8086/8088 architecture;
2. Knowledge of the 8086/8088 instruction set and ability to utilize it in programming;
3. Ability to interface various devices to the microprocessor;
4. Gain knowledge of various advanced processor architectures such as 80X86, Pentium and Multicore Processors.

Contents:

Introduction to 8-bit, 16-bit, and 32-bit microprocessors: architecture, addressing modes, instruction set, interrupts, multi-tasking and virtual memory; Memory interface; Bus interface; Arithmetic co-processor; Microcontrollers; Integrating microprocessor with interfacing chips; Programmable peripheral interfacing chip with interface to A/D and D/A converters; Keyboard/display interface; Programmable timer; Programmable interrupt controller, DMA controller; Introduction to embedded systems: overview of the design flow, Embedded systems specifications and modeling; Embedded hardware platforms and peripherals; Interfacing to the external world through sensors and actuators.

Reference Books:

1) Md. Rafiquzzaman, *Microprocessor and Microcomputer Based System Design*, Published by CRC Press, 2nd Edition.
2) Douglas Hall, *Microprocessors and Interfacing Programming and Hardware*, Published by McGraw Hill, 3rd Edition.
3) Robert L. Hummel, *PC Magazine Programmer's Technical Reference: The Processor and Coprocessor*, Published by Ziff-Davis Press, Illustrated Edition.

CSE 2302	Microprocessor and Interfacing Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 2301. Experiments will be performed using Microprocessor and Microcontroller.

CSE 2303	Theory of Computation		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective is to introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notations of algorithm, decidability, complexity and

compatibility. Also this course will develop students' ability to understand and conduct mathematical proofs for computation and algorithms.

Outcome:

1. analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars;
2. demonstrate the understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving;
3. prove the basic results of the Theory of Computation;
4. State and explain the relevance of the Church-Turing thesis.

Contents:

Regular languages: regular expressions, non-regular languages; Finite automata: deterministic finite automata, nondeterministic finite automata, equivalence and conversion of deterministic and nondeterministic finite automata, pushdown automata; Context free languages: Context free grammars, ambiguity, Chomsky normal form, pumping lemma; Turing machines: basic machines, configuration, computing with Turing machines, combining Turing machines, Church-Turing thesis, Hilbert's problems; Decidability: Decidable Languages, Undecidability, halting problem, Reducibility; Complexity: Time complexity, class P, class NP, NP-completeness, space complexity, Savitch's theorem.

Reference Books:

1) Michael Sipser, *Introduction to Theory of Computation*, Published by Thomson, 2nd Edition.
2) John C. Martin, *Introduction to Languages and Theory of Computation*, Published by McGraw-Hill, 3rd Edition.

MATH 2361	**Complex Variable and Fourier Transformation**		**3.00**

Prerequisite: MATH 1163 Contact Hour: 4 hours/week.

Objective:

This course covers the theory and application of complex variables and Fourier Transformation. Complex variable begins with the exploration of the algebraic, geometric and topological structures of the complex number field. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced. The notion of the Riemann sheet is presented to help student visualize multi-valued complex functions. Complex integration and complex power series are presented. Fourier transformation includes the Fourier series, and the discrete Fourier transform; those are necessary for analysis signal processing and transmission for storing, Internet and networking.

Outcome:

1. Explain the fundamental concepts of partial differential equations and their role in modern mathematics and applied contexts;
2. Demonstrate accurate and efficient use of Fourier series, complex analysis and integral transform techniques;
3. Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from partial differential equations and complex analysis;
4. Apply problem-solving using Fourier series, complex analysis and integral transform techniques applied to diverse situations in physics, engineering and other mathematical contexts;

5. Explain the use and applications of partial differential equations and/or complex analysis to some topic related to undergraduate study, employment or other experience.

Contents:

Functions of a complex variable; Limits and continuity of functions of complex variable; Complex differentiation and Cauchy- Riemann Equations; Mapping by elementary functions; Line integral of a complex function; Cauchy's Integral Theorem; Cauchy's Integral Formula; Liouville's Theorem; Taylor's Theorem and Laurent's theorem; Singular points; Residue; Cauchy's Residue Theorem; Contour integration; Mapping.

Fourier series; Fourier sine and cosine series, half range Fourier series, Fourier integral, complex form of the Fourier series, Parseval's formula finding Fourier series of various functions; Fourier transformation;

Reference Books:

1. E. Brigham, *Fast Fourier Transformation and Its Applications*, published by Prentice Hall.
2. Leon Ehrenpreis, *Fourier analysis in Several Complex Variables*, published by Dover Publications Inc.
3. Francis J. Flanigan, *Complex Variables*, published by Dover Publications Inc., 1983.
4. Richard A. Silverman, *Introductory Complex Analysis*, published by Dover Publications Inc., 1984.

CSE 2305	Database Management System		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of this course is to familiarize the students with the fundamental concepts of database system both in terms of use and implementation/design. Students will be able to construct simple and advanced database queries using Structured Query Langugage (SQL). They will understand and successfully apply logical database design principles including ER diagrams and database normalization.

Outcome:

1. Understand and evaluate the role of database management systems in information technology applications within organizations;
2. Recognize and use contemporary logical design methods and tools for databases;
3. Derive a physical design for a database from its logical design;
4. Implement a database solution to an information technology problem;
5. Understand the SQL data definition and SQL query languages.

Contents:

Concepts of database systems; Data Models: Entity-Relationship model, Relational model; Query Languages: Relational algebra, SQL; Constraints and triggers; Functional dependencies and normalization; File organization and data storage; Indexing: primary and secondary indexes, B+ trees, hash tables; Query optimization; Transaction management; Recovery; Concurrency control; Access control and security; Semi-structured database: XML, XPath, XQuery; Object oriented and object relational databases; timestamp management; serializability; deadlock handling.

Reference Books:

1) Abraham Silberschartz, Henry F. Korth and S Sudershan, *Database System Concepts*, Published by McGraw-Hill, 5th Edition.

2) Ivan Bayross, *SQL, PL/SQL- The Programming Language of Oracle*, Published by BPB Publications, 3rd Edition.
3) Scott Urman, Ron Hardman and Michael McLaughlin, *Oracle Database 10g PL/SQL Programming*, Published by Tata McGraw-Hill.

CSE 2306	Database Management System Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 2305 using MS-SQL Server, MySQL and Oracle.

CSE 3101	System Analysis and Design		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

System Analysis and Design refers to the process of examining a business situation with the intent of improving it through better procedures and methods. System analysis and design relates to shaping organizations, improving performance and achieving objectives for profitability and growth. The emphasis is on systems in action, the relationships among subsystems and their contribution to meeting a common goal. Looking at a system and determining how adequately it functions, the changes to be made and the quality of the output are parts of system analysis.

Outcome:

1. Gather data to analyze and specify the requirements of a system;
2. Design system components and environments;
3. Build general and detailed models that assist programmers in implementing a system;
4. Design a database for storing data and a user interface for data input and output, as well as controls to protect the system and its data.

Contents:

System analysis fundamentals: systems, roles, and development methodologies; Understanding and modeling organizational system; Project management; Information requirements analysis: Interactive methods; Information gathering: Unobtrusive methods; agile modeling and prototyping; The analysis process: Using data flow diagrams; Analyzing systems using data dictionaries; Process specifications and structured decisions; Object oriented systems analysis and design using UML; The essentials of design: Designing effective output, Designing effective input; Designing databases; Human-computer interaction; Quality assurance and implementation: Designing accurate data entry procedures; Quality assurance and implementation.

Reference Books:

1) Elias M. Awad, *Systems Analysis and Design*, Published by Galgotia Publications Pvt Ltd, 2nd Edition.
2) I. T. Hawryszkiewycz, *Introduction to Systems Analysis and Design*, Published by Prentice Hallof India, 3rd Edition.

CSE 3102	System Analysis and Design Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3101 and design of a real life full-phase customized system.

CSE 3103	Compiler		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Compiler is an introductory course on the basic concepts of language translation and principles of compiler design. This course is intended to introduce students to the theory and tools that can be used to perform a grammar-oriented translation of a high level programming language into an executable code. The techniques and tools can also be employed in wider area of application that requires a grammar-oriented analysis and transformation.

Outcome:

1. Specify and analyze the lexical, syntactic and semantic structures of advanced language features;
2. Separate the lexical, syntactic and semantic analysis into meaningful phases for a compiler to undertake language translation;
3. Write a scanner, parser, and semantic analyzer without the aid of automatic generators;
4. Turn fully processed source code for a novel language into machine code for a novel computer;
5. Describe techniques for intermediate code and machine code optimization.

Contents:

Basic issues, compiler structure, front end, back end; Lexical analysis: Tokens, patterns, and lexemes, input buffering, transition diagrams, lexical-analyzer generator; Syntax analysis: Elimination of left recursion, left factoring, FIRST and FOLLOW, LL(1) grammars, nonrecursive predictive parsing, parser generators; Syntax-directed translation: Syntax- directed definitions, inherited and synthesized attributes, dependency graphs, syntax-directed translation schemes; Semantic analysis: Type expressions, type equivalence, type-checking; Run-time environments: Storage organization, static versus dynamic storage allocation, activation trees, activation records; Intermediate code generation: Directed acyclic graphs for expressions, three-address code, quadruples, triples, static single-assignment form; Code generation; Code optimization: Basic blocks and flow graphs, next-use information, optimization of basic blocks.

Reference Books:

1) Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman, *Compilers- Principles, Techniques and Tools*, Published by Addison Waesley Longman Inc, 2nd Edition.

CSE 3104	Compiler Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3103 using C/C++/Java programming language.

CSE 3105	Data Communication		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course discusses the evolution of early networks and the Internet. This also demonstrates the ability to use effectively a range of common networked applications including e-mail, telnet, FTP, and web browsers, online web courses, and instant messaging. Emerging technologies in the net-centric computing area and assess their current capabilities, limitations, and near-term potential are also addressed in this course.

Outcome:

1. Understand the fundamental concepts of data communications and networking;
2. Identify different components and their respective roles in a computer communication system;
3. Apply the knowledge, concepts and terms related to data communication and networking;
4. Solve problems in networking by referring to problems solving steps through relevant information by choosing suitable techniques.

Contents:

Introduction to signals; Review of Fourier Transform; Frequency Response of Linear Systems; Analog Modulation: AM, DSB-SC, SSB- SC, VSB, FM, PM; Introduction to digital data communication; Sampling theorem; Quantization; Pulse modulation: PAM, PDM, PPM, PCM, delta modulation, differential PCM; Intersymbol interference; Pulse shaping; Line coding; Digital modulation: ASK, FSK, BPSK, QPSK, Offset QPSK, 4-shifted QPSK, MSK, GMSK, QAM; Multiple access techniques: TDM, FDM; Random processes; Additive White Gaussian Noise (AWGN); Error rate due to noise; Introduction to information theory; Concept of channel coding and capacity.

Reference Books:

1) Behrouz A. Forouzan, *Data Communications and Networking*, 4th Edition.
2) William Stallings, *Data and Computer Communications*, Published by Pearson, 8th Edition.

CSE 3107	Information System Management		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The main objective of this course is to provide students with an overall understanding of the main concepts of information systems, and to highlight the importance of information systems in modern organizations and societies.

Outcome:

1. Explain complex software within the context of business user needs through training presentations and written documentation;
2. Distinguish relationships between programming languages and information systems;
3. Analyze existing systems and design technology solutions appropriate to the goals of an organization;
4. Explain the various roles information systems have toward advancing strategic goals and the operational success of an organization.

Contents:
Information systems management: importance of information systems (IS) management; IS management's leadership role; strategic uses of IT; IS planning; managing essential technologies: distributed systems; managing telecommunications; managing information resources; and managing operations; managing system development: technologies for developing systems and management issues in system development; systems for supporting knowledge work: supporting decision making; collaboration, and knowledge works; acquisition of hardware, software, networks, and services: request for proposal, acquisition methods (buy, rent, or lease), software acquisition, and analysis of alternatives; people and technology: the challenges ahead.

Reference Books:
1. B. C. McNurlin and R. H. Jr. Sprague, *Information Systems Management in Practice*, Published by Prentice-Hall, 7th Edition.
2. Keri E. Pearlson and Carol S. Saunders, *Managing and Using Information Systems: A Strategic Approach*, published by Wiley, 5th Edition.

CSE 3201	**Computer Network**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
To achieve skills in network programming through development of distributed applications using the socket interface to TCP and UDP. Understanding the application layer protocol HTTP (used by the World Wide Web) and web-based programming and the layered design of computer networks and the key concepts at the application layer through the link layer are also considered in this course.

Outcome:
1. Describe the basis and structure of an abstract layered protocol model;
2. Describe, analyze and compare a number of datalink, network, and transport layer protocols;
3. Design and implement datalink or network layer protocols within a simulated networking environment;
4. Describe and analyze various related technical, administrative and social aspects of specific computer network protocols from standards documents and other primary materials found through research;
5. Identify and apply basic theorems and formulae for the information-theoretic basis of communication and the performance of physical, datalink and network protocols.

Contents:

Introduction to Computer Networks; Protocol hierarchies; Data link control: Link layer and services; Error Detection and Correction; Multiple access protocol: Standards IEEE 802.*; Hubs, Bridges, and Switches, Fast Ethernet; Routing architecture and algorithms; IPV4, IPV6, ARP, RARP; Introduction to transport layer: UDP,TCP; Principles of Reliable data transfer, Principles of congestion control, TCP, Congestion control; Application layer services: Web, HTTP, FTP, SMTP, DNS architecture; Network security: Cryptography, DES, public key algorithm; Authentication; Digital signatures.

Reference Books:
1) James Kurose and Keith Ross, Computer Networking: A Top-Down Approach, Published by Addison-Wesley, 6th Edition.
2) Andrew S. Tanenbaum and David J. Wetheral, Computer Networks, Published by Prentice Hall, 5th Edition.

CSE 3202	Computer Network Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3201.

CSE 3203	Operating System		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Describe the functions of the major components of an operating system. Compare and contrast alternative possible implementations for some of these components and analyze the performance of components Understanding the system call interface and the key concepts in the design of an operating system kernel.

Outcome:

1. Describe how computing resources (such as CPU and memory) are managed by the operating system; describe the basic principles used in the design of modern operating systems;
2. Summarize the full range of considerations in the design of file systems, summaries techniques for achieving synchronization in an operation system;
3. Explain the objective and functions of modern operating systems, explain memory hierarchy and cost-performance trade-offs, explain the operation, implementation and performance of modern operating systems, and the relative merits and suitability of each for complex user applications;
4. Compare and contrast the common algorithms used for both pre-emptive and non-pre-emptive scheduling of tasks in operating systems, such a priority, performance comparison, and fair-share schemes. Contrast kernel and user mode in an operating system.

Contents:

Operating system: its role in computer systems; multitasking, multiuser, multiprocessing OS; Operating system structures; Process: process concept and scheduling, inter-process communication, communication in client-server systems; CPU scheduling: scheduling criteria and algorithms, thread scheduling, multiple-processor scheduling; Process synchronization: critical-section problem, semaphores, monitors; Deadlock: resource allocation and deadlock, deadlock detection, prevention and recovery; Memory management: swapping, paging, segmentation, virtual memory; Input/ Output: hardware, software, disk, terminals, clocks; File Systems: files, directories, security, protection; Case study of some operating systems.

Reference Books:

1) A. Silberschart, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, Published by Willey, 6th Edition.
2) Andrew S. Tanenbaum, *Modern Operating Systems*, Published by Pearson, 3rd Edition.

CSE 3204	Operating System Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3203 in Linux environment and using Linux scripts. Introduction to the UNIX Operating System; The Directory Structure; Unix Communications; Utilities and Filters; I/O redirection; controlling child processes; C-shell programming; Bourne shell programming; The emacs editor; Stream Editing; System Administration.

Reference Books:

1) Graham Glass and King Ables, *UNIX for Programmers and Users*, Published by Pearson, 3rd Edition.

CSE 3205	Applied Statistics and Queuing Theory		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The course concentrates on probability theory, statistical methods and the introductory mathematics to facilitate the analysis of algorithms and advanced computer programming. The objective of this course is to introduce students to a collection of mathematical tools, which will help to deal with the randomness or stochasticity of many technological operations, controlled manipulation of mathematical formulas and a set of techniques for solving problems.

Outcome:

1. Define and explain basic concepts in descriptive statistics and probability theory
2. Solve some standard problems that include random variables
3. Construct a confidence interval to estimate a population mean
4. Define and explain basic concepts in the theory Markov processes, M/M/m, M/M/m/K and M/M/m/K/C queuing systems
5. Derive and apply main formulas for some properties (such as stationary probabilities, average waiting and system time, expected number of customers in the queue, etc.) of M/M/m, M/M/m/K and M/M/m/K/C queuing systems.

Contents:

Recurrent problems; Manipulation of sums; Integer functions; Number theory; Binomial coefficient; Special numbers; Generating functions; Combinatorial game theory; Introduction to probability theory, expectation; Random variables; Conditional Probability and Conditional Expectation; Stochastic process; Markov chains: discrete parameter, continuous parameter, birth-death process; Queuing models: birth-death model, Markovian model, open and closed queuing network; Application of queuing models.

Reference Books:

1) Sheldon M. Ross, *Introduction to Probability Models*, Published by Elsevier, 9th Edition.
2) Ronald L. Graham, Donald E. Knuth and Oren Patashnik, *Concrete Mathematics*, Published by Addison-Wesley, 2nd Edition.

CSE 3207	Cyber Crime and Security		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Main objectives of this course are understanding security concepts, Ethics in Network Security, understanding security threats, and the security services and mechanisms to counter them, comprehending and apply relevant cryptographic techniques, comprehending security services and mechanisms in the network protocol stack, comprehending and apply authentication services and mechanisms, comprehending and apply relevant protocol like SSL, SSH, comprehending and apply email security services and mechanisms, comprehending and apply web security services and mechanisms, comprehending computer and network access control.

Outcome:

1. The importance of taking a multi-disciplinary approach to cyber security;
2. The cyber threat landscape, both in terms of recent emergent issues and those issues which recur over time;
3. The roles ad influences of governments, commercial and other organizations, citizens and criminals in cyber security affairs;
4. General principles and strategies that can be applied to systems to make them more robust to attack;
5. Key factors in cyber security from different disciplinary views including computer science, management, law, criminology and social sciences;
6. Issues surrounding privacy, anonymity and pervasive passive monitoring

Contents:

Remote access technologies and vulnerabilities; accessibility; Fundamentals on security and cryptography; security standards: data encryption standard (DES), RSA, digital signature algorithm (DSA), SHA, SSL, secure sockets layer(SSL), CBC, IPSec, AES and SET; distributed denial of service (DDOS) attacks; security for communication protocols; security for operating systems and mobile programs; security for electronic commerce, passwords and offline attacks; network security applications: authentication, e-mail, IP and web; system security: intruders, malicious software and firewalls; PKI smart cards, secure multipurpose internet mail extensions; viruses and spy ware; security models; wireless security, sandboxing, router security strategies and network security assessment.

Reference Books:

1) William Stallings, *Network Security Essentials Applications and Standards*, published by Prentice Hall, 5th Edition.
2) Eric Cole, *Network Security Bible*, published by Wiley.

CSE 3301	Programming for Mobile Devices		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

This course has been developed to help the student make that step into building commercial mobile Apps a reality. This course will focus on building mobile web apps, which will work across multiple platforms including Android, iOS, and/or others. This course has a technical focus and develops an in-depth expertise of core technical disciplines such as designing, developing and testing software solutions for mobile platforms. After completing this course, the student will understand what it takes to build professional Apps for mobile devices while gaining experience and knowledge in using platforms and tools such as Objective-C Interface Builder for Apple, Java and Eclipse for Android combined with SDK and 3rd party libraries such as PhoneGap and Jquery Mobile. The student will be provided with practical and relevant hands-on tutorials combined with

modern approaches to building commercial mobile apps, including invaluable insights into the mobile app development industry. They will also be given the opportunity to utilize and develop these skills through appropriate practical work and be able to apply these skills and knowledge to their own development projects in the future.

On completion of this course, the students will gain practical knowledge in hardware interfaces for mobile devices, UML for mobile applications design, XML for Mobile Computing, building mobile apps using HTML5, implementing JQuery mobile, working with Phonegap to develop mobile apps, building iOS applications using Objective-C, iOS SDK, Android app development using Eclipse and Android SDK.

CSE 3302	**Programming for Mobile Devices Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3301. Students will develop mobile applications in groups.

CSE 3303	**Computer Graphics**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course intends to develop the basic concepts of computer graphics including 2D and 3D graphics. Moreover, the goal is to teach the students about different algorithms, modeling, illumination and application in rendering different scenario.

Outcome:

1. Know and be able to describe the general software architecture of programs that use 3D computer graphics;
2. Know and be able to discuss hardware system architecture for computer graphics. This includes, but is not limited to: graphics pipeline, frame buffers, and graphic accelerators/co-processors;
3. Know and be able to use a current 3D graphics API (e.g., OpenGL or DirectX);
4. Know and be able to select among models for lighting/shading: Color, ambient light; distant and light with sources; Phong reflection model; and shading (flat, smooth, Gourand, Phong);
5. Know and be able to use and select among current models for surfaces (e.g., geometric; polygonal; hierarchical; mesh; curves, splines, and NURBS; particle.

Contents:

Basics of computer graphics and its applications; Raster graphics: images and colors; 3D rasterization pipeline; 3D modeling: parametric curves and surfaces using B-spline and Bezier curves and surfaces, polygonal meshes, subdivision surfaces, BSP trees, voxels, sweeps, fractals; Scene graphs; Transformations: modeling, viewing, projection, and viewport transformations; 3D rendering; Visible surface detection and hidden surface removal methods: back-face detection, depth buffer method, depth-sorting method, BSP trees method, ray casting methods; Direct illumination; Global illumination: shadows, ray tracing, and radiosity; Shading and textures; Scan conversion and clipping; Computer animation: kinematics, motion capture, and dynamics-passive and active; Application development using OpenGL.

Reference Books:

1) Roy A. Plastock and Gordon Kalley, *Schaum's Outline of Theory and Problems of Computer Graphics*, published by McGraw-Hill, 2nd Edition.
2) Foley and VanDam, *Computer Graphics Principles and Practice*, Published by Pearson, 2nd Edition.

CSE 3304	Computer Graphics Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 3303 using OpenGL and C/C++/Java programming language.

Reference Books:

1) Dave Shreiner, Mason Woo, Jackie Neider and Tom Davis, OpenGL Programming Guide, Published by Addison-Wesley, 2nd Edition.

CSE 3305	Software Engineering		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Understand the software life cycle. Be able to elicit requirements from clients and specify those requirements. Be able to perform detail software design activities. Have practical experience using UML.

Outcome:

1. Manage object-oriented and classical software construction projects including planning, scheduling, and risk assessment/management;
2. Author software requirement documents with the appropriate content;
3. Author formal specifications for software systems;
4. Demonstrate proficiency in rapid software development techniques;
5. Identify specific components of a software design that can be targeted for reuse;
6. Demonstrate proficiency in software development cost estimation.

Contents:

Concepts of software engineering: software engineering paradigms, different phases of software system development, different types of information, qualities of information; Project management concepts: software process and project metrics, software project planning, risk analysis and management, project scheduling and tracking, software cost analysis, COCOMO model; Analysis concepts and principles: requirement analysis, analysis modeling, data modeling; Design concepts and principles: architectural design, user interface design, object oriented software development and design, iterative development and the unified process, sequential waterfall life cycles, use case model for requirement writing, elaboration using system sequence diagram, domain model, visualizing concept classes; UML diagrams: Interaction and Collaboration Diagram for designing Software, class diagram; GoF design patterns: adapter, factory, singleton, strategy, composite, facade, and observer; Content management systems: concepts, planning and developing dynamic web content sites; Software testing: white box and black box testing, basis path testing, testing for specialized environment; Software testing strategies: unit testing, integration testing, validation testing, system testing; Art of debugging; Analysis of system maintenance and upgrading: software repair, downtime, error and faults, specification and correction, maintenance cost models, documentation; Software quality assurance: quality factors. Software quality measures, cost impact of software defects, concepts of software reliability, availability and safety, function based metrics and bang metrics, metrics for analysis and design model, metrics for source code, testing and maintenance.

Reference Books:

1) Roger S. Pressman, *Software Engineering: A Practitioner's Approach*, Published by McGraw Hill, 6th Edition.
2) Ian Sommerville, *Software Engineering*, Published by Pearson, 8th Edition.
3) David Gustafson, *Schaum's Outline of Software Engineering*, Published by McGraw Hill, 2nd Edition.

CSE 3306	Software Engineering Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on requirement discovery and analysis, software design, report writing on software design and other features of CSE 3305.

CSE 4000	Project and Thesis		6.00

Prerequisite: Completion of 108 CH Contact Hour: 4×4 hours/week.

A student must complete the required credit hour thesis and/or research project. The student can apply for registering his/her thesis after completion of minimum 108 credit hours. The duration of performing thesis is 12 months. No more than two students can work together in a thesis work under the supervision of a supervisor. No one outside the thesis group can be involved into the research work otherwise permitted by the supervisor. Any work performed for any reason not included within the academic curriculum cannot be allowed or submitted as their thesis work.

CSE 4101	Artificial Intelligence		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

To provide with understanding of the role of Artificial Intelligence, Expert Systems and Decision Models in real life scenario. Develop abilities to apply, build and modify decision models to solve real problems. Explore the issues involved in the design and development of Artificial Intelligence Based Decision Support Systems and discuss the role these systems play in the business environment. Gain an in-Depth Knowledge of a particular type of Artificial Intelligence Technique, namely Genetic Algorithms. Gain the knowledge to build a prototype Artificial Intelligence Based Decision Support System.

Outcome:

1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem;
2. Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, etc);
3. Implement basic AI algorithms (e.g., standard search or constraint propagation algorithms);
4. Design and perform an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.

Contents:
Introduction to old and new AI techniques; Search techniques in AI; Constraint satisfaction problems; Game playing; Knowledge representation and reasoning; Propositional and first order logic, inference in first order logic; Planning; Probabilistic reasoning; Learning in symbolic and non- symbolic representation; Expert systems and knowledge engineering; Natural language processing; Computer vision and image understanding.

Reference Books:

1) Start J Rusell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, Published by Prentice Hall, 2nd Edition.
2) Elaine Rich and Kevin Knight, *Artificial Intelligence*, Published by McGraw Hill, 2nd Edition.

CSE 4102	**Artificial Intelligence Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4101.

CSE 4200	**Web Based Software Development**		**2.00**

Prerequisite: None. Contact Hour: 4 hours/week.

The course covers construction and design of dynamic web pages. The emphasis lies on standardized HTML and CSS to create structure and appearance. The course also covers basic JavaScript to create a dynamic behavior on web sites, basic version control, the basics of JQuery and Ajax. Other parts that are covered are availability, responsive design and validation of web pages.

CSE 4202	**Technical Writing**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Objective:

To give students an overview on basic business and research articles. The more emphasize will be given on technical report writing and communication skills.

Outcome:

1. Understand and know how to follow the stages of the writing process (prewriting/writing/rewriting) and apply them to technical and workplace writing tasks;
2. Be able to produce a set of documents related to technology and writing in the workplace and will have improved their ability to write clearly and accurately;
3. Understand the basic components of definitions, descriptions, process explanations, and other common forms of technical writing;
4. Be familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation;
5. Be able to read, understand, and interpret material on technology;

6. Have an appreciation for some of the ideas, issues, and problems involved in writing about technology and in workplace writing.

Contents:

Purposes and types of writing; mechanics of writing; basic grammar, effective paragraph and essay writing; writing personal letters, official and business letters (including sales letter, claim and adjustment letter, recommendation letter, etc); report writing (progress report, study report, etc).

Reference Books:

1) S. D. Sharma, *A Textbook of Scientific and Technical Communication Writing for Engineers and Professionals*, published by Sarup & Sons.
2) Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, published by OUP India, 2nd Edition.

CSE 4203	Professionalism and Ethics		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course is intended to contribute to the ethical development of the professional. Issues pertaining to legal responsibilities, professional ethical standards and general professional conduct in contemporary society are considered. This course is intended to acquaint the participant with the content of the Code of Ethics of the AAMFT, the process of ethical decisional making and, hence, to contribute to the overall ethical development of the professional. Issues pertaining to legal responsibilities and liabilities, professional ethical standards and general professional conduct in contemporary society will be considered.

Outcome:

1. Be able to distinguish among morals, values, ethics, and the law and to explore how they each impacts professional practice;
2. Have an increased personal understanding of issues related to ethics and the law with professional environment;
3. Be able to examine one's own ethical decision-making processes and develop guidelines for enhancing one's ability to generate ethical behaviors and solutions to conflicts arising in the service.

Contents:

Relationship between business and society; Ethics and Capitalism; Identifying stakeholders and issues Stakeholder Relations and Analysis; Ethical reasoning; Regulating Business Ownership and Governance of Corporation; Ethics in the Workplace and Marketplace; ethics of other professions; Ethics of several major professions: Business Ethics, Media Ethics, Police Ethics, Medical Ethics, Legal Ethics, and Research Ethics; Nature of a profession; Professional codes of ethics; Confidentiality; Whistle-blowing; Responsibility of business to the environment; Uses and abuses of human research, and animal ethics in research.

Reference Books:

1) John Rowan & Samuel Zinaich. *Ethics for the Professions.* Jnr. Wadsworth. 2003.
2) *Professionalism and Ethics – Custom*. McGraw-Hill.

CSE 4300	Industrial Training		2.00

Prerequisite: None. Contact Hour: 4 hours/week.

The purpose of Industrial Training is to expose students to real work of environment experience and at the same time, to gain the knowledge through hands on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. Moreover, this practical training program allows students to relate theoretical knowledge with its application in the manufacturing/development industry.

The objectives of industrial training are:

1. To provide students the opportunity to test their interest in a particular career before permanent commitments are made;
2. To develop skills in the application of theory to practical work situations;
3. To develop skills and techniques directly applicable to their careers;
4. To increase a student's sense of responsibility and good work habits;
5. To expose students to real work environment experience gain knowledge in writing report in technical works/projects;
6. To increase student earning potential upon graduation;
7. To build the strength, teamwork spirit and self-confidence in students life;
8. To enhance the ability to improve students creativity skills and sharing ideas;
9. To build a good communication skill with group of workers and to learn proper behavior of corporate life in industrial sector;
10. To instill with good moral values such as responsibility, commitment and trustworthy among the students during their training.

Option –I

CSE 4401	IT Entrepreneurship Development		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Today's business world demands both sharp technical skills and broad business insight. IT Entrepreneurship Development course offers a balanced mix of thinking and hands-on approaches, with plenty of room for entrepreneurial creativity.

Outcome:

1. Demonstrate a fundamental comprehension of business opportunity evaluation, from the perspective of a prospective investor;
2. Identify the most recognized sources of potential funding and financing for business start-ups and/or expansion;
3. Demonstrate extemporaneous speaking skills developed through in-class discussion of text materials, case study analyses, and current entrepreneurship-related issues.

Contents:

Concept of entrepreneurship, need of entrepreneurship, origin and development of entrepreneurship; govt. agencies promoting entrepreneurship; entrepreneur development program, self-employment programs, the entrepreneurial development perspective; creating entrepreneurial venture; entrepreneurship development and government; project management; why do entrepreneurs fail – elaboration on solutions for the problems; infrastructure and logistics; business support; procedures; marketing; IT industry; legal and regulatory framework; productive sectors; decision making and the political economy of information technology; national

information and communication infrastructure policies and plans; the wireless revolution and universal access; emergence of VoIP; legal regime that foster development of IT business; the role of the private sector in general and the business sector in particular in closing the digital divide; telecommunications development strategy; cyber cafe; digital business ecosystems; the law and digital business ecosystems; Internet telephony − the regulatory issues; developments and challenges in the protection of intellectual property rights.

Reference Books:

1) Donald F. Kuratko, *Entrepreneurship: Theory, Process and Practice*, published by Cengage Learning.
2) Fang Zhao, *Information Technology Entrepreneurship and Innovation*, published by Information Science Reference.

CSE 4403	E-Commerce and E-Governance	3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course provides the students the fundamental knowledge on e-commerce and e-business. E-commerce is the system that allows selling and buying something via electronic means. E-business consists of the exchange of data to facilitate the financing and payment aspects of business transactions. This is an effective and efficient way of communicating within an organization and one of the most effective and useful ways of conducting business.

Outcome:

1. Recognize the impact of Information and Communication technologies, especially of the Internet in business operations
2. Recognize the fundamental principles of e-Commerce and e-Governance
3. Use tools and services of the internet in the development of a virtual e-commerce site.

Contents:

Vision and mission of e-Government; status affecting e-Government development; Principles of e-Government strategy; current issues and trends in e-government; ways the Internet can improve government's responsiveness; identifying career requirements for e-government services; web site management; implications of public private partnerships;e-Government policy frameworks; development of portal architecture;key e-government practices; citizen centric web design; e-government legal/social drivers; e-Government policy issues; the management of strategy and projects; data security; quality assurance; political challenges and ethical challenges; security issues and the need for a certification authority; delivery channels and service delivery; capacity building and business process re-engineering; e-Government service branding and communications strategy; e-Government financing; comparative case study of e-Government implementation and programme structures; unicode and ICT in local languages; issues in transliteration and natural language translation; records management; service oriented architecture; IT workforce; concepts in bridging the digital divide; working with donors; models of public-private partnerships (PPP); application scenarios for G2G, G2B and G2C; emergence of new e-sectors such as e-Health, e-Water & e-Tourism; ICT for democracy and development; transparency and right to information; proprietary vs. open source software; e-literacy and illiteracy; Categories of e-Business (b2b, b2c, b2a etc); electronic markets; electronic data interchange; internet commerce; e-Business planning; business and operational aspects of e-Business; data warehousing, data mining and intelligent agents; electronic payment; cryptography techniques for payment systems; systems based on credit cards; electronic checks; electronic cash payment systems; micro payments.

Reference Books:

1) Dave Chaffey, *E-Business and E-Commerce Management: Strategy, Implementation and Practice*, published by Prentice Hall, 5th Edition.

2) Efraim Turban, David King and Judy Lang, *Introduction to Electronic Commerce*, published by Prentice Hall, 3rd Edition.

CSE 4405	IT Laws, Regulations and Ethics		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The main objective of this course is to educate the prospective IT professionals regarding laws, regulations and security. The laws and regulations aim to ensure transparency in online transactions. The seller needs to provide the consumer with necessary information such as terms and conditions and fine as well as give them the right to cancel their order within a specified time. A security wake-up call for companies conducting business over the Internet will be the wave of the future, provided businesses can allay consumer fears about security. This course addresses the essential elements of safe electronic commerce and electronic businesses over the Internet.

Outcome:

1. Students identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional;
2. Students locate and apply case law and common law to current legal dilemmas in the technology field;
3. Students demonstrate leadership and teamwork.

Contents:

The legal and social environment of E-commerce; uniform commercial code; Validity and enforceability of electronic agreements; evidentiary problems; privacy, consumer rights; copyright and trademark laws; laws which affect online buying and purchasing; law enforcement; evidence collection and preservation; customer security; digital signatures and certificates; digital signature laws; secure socket layers, PCI, SET, firewalls and Kerberos; secure transactions; computer monitoring; corporate e-mail privacy, computer crimes security for Internet trading, security tools; non repudiation services.

Reference Books:

1) Paul Todd, *E-Commerce Law*, published by Routledge-Cavendish.
2) Jane P. Mallor, *Business Law: The Ethical, Global and E-Commerce Environment*, published by Irwin/McGraw Hill, 13th Edition.
3) Anup K. Ghosh, *E-Commerce Security: Weak Links, Best Defenses*, published by Wiley.

CSE 4407	Software Testing and Quality Assurance		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course enables students understanding credible resources verified through methodological software engineering processes. The students are to be able to test techniques, measures, and processes.

Outcome:

1. Apply modern software testing processes in relation to software development and project management;

2. Create test strategies and plans, design test cases, prioritize and execute them;
3. Manage incidents and risks within a project;
4. To gain expertise in designing, implementation and development of computer based systems and IT processes.

Contents:

Testing in the lifecycle; testing objectives; the fundamental test process; testing and risk; test policy, test strategy, test plans; entry and exit criteria; estimating techniques; test monitoring; incident management process; fundamentals of test analysis; test environment requirements; selection of techniques; coverage measures; test cases; levels of testing - unit testing, integration testing, system testing, acceptance testing, alpha testing and beta testing, static vs. dynamic testing, manual vs. automatic testing, testers workbench; different types of testing - installation testing, usability testing, regression testing, performance testing, load testing, stress testing, security testing; static and dynamic testing; black box and white box testing; structural testing; reliability assessment; reliability assessment; testing real time system; testing documentation; test reports; test estimation; test monitoring and control; test technique, test type and test coverage selection; test tool selection and implementation; foundations of software project management; organization structure and staffing; motivation, authority and influence; conflict management; proposal preparation; a large engineering software system management; client management; managing software project teams; project planning and scheduling; risk management; configuration management; pricing estimation and cost control; quality assurance and accreditation; factors affecting software quality; software quality assurance plans; business context and legal issues for software projects; software measurement: testing, upgrading and maintenance; network systems; and international project management.

Reference Books:

1) SagarNaik and PiyuTripathy, *Software Testing and Quality Assurance: Theory and Practice*, published by Wiley- Spektrum.
2) Ron Patton, *Software Testing*, published by Sams Publishing.

CSE 4409	Software Project Management		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

This course enables students to learn the discipline of planning, organizing, motivating, and controlling resources to achieve specific goals from beginning and ending. The project management is to bring about beneficial change or added value repetitive, permanent, or semi-permanent functional activities to produce products or services, which requires the development of distinct technical skills and management strategies.

Outcome:

1. Problem Solving and Critical Thinking (PS&CT);
2. Communication and Interpersonal Skills (C&IS);
3. Ethical and Professional Responsibilities (E&PR).

Contents:

Foundations of software project management; organization structure and staffing; motivation, authority and influence; conflict management; proposal preparation; a large engineering software system management; client management; managing software project teams; project planning and scheduling; risk management; configuration management; pricing estimation and cost control; quality assurance and accreditation; factors affecting software quality; software quality assurance plans; business context and legal issues for software projects; software measurement: testing, upgrading and maintenance; network systems; and international project management.

Reference Books:

1) Murali K. Chemuturi and Thomas M. Cagley Jr., *Mastering Software Project Management: Best Practices, Tools and Techniques*, published by J. Ross Publishing.
2) Andrew Stellman and Jennifer Greene, *Applied Software Project Management*, published by O'Reilly Media.

CSE 4411	Basic Graph Theory		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of this course is to learn the theorems and properties of graphs and to model and solve real life problems using graph theory.

Outcome:

1. Write precise and accurate mathematical definitions of objects in graph theory;
2. Use mathematical definitions to identify and construct examples and to distinguish examples from non-examples;
3. Validate and critically assess a mathematical proof;
4. Use a combination of theoretical knowledge and independent mathematical thinking in creative investigation of questions in graph theory.

Contents:

Graphs and simple graphs, digraphs, subgraphs, vertex-degrees, walks, paths and cycles; Trees, spanning trees in graphs, distance in graphs; Complementary graphs, cut-vertices, bridges and blocks, k-connected graphs; Euler tours, Hamiltonian cycles, Chinese Postman Problem, Travelling Salesman Problem; Chromatic number, Chromatic polynomials, Chromatic index, Vizing's theorem, planar graphs, perfect graphs.

Reference Books:

1) NarsinghDeo, *Graph Thoery with Applications to Engineering and Computer Science*, Published by Prentice-Hall of India Pvt Ltd.
2) Douglas B. West, *Introduction to Graph Theory*, Published by Pearson, 2nd Edition

CSE 4413	Fault Tolerant System		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objectives of this course is to create understanding of the fundamental concepts of fault-tolerance**,** learn basic techniques for achieving fault-tolerance in electronic, communication and software systems, to develop skills in modeling and evaluating fault-tolerant architectures in terms of reliability, availability and safety to gain knowledge in sources of faults and means for their prevention and forecasting to understand merits and limitations of fault-tolerant design

Outcome:

1. Enumerate the need and necessity to consider fault-tolerant design in digital systems.
2. Explain vividly, the various techniques for fault modeling and tests generation.
3. Determine the various forms of redundancy for enhancing reliability of digital systems.

4. Evaluate reliability of systems with permanent and temporary faults.

Contents:

This course addresses design, modeling, analysis, and integration of hardware and software to achieve dependable computing systems employing on-line fault-tolerance. It covers the concepts and terminologies of Fault-Tolerant System Design including: Reliability, Dependability, Maintainability, Redundancy, Error Detection, Damage Confinement, Error Recovery, Fault Treatment, Redundancy Management, Voting, Information Redundancy, Random Variables, cdf, pdf, Expectation, Bathtub Curve, MTTF, Reliability of Series/Parallel Systems, Stand-by Redundancy, M-of-N System, Reliability Block Diagrams, Fault Trees, Markov Process, Petri Nets, General Stochastic Petri Nets, Recovery Strategies, Roll-back Recovery, Agreement and Consensus, Byzantine Clock Synchronization, RAID, Fail-Stop Processes, Systems Diagnosis, Case studies. I always change the material slightly to account for interesting changes in the field.

Reference Books:

1) I. Koren and C. Mani Krishna, *Fault-tolerant Systems*, 1st edition, 2007, Morgan Kaufmann.
2) D. P. Siewiorek and R. S. Swarz, *Reliable Computer Systems - Design and Evaluation*, 3rd edition, 1998, A.K. Peters, Limited.
3) D. K. Pradhan, ed., *Fault Tolerant Computer System Design*, 1st edition, 1996, Prentice-Hall.

CSE 4415	**Basic Multimedia Theory**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Students undertaking this course develop strong practical skills which are to be enhanced through the study of the critical elements of multimedia and communication theory, research and project development and professional practice. The teaching and coursework aims to heighten experiential learning, team and group work, understanding of the relevant communication and multimedia theories and applications, as well as critical approaches to research and design and project management.

Outcome:

1. Learn concepts of Multimedia Systems, Text, Audio Text and Audio tools, MIDI Image and Video Image , synchronization accuracy specification factors;
2. Be able to differentiate among various storage models and Access Techniques of Multimedia devices;
3. Gain knowledge of Image segmentation and video segmentation;
4. Learn about Document Architecture, Content Management and the application of multimedia.

Contents:

Overview of multimedia systems; multimedia storage; data compression techniques for audio and video; synchronization; multimedia networking and protocols; QOS principles; multimedia coding and streaming; mobile multimedia communications; operating system support for multimedia; hypermedia system; standards for multimedia; multimedia database and multimedia applications, required hardware and communication supports for multimedia applications; application-specific multimedia signal processing and communications.

Reference Books:

1) Suzanne Weixel, *Multimedia Basics*, published by Cengage Learning.
2) Richard E. Mayer, *Multimedia Learning*, published by Cambridge University Press.

CSE 4419	Bioinformatics		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Computational methods for analyzing biological systems. Dynamic programming, Markov models, Neural Networks, and Bayesian analysis are used to predict secondary structure, tertiary structure, and active sites for drug docking given molecular DNA sequence data.

Outcome:

1. Demonstrate an advanced understanding of biological sciences by articulating the methods of science, explaining why current biological knowledge is both contestable and testable through further inquiry, and explaining the role and relevance of biotechnology in society;
2. Demonstrate cognitive skills in mastery of advanced theoretical knowledge in biotechnology and apply this knowledge to solve complex problems in existing and new areas.

Contents:

Definition of learning systems; Goals and applications of machine learning; Aspects of developing a learning system: training data, concept representation, function approximation; Algorithmic models of learning; Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience; Bayesian, maximum a posteriori, and minimum description length frameworks; Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden

Reference Books:

1. Cristianini and Hahn, *Introduction to Computational Genomics*.

CSE 4417	Machine Learning		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Learn about some of the most widely used and successful machine learning techniques. Be able to formulate machine learning problems corresponding to different applications. Understand a range of machine learning algorithms along with their strengths and weaknesses. Understand the basic theory underlying machine learning. Be able to apply machine learning algorithms to solve problems of moderate complexity. Be able to understand knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human-computer interaction.

Outcome:

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.;
2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches;
3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning;
4. Be able to design and implement various machine learning algorithms in a range of real-world applications.

Contents:

Definition of learning systems; Goals and applications of machine learning; Aspects of developing a learning system: training data, concept representation, function approximation; Algorithmic models of learning; Learning classifiers, functions, relations, grammars, probabilistic models, value functions, behaviors and programs from experience; Bayesian, maximum a posteriori, and minimum description length frameworks; Parameter estimation, sufficient statistics, decision trees, neural networks, support vector machines, Bayesian networks, bag of words classifiers, N-gram models; Markov and Hidden Markov models, probabilistic relational models, association rules, nearest neighbor classifiers, locally weighted regression, ensemble classifiers; Computational learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting; Dimensionality reduction, feature selection and visualization; Clustering, mixture models, k-means clustering, hierarchical clustering, distributional clustering; Reinforcement learning; Learning from heterogeneous, distributed, data and knowledge; Selected applications in data mining, automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human-computer interaction, semantic web, and bioinformatics and computational biology.

Reference Books:

1) Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, published by The MIT Press.
2) Tom M. Mitchell, *Machine Learning*, published by McGraw-Hill.

CSE 4421	**Robotics**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

How to design robots for specific activities and scenarios, how to use Robolab programming software. Gears, pulleys, torque, friction, timing, sensors, and program loops. To design, develop and complete robotic activities and challenges.

Outcome:

1. Be familiar with various robot sensors and their perception principles that enable a robot to analyze their environment, reason and take appropriate actions toward the given goal.
2. Understand, analyze and solve problems in spatial coordinate representation and spatial transformation, robot locomotion design, kinematics, motion control, localization and mapping, navigation and path planning.
3. Be able to design and implement a robotic project on a physical mobile robot platform, with tasks involving project specification, algorithm design, software programming, simulation and modeling, control and obstacle avoidance in a complex and interactive environment.

Contents:

Introduction, Actuators and Drives, Control Components, I/O Interface, and PWM Amplifiers, Control Software, Control Software – 2,Sensor, De-mining Robot: Implement Basic Sensor-based Controls; Plan Strategy for De-mining Task, Kinematics, Differential Motion, Statics, Energy Method, Hybrid Position-force

Control, Compliance, End-effecter Design, Non-holonomic Systems, Legged Robots, Multi-fingered Hands, Dynamics, Computed Torque Control, Sensors, computer Vision, Navigation, Tele-robotics and Virtual Reality.

Reference Books:

1) Fu, Gonzalez and Lee , *Robotics: Control, Sensing, Vision and Intelligence*
2) D. P. Siewiorek and R. S. Swarz, *Robotics, Vision and Control: Fundamental Algorithms in MATLAB*

CSE 4425	**Cloud Computing**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Students can understand various basic concepts related to cloud computing technologies, architecture and concept of different cloud models: IaaS, PaaS, SaaS. Big data analysis tools and techniques. Understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization.

Outcome:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing;
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc;
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions;
4. Provide the appropriate cloud computing solutions and recommendations according to the applications used.

Contents:

The course presents a top-down view of cloud computing, from applications and administration to programming and infrastructure. Its main focus is on parallel programming techniques for cloud computing and large scale distributed systems which form the cloud infrastructure. The topics include: overview of cloud computing, cloud systems, parallel processing in the cloud, distributed storage systems, virtualization, security in the cloud, and multicore operating systems. Students will study state-of-the-art solutions for cloud computing developed by Google, Amazon, Microsoft, Yahoo, VMWare, etc. Students will also apply what they learn in one programming assignment and one project executed over Amazon Web Services.

Reference Books:

1) Morgan Kaufmann, *Distributed and Cloud Computing*, 1st edition, 2011.
2) Thomas Erl, Ricardo Puttini and Zaigham Mahmood, *Cloud Computing: Concepts, Technology and Architecture*, Published by Prentice Hall, 1st edition.

Option -II

CSE 4501	Digital Signal Processing		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
This course is designed to provide students with a comprehensive treatment of the important issues in design, implementation and applications of digital signal processing concepts and algorithms.

Outcome:
1. Explain the basic concepts of signals, signal processing and digital signals, and characterize signals and systems in discrete time, including use of the z-transform;
2. Use the Fourier transform and convolution to filter signals; explain the properties of the discrete-time Fourier transform; apply the discrete-time Fourier transform and the fast Fourier transform;
3. Design finite impulse response (FIR) filters to satisfy a desired frequency response; explain the role of the window function and describe its influence on FIR filters; design infinite impulse response (IIR) filters on the basis of an analogue design.

Contents:
This course provides an introduction to digital signal processing for both undergraduate and for graduate students. In this course, a detailed examination of basic digital signal processing operations including sampling/reconstruction of continuous time signals, Fourier and Z-transforms will be given. The Fourier and Z-transforms will be used to analyze the stability of systems, and to find the system transfer function. The discrete Fourier transform (DFT) and fast Fourier transform (FFT) will be studied. Finally, we will examine time and frequency domain techniques for designing and applying infinite impulse response (IIR) and finite impulse response (FIR) digital filters. Two-dimensional signals and introductory image processing operations will also be discussed.

Reference Books:
1) A. V. Oppenheim and R. W. Schafer, *Discrete Time Signal Processing*, Prentice Hall

CSE 4502	Digital Signal Processing Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4451.

CSE 4503	Data and Web Mining		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
Data mining is a discipline within knowledge discovery that seeks to facilitate the exploration and analysis of large quantities of data, by automatic or semiautomatic means. This subject provides a practical and technical introduction to knowledge discovery and data mining. Topics to be covered include problems of data analysis in databases, discovering patterns in the data, and knowledge interpretation, extraction and visualization. Along with various types of machine learning techniques and statistical techniques:

Outcome:

1. Understand the common algorithms and techniques for information retrieval (document indexing and retrieval, query processing, etc);
2. The quantitative evaluation methods for the IR systems and data mining techniques;
3. The popular probabilistic retrieval methods and ranking principles;
4. The techniques and algorithms existing in practical retrieval and data mining systems such as those in web search engines and recommender systems;
5. The challenges and existing techniques for the emerging topics of Map Reduce, portfolio retrieval and online advertising.

Contents:

Introduction to data mining; data warehousing and OLAP technology for data mining; data preprocessing; data mining primitives, languages and systems; descriptive data mining: characterization and comparison; association analysis; classification and prediction; cluster analysis; mining complex types of data; applications and trends in data mining; Models, Methodologies, and Processes; The KDD Process; Generic Tasks; Broad Themes (Search, Induction, Querying, Approximation, and Compression); Application Areas; The Good, Bad, and Ugly of Data Mining Practice: Data Dredging, Data Fishing, and Data Scrubbing; Attribute-Value Learning Techniques; Decision Trees; Decision Lists; Classification and Regression Trees; Association Rules; Correlations; Rule-Based Mining; Sequential versus Simultaneous Paradigms; Propositional Representations; Customized Data Structures for Speeding up Data Mining Algorithms; Relational Mining Techniques: Inductive Logic Programming; Commercial Software such as PROGOL, Aleph, Golem, FOIL, Tertius, and WARMR; Main Approaches to ILP; Rule Induction, Beam Search, Logical Decision Trees, Clausal Discovery, Model Selection; Inverse Resolution, Relative Least General Generalization. Propositionalization Techniques; Recursive Rule Generation. Operators for Efficient Search of Relational Spaces; Learning from Interpretations; Comparative Merits of Attribute-Value and Relational Mining Techniques; Domain Theories and Incorporating Prior Background Knowledge; Probabilistic Techniques; Bayesian Networks; Conditional Independence and its Modeling; Inference and Representational Complexity; Gradient Ascent Training; EM Algorithms; Combining Relational and Probabilistic Techniques (PRMs); Incremental Learning; Approximations and Tweaks; Techniques from Numerical Analysis and Statistics; Matrix-theoretic Approaches to Clustering (inc. K-means); Singular Value Decomposition (SVD) and Principal Component Analysis (PCA); Latent Semantic Indexing (LSI); Semi-Discrete Decompositions; Non-Negative Matrix Factorizations; Independent Component Analysis (ICA); Latent Variables; Factor Analysis; Mixed Models; Modeling for Data Mining and Methodology; Spatial Aggregation (SA); Closing-the-Loop; Sampling Strategies; Feature Extraction; Identifying Relevant Features; Model Assessment; Bayesian Model Inference and Averaging; Applications: Data Mining Applications in Bio-informatics, Personalization, Information Retrieval, Web Modeling, Filtering, and Text Processing.

Reference Books:

1) Krzysztof J. Cios, WitoldPedrycz, Roman W. Swiniarski and Lukasz A. Kurgan, *Data Mining: A Knowledge Discovery Approach*, published by Springer.
2) Alex A. Freitas, *Data and Web Mining with Evolutionary Algorithms*, published by Springer.
3) Daniel T. Larose, *Discovering Knowledge in Data: An Introduction to Data Mining*, published by Wiley-Interscience.

CSE 4504	Data and Web Mining Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4453.

CSE 4505	Wireless Network		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
The objective of this course is to enable students to be able to work with wireless environment as well as to construct and to manage wireless LANs in Windows and Linux environments. Studying this course the students is to be able to understand the different types of personal, local, wide and metropolitan wireless networks including Bluetooth, 802.11 LANs, cellular and WiMAX networks.

Outcome:
1. Identify the basic concept of wireless networks;
2. Analyze traffic theories, mobile radio propagation, channel coding, and cellular concepts;
3. Compare and contrast multiple division techniques, mobile communication systems, and existing wireless networks;
4. Classify network protocols, ad hoc and sensor networks, wireless MANs, LANs and PANs.

Contents:
Introduction to wireless networks; wireless transmission; frequencies; regulations; antennas; wireless signal propagation; modulation; spread spectrum; cellular system; media access; different types of wireless communication networks; different generations; mobile communication systems: GSM, HSCSD, GPRS, and EDGE; wireless telecommunication systems; TETRA; CDMA2000; satellite communication system; broadcast systems; digital radio; localization systems; wireless LANs; Wi-Fi and WiMAX technologies; Bluetooth; network protocols; mobile IP; ad-hoc networking; wireless sensor networks; transport protocols; reliable transmission; flow control; support for mobility, wireless WWW; WAP and i-mode; wireless security; mobile programming using J2ME.

Reference Books:

1) William Stallings, *Wireless Communications and Networks*, published by Prentice Hall.
2) Ron Price, *Fundamentals of Wireless Networking*, published by McGraw-Hill/Irwin.
3) Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, published by Prentice Hall.

CSE 4506	Wireless Network Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4455.

CSE 4507	Software Architecture		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
Understand the role of software architecture in the development of an enterprise application system. Examine and compare various architecture view types and styles. Develop the ability to read and understand the models that are used to document software architecture. Understand the nature of and the advantages and disadvantages for various architectural choices. Examine and compare centralized vs distributed architectures. Explore various aspects of client-server architectures including web architectures.

Outcome:

1. Software Architectural perspective and how it differs from lower-level design;
2. Ability to develop and apply a Software Architectural Development Fishbone Diagram;
3. Understand and apply various Software Size and Complexity Estimation Techniques with respect to requirements;
4. Perform software sizing analysis based on architectural components and requirements analysis.

Contents:

Requirements Engineering in the engineering life cycle; eliciting requirements; modeling and analysis; communicating the requirements; agreeing requirements; evolving requirements; method engineering; problem frames; viewpoints-Oriented requirements engineering; procedure and processes; project and risk management; responsibilities and roles; identification of requirements; specification of requirements; requirements analysis; tracking of requirements; requirements documentation; documentation of requirements using natural language; model-based documentation of requirements; checking and reconciling requirements; requirements Management; requirements engineering in agile methods; fluctuating and conflicting requirements; communication and coordination breakdown; tools; introduction to design process; design process and concepts; inception phase; elaboration phase; construction phase; transition phase; software architecture: control hierarchy; structural partitioning; information hiding: Effective modular design - functional independence; cohesion, coupling; design specification outline; architectural design; real time systems; SCM; layered behavioral model of software development process; relations between RE and software design.

Reference Books:

1) I. Gorton, *Essential Software Architecture*, published by Springer, 2nd Edition.
2) L. Bass, P. Clements and R. Kazman, *Software Architecture in Practice*, published by Addison-Wesley.
3) R. Taylor, N. Medvidovic, E. Dashofy, *Software Architecture: Foundations, Theory and Practice*, published by Wiley.

CSE 4508	**Software Architecture Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4457.

CSE 4509	**Distributed Database Management System**		**3.00**

Prerequisite: Contact Hour: 4 hours/week.

Objective:

This course will introduce principles and foundations of distributed databases, including architecture, design issues, integrity control, and query processing and optimization, transactions, and concurrency control.

Outcome:

1. Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process;
2. Evaluate simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer;

3. Explain how the two-phase commit protocol is used to deal with committing a transaction that accesses databases stored on multiple nodes;
4. Describe distributed concurrency control based on the distinguished copy techniques and the voting methods.

Contents:
Concepts of distributed database; levels of distribution transparency; distributed database design; translation of global queries to fragment queries; optimization of access strategies; management of distributed transaction; concurrency control; distributed database administration; homogeneous and heterogeneous distributed database; parallel database: basic concepts and design issues; multimedia database system: basic concepts and design issues; database wire-housing and data-mining concepts and algorithm.

Reference Books:
1) Saeed K. Rahimi and Frank S. Haug, *Distributed Database Management Systems: A Practical Approach*, published by Wiley-IEEE Computer Society Pr.
2) Stefano Ceri and Giuseppe Pelagatti, *Distributed Databases: Principles and Systems*, published by McGraw-Hill.

CSE 4510	**Distributed Database Management System Sessional**	**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4459.

CSE 4511	**Digital Image Processing**	**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
Introduce the student to analytical tools and methods which are currently used in digital image processing as applied to image information for human viewing. Then apply these tools in the laboratory in image restoration, enhancement and compression.

Outcomes:
1. Explain how digital images are represented and manipulated in a computer, including reading and writing from storage, and displaying;
2. Write a program which implements fundamental image processing algorithms;
3. Be conversant with the mathematical description of image processing techniques and know how to go from the equations to code.

Contents:
Digital image fundamentals: representation, sampling and quantization, image acquisition, basic relationships between pixels, imaging geometry; Image transforms: discrete Fourier transform, discrete cosine transform, Walsh and Hadamard transforms, Hotelling transform; Image enhancement: in spatial domain and in frequency domain, image smoothing and sharpening; Image restoration: degradation models, inverse filter, Wiener filter; Color and pseudo-color image processing; Image segmentation: detection of discontinuities, thresholding, region-oriented segmentation, the use of motion analysis in segmentation.

Reference Books:
1) R. C. Gonzalez and E. E. Woods, *Digital Image Processing*, Prentice Hall,

2) A. Rosenfeld and A. C. Kak, *Digital Picture Processing*, Academic Press.

CSE 4512	Digital Image Processing Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4461.

CSE 4513	Simulation and Modeling		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of this course is to explain the benefits of simulation and model in a range of important application areas, demonstrate the ability to apply the techniques of modeling and simulation to a range of problem areas and evaluate a simulation, highlighting the benefits and the drawbacks.

Outcome:

1. Ability to model deterministic systems and differentiate between nonlinear and linear models;
2. Ability to numerically simulate linear and non-linear ordinary differential equations and deterministic systems;
3. Ability to comprehend and apply advanced theory-based understanding of engineering fundamentals and specialist bodies of knowledge in the selected discipline area to predict the effect of engineering activities.
4. Ability to plan and execute a substantial research-based assessment tasks, with creativity and initiative in new situations in professional practice and with a high level of personal autonomy and accountability.

Contents:

Simulation methods; model building, random number generator; statistical analysis of results; validation and verification techniques; Digital simulation of continuous systems; Simulation and analytical methods for analysis of computer systems and practical problems in business and practice; Introduction to simulation packages.

Reference Books:

1) Averill M. Law and W. David Kelton, *Simulation Modeling and Analysis*, published by McGraw-Hill College.
2) Barry L. Nelson and Mathematics, *Stochastic Modeling: Analysis and Simulation*, published by Dover Publications.

CSE 4514	Simulation and Modeling Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4463.

CSE 4515	Pattern Recognition		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

Able to know the basic principles of pattern recognition theory and the main application domains. Understand the fundamental pattern recognition methods and algorithms. Apply well –known algorithms to pilot problems. Select the most efficient algorithm, based on problem requirements. Design the methodology for pattern recognition problems of medium complexity.

Outcome:

1. Identify areas where Pattern Recognition and Machine Learning can offer a solution.
2. Describe the strength and limitations of some techniques used in computational Machine Learning for classification, regression and density estimation problems.
3. Describe genetic algorithms, validation methods and sampling technique.

Contents:

Pattern Recognition: Introduction, Importance; Statistical and Neural Pattern Recognition: Bayesian classifier, Bayes decision theory, discriminant functions and decision surfaces, Bayesian classifier for normal distributions; Linear classifiers: Discriminant functions and decision hyper planes, perceptron algorithm, least squares methods; Nonlinear classifiers: Two and three layer perceptrons, back propagation algorithm, Template matching: Optimal path searching techniques, dynamic programming methods, correction methods; Context dependent classification: Observable and hidden Markov models, Viterbi algorithm; Syntactic Pattern Recognition: Grammar types, string generation as pattern description, cocke-youngers-kashmi phasing, tree grammar, graph isomorphism, Match graph, Cliques.

Reference Books:

1) William Gibson, *Pattern Recognition*, published by Berkley.
2) SergiosTheodoridis and KonstantinosKoutroumbas, *Pattern Recognition*, published by Academic Press.

CSE 4516	Pattern Recognition Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4465.

CSE 4517	Communication Engineering		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The principle objective of this course is to prepare the students with the knowledge of advanced data communication theories along with different modularization technique and different coding scheme for data transmission.

Outcome:

1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
2. Application of established engineering methods to complex engineering problem solving.
3. Describe the basic theory and operation of analogue communication systems, especially AM and FM modulation.
4. Describe the fundamentals of digital communication systems, especially baseband signaling, digital modulation techniques (e.g. FSK, PSK, QAM), inter-symbol interference and error rates.

Contents:

Remote access technologies and vulnerabilities**;** **a**ccessibility**;** Communication networks; optical communication; statistical communication theory; satellite communication; wireless and mobile communication; communication switching systems; random processes; continuous-wave modulation; continuous-wave; pulse modulation; baseband pulse transmission; signal-space analysis; need for modulation, amplitude modulation, AM demodulator, SSB modulation, vestigial sideband modulation, AM transmitter and receiver, noise and bandwidth in AM, carrier communication, basic principles of pulsed and CW radar; frequency modulation, FM demodulator, phase modulation, FM transmitter and receiver, noise and bandwidth in FM, ground wave, sky wave and space wave propagation, basic principles of BW and color TV; sampling theorem, PAM, PWM, PPM, pulse code modulation, noise in PCM, delta modulation, adaptive delta modulation, DPCM, M'ary system, FDM and TDM; sampling theorem, PAM, PWM, PPM, pulse code modulation, noise in PCM, delta modulation, adaptive delta modulation, DPCM, M'ary system, FDM and TDM; digital modulation, ASK, FSK, PSK, DPSK, basic principles of optical communication, satellite comm., mobile comm.; entropy, mutual information, channel capacity, Shannon theorem, Shannon-Hartley theorem, Shannon-Fano code, Huffman code, parity check code, Hamming's single error correction code.

Reference Books:

1) John M. Wozencraft and Irwin Mark Jacobs, *Principles of Communication Engineering*, published by Waveland Pr Inc.
2) John G. Proakis and MasoudSalehi, *Communication Systems Engineering*, published by Prentice Hall.

CSE 4518	Communication Engineering Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.
Laboratory works based on CSE 4467.

CSE 4519	Internet Engineering		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The principle objective of this course is to convergence of video/voice/data, Quality of Service provisioning, access technologies (wireless, optical, power-line networks), mobile networking, novel high-bandwidth applications, P2P networks and sensor networks are examples of areas of active research and growth. This course attempts to provide an understanding of the broad landscape of existing and emerging networking and inter-networking technologies.

Outcomes:

1. Be able to describe the advanced functions performed by the Internet Protocol (IP) and supporting protocols (eg. ICMP, UDP);

2. Be able to describe IP addressing and are able to design an internetwork with assigned addresses and NAT ;
3. Describe the inner workings of interior routing protocols (eg. RIP and OSPF);
4. Describe IP switching and the operation of MPLS.

***Contents**:*
This course covers the fundamentals of Internet Engineering, including network and MAC addressing, hubs, switches, routing, IPv4, IPv6, DNS, SNMP, DHCP, and firewalls. This course is a hands-on" lab-oriented course where the lectures prepare the students for in depth labs using simulated equipment that ISPs use. Upon completion of the class, students will be able to design and implement simple IP-based networks using both IPv4 and IPv6, as well as static or dynamic routing. Students will be able to establish basic network infrastructure such as DHCP, security, and network monitoring. Students will be able to perform trouble-shooting and fault isolation procedures.

Reference Books:
1) Eve Andersson, Philip Greenspun, and Andrew Grumet, *Software Engineering for Internet Applications*, MIT Press.
2) Daniel Minoli, *Internet and Intranet Engineering*, McGraw-Hill.

CSE 4520	**Internet Engineering Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4469.

CSE 4521	**Deep Learning**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
Students will develop a clear understanding of the motivation for deep learning, and design intelligent systems that learn from complex and/or large-scale datasets.

Outcome:

1. Describe the fundamental advancements made in deep learning in the past 5 years and explain why they have led to a small revolution in the field of machine learning and perception in multiple modalities;
2. Describe how these techniques relate to previous methods that were state of the art, for example typical computer vision pipelines;
3. Categorize, compare, and contrast various deep learning algorithms and explain which are better suited for particular types of real-world data or problems than others;
4. Design and carry out a project within their area of interest, apply the learned techniques to new types of data within this area, and analyze the performance of the algorithms within it.

Contents:
The course will cover connectionist architectures commonly associated with deep learning, e.g., basic neural networks, convolutional neural networks and recurrent neural networks. Methods to train and optimize the architectures and methods to perform effective inference with them, will be the main focus. Students will be encouraged to use open source software libraries such as Tensorflow.

Reference Books:

1) I. Goodfellow, Y. Bengio and A. Courville, *Deep Learning*, MIT Press, 2016.

CSE 4522	**Deep Learning Sessional**		**1.00**

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4471

CSE 4523	**Human Machine Interaction**		**3.00**

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:
The principle objective of this course is to design interactive products or systems to support people in their everyday and working lives.

Outcome:

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing;
2. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms;
3. Apply an interactive design process and universal design principles to designing HCI systems;
4. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems;
5. Discuss tasks and dialogs of relevant HCI systems based on task analysis and dialog design;
6. Analyze and discuss HCI issues in groupware, ubiquitous computing, virtual reality, multimedia, and Word Wide Web-related environments.

Contents:
User interface development: iterative design, rapid prototyping, low-fidelity interactive prototyping, comparative evaluation of multiple interfaces, evaluation of user interface, heuristic evaluation; UI design models: system model, interface model, user model; Usability: consistency, simplicity, learnability, efficiency, safety, ergonomics, aesthetics; Accessibility: kinds of impairments, assistive technology, universal design, accessibility APIs; Internationalization and Localization: translation, text direction, sort order, formatting, color conventions, icons; User research methods: experiments, experiment design techniques, field study, survey; Multimodal signal processing: recognize human emotions through combination of spoken language, gestures, facial expressions; Case studies.

Reference Books:

1. Alan Dix, Janet Finlay and Gregory D. Abowd, Russell Beale, *Human Computer Interaction*,

published by Prentice Hall

2. International Design Foundation, *Encyclopedia of Human Computer Interaction.*

CSE 4524	Human Machine Interaction Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4473.

CSE 4525	Switching and Routing		3.00

Prerequisite: None. Contact Hour: 4 hours/week.

Objective:

The objective of this course is to advance the state of the art in theory and applications of information switching and networking to bring the students into interest in various aspects of communications switching and routing such as theory and architecture, tale-traffic theory, mobility and call control, signaling protocol, intelligent networks and service features, switching software architecture, management, economics and applications of switching and routing systems.

Outcome:

1. Understand and describe the devices and services used to support communications in data networks and the Internet;
2. Understand and describe the role of protocol layers in data networks;
3. Understand and describe the importance of addressing and naming schemes at various layers of data networks in IPv4 and IPv6 environments;
4. Design, calculate, and apply subnet masks and addresses to fulfill given requirements in IPv4 and IPv6 networks;
5. Explain fundamental Ethernet concepts such as media, services, and operations;
6. Build a simple Ethernet network using routers and switches.

Contents:

Introduction of network and network model; interconnection at different layers; relays; Ethernet; different types of repeaters, hubs, bridges and switches; broadcast and collision domains; campus network; connecting the switch blocks; VLANs; layer 2 switch and spanning tree protocol; using spanning tree with VLANs; inter-VLAN routing; multi-layer switching; multicast; traffic isolation; interior routing protocols: RIP, OSPF, IGRP and EIGRP; autonomous systems; exterior routing protocols: EGP, BGP and IDRP; layer 3 switching; MPLS; queuing techniques; over provisioning; traffic shaping; and congestion control.

Reference Books:

1) Wendell Odom, Rus Healy and Denise Donohue, *CCIE Routing and Switching Certification Guide*, published by Cisco Press, 4th Edition.
2) Douglas E. Comer, *Internetworking with TCP/IP*, published by Addison-Wesley, 6th Edition.

CSE 4526	Switching and Routing Sessional		1.00

Prerequisite: None. Contact Hour: 2 hours/week.

Laboratory works based on CSE 4525.

3. Faculty

Faculty	Research Areas
Prof. Dr. Mohammad Mahfuzul Islam	Network Security, Steganography, Computer Forensics, Wireless Sensor Networks, Social Networks, Biometric Security, Information Security
Shah Reza Mohammad Fahad Ul Hossain	Artificial Intelligence, Robotics, Machine Learning
Md. Hasanuzzaman	Network Architecture and Security, Data Science and Big Data, Cyber Security, Cloud Computing
Md. Mostafizur Rahman	Image Processing, Computer Vision
Md. Manjurul Haque	Artificial Intelligence, Machine Learning, Natural Language Processing

4. Research:

a. Area
b. Research Evaluation Cell
c. Seminars
d. Research Collaboration

RESEACH AREAS

- Artificial Intelligence & Robotics
- Cloud Computing and Distributed Systems
- Data Networking and Information Security
- Database and Information Systems
- Embedded Systems and Internet of Things (IoT)
- Human Computer Interaction (HCI)
- Mobile, Wireless and Web Applications Development
- Modeling and Simulation
- Signals and Image Processing
- Software Engineering
- Technology Transfer and Policy
- VLSI Technology

Research Evaluation Cell

Department of CSE, Canadian University of Bangladesh pleased to activate their three Research Cells with the Principal Investigators and the selected 7 (Seven) Research Assistants through the 'Research Evaluation Test' with the following details:

1. **Artificial Intelligence and Machine Learning Cell (AIMLC)**

   (Head of the Cell and Principal Investigator: Mr. SRM Fahad Hossain)

2. **Software & Web Development Cell (SWDC)**

   (Head of the Cell and Principal Investigator. Md. Mostafizur RahmanCo-Investigator: Mr. Manjurul Haque)
3. **Network Architecture and Security Management Cell (NASMC)**

   (Head of the Cell and Principal Investigator: Mr. Hasanuzzaman)
4. **Image Processing and Computer Vision Lab (IPCV)**

   (Head of the Cell and Principal Investigator. Md. Mostafizur Rahman
5. **Data Science & Big Data Research Lab (DSBDRL)**
   (Head of the Cell and Principal Investigator: Mr. Hasanuzzaman)
6. **Computer Hacking Forensics Investigator and Cyber Security Research Lab (CHFICSRL)**

   (Head of the Cell and Principal Investigator: Mr. Hasanuzzaman)
7. **Robotics Research Lab**
   (Head of the Cell and Principal Investigator: Mr. SRM Fahad Hossain)

SEMINARS

1. ITEE Project in collaboration with JICA (Japan International Cooperation Agency) to receive training on '120 Hours Intensive ITEE Preparation
2. A seminar on graphic design and building a career on graphic design
3. A seminar on e-commerce and on digital advertisements
4. A Workshop on Mobile App Developing

RESEARCH COLLABORATION

Faculty members and Students of the Department of CSE at CUB maintain various Research Collaboration with other universities, government and non-government organizations both locally and globally. Following are few of the collaborative research projects that are currently underway at the Department of CSE

1. ICC (Innovation and Commercialization Centre) collaborating with Ministry of ICT, Bangladesh for developing Smart City Planning.

2. IoT and Big Data Analysis under ICC (Innovation and Commercialization).

5. LAB

1. Computer Programming Lab
2. Network Architecture and Security Lab
3. Software & Web Development Lab
4. Robotics Research Lab
5. Computer Graphics Lab
6. Digital Logic Design Lab
7. VLSI Design Lab
8. Cloud Computing Lab
9. Computer Gaming Lab
10. Data Structure and Algorithm Lab
11. Database Administrative and Design lab

6. PUBLICATION AREAS

- Artificial Intelligence & Robotics **(Journal | Conference | Book Chapter | Others)**
- Cloud Computing and Distributed Systems **(Journal | Conference)**
- Data Networking and Information Security **(Journal | Conference)**
- Database and Information Systems **(Journal | Conference | Book Chapter | Others)**
- Embedded Systems and Internet of Things (IoT) **(Journal | Conference | Others)**
- Human Computer Interaction (HCI) **(Journal | Conference | Book Chapter)**
- Mobile, Wireless and Web Applications Development **(Journal | Conference)**
- Modeling and Simulation **(Journal | Book:Book | Conference | Book Chapter | Others)**

8. INTERNSHIP

1. Student Mobility at Universiti Technologi PETRONAS(UTP)
   After completing first year in the CSE department, the students can go for a semester to UTP paying the local(CUB) tuition fees.
2. Foreign Industrial Training
   Under the UTP, Malaysia, our final year students can go to conduct their industrial training at UTP's dedicated research centers.

3. 35 Multinational Companies for possible job placement
   We do our best to provide our alumni possible job placement in multinational Company