Curriculum

for

Bachelor of Science in Computer Science and Engineering

Computer Science and Engineering Discipline
Khulna University

December, 2016

1. Name of the Program: Bachelor of Science in Computer Science and Engineering

2. Vision

To provide leaders in the field of computer science and engineering by producing globally competitive professional.

3. Mission

Computer Science and Engineering Discipline is committed to develop graduates with the state of the art knowledge and expertise to the world class industries and research groups. It also creates facilities for the scholarly research activities for both students and faculties.

4. Objectives of the Program

The graduates of Computer Science and Engineering are expected to demonstrate:

- Ability to achieve academic and professional excellence in Computer Science and Engineering by imparting in-depth knowledge.
- Ability to apply achieved knowledge to design, implement and evaluate computer based systems to meet desired needs.
- Ability to analyze the local and global impacts of information technology on individuals, organizations and society and apply the earned knowledge to those issues.
- Take a leadership role in the chosen field.

5. Learning outcomes

The expected abilities of CSE graduates students after the completion of the program are the following:

- Demonstrate the ability to apply knowledge of computer science and engineering to develop and analyze computing systems.
- Understand the theory and concepts underlying computer science and engineering.
- Analyze a problem, and identify and define the computing requirements for its solution.
- Handle and use different ICT equipments according to the instructions of the Discipline.
- Evaluate, verify, trouble-shoot, test and analyze an existing computer-based system, process, component or program.
- Demonstrate an ability to use current techniques, skills and tools for computing practice.
- Work effectively in teams in designing and implementing software systems and effectively manage conflicts, optimize resources and meet deadlines.
- Demonstrate the ability to orally communicate ideas and concepts clearly and in an organized manner.
- Demonstrate the ability to write good quality research/technical papers, clear system documentation and user documentation.

6. Course structure

Program duration:04 years

Number of terms:08

Term duration:21 Weeks (Class 13 weeks + Preparatory Leave 2 weeks + Final Examinations 4 weeks + Term break 2 weeks)

Minimum credit hours to be earned:160.25

Credit definition: Theory course: 1 contact hour/week = 1 credit, sessional course: 2 contact hours/week = 1 credit

6.1 Summary of the total available credits (core and optional) from different areas of study

Year	Term	Total Credit
First	I	20.75
	II	20.50
Second	I	20.75
	II	21.25
Third	I	21.25
	II	22.50
Fourth	I	16.75
	II	16.50
	Total	**160.25**

Total Credit Hours Requirements	160.25 Credit
Total Credit Hours in Core Courses of CSE Discipline	103.00 Credit
Total Credit Hours in Core Courses of CSE and other Disciplines	142.25 Credit
Total Credit Hours in Optional Courses	18.00 (11.23% of total credit hours) out of 88.5 in optional courses
Total Credit Hours in Basic Science	18.75(11.70% of total credit)
Total Credit Hours in Business Courses	5.00 (3.12% of total credit)
Total Credit Hours in Humanities and Social Science	8.75 (5.46% of total credit)

Year	Term	Credit Hours		Total Credit
		Compulsory	Optional	
First	I	20.75	--	20.75
	II	20.50	--	20.50
Second	I	20.75	--	20.75
	II	21.25	--	21.25
Third	I	21.25	--	21.25
	II	18.00	4.50	22.50
Fourth	I	13.75	3.00	16.75
	II	6.00	10.50	16.50
Total		**142.25**	**18.00**	**160.25**

6.2 Course outline

Term-wise course outline for the entire program is as follows:

FIRST YEAR, FIRST TERM

Course No.		Course Title	Hours/Week		Credit
			Theory	Sessional	
CSE	1103	Structured Programming I	2	0	2.00
CSE	1104	Structured Programming I Laboratory	0	3	1.50
CSE	1105	Discrete Mathematics	3	0	3.00
ME	1151	Mechanics and Heat Engineering	3	0	3.00
ME	1152	Engineering Drawing and CAD Project	0	1.5	0.75
ECE	1151	Electrical Circuits	3	0	3.00
ECE	1152	Electrical Circuits Laboratory	0	1.5	0.75
Math	1153	Calculus	3	0	3.00
Phy	1153	Physics	3	0	3.00
Phy	1154	Physics Laboratory	0	1.5	0.75
Total:		**6 Theory + 4 Sessional**	**17**	**7.5**	**20.75**

FIRST YEAR, SECOND TERM

Course No.		Course Title	Hours/Week		Credit
			Theory	Sessional	
CSE	1201	Object Oriented Programming	3	0	3.00
CSE	1202	Object Oriented Programming Laboratory	0	3	1.50
CSE	1203	Structured Programming II	2	0	2.00
CSE	1204	Structured Programming Laboratory II	0	3	1.50
ECE	1251	Electronic Devices and Circuits	3	0	3.00
ECE	1252	Electronic Devices and Circuits Laboratory	0	1.5	0.75
Math	1253	Geometry and Differential Equations	3	0	3.00
Chem	1251	Chemistry	3	0	3.00
Eng	1251	English	2	0	2.00
Eng	1252	English Skills Laboratory	0	1.5	0.75
Total:		**6 Theory + 4 Sessional**	**16**	**9**	**20.50**

SECOND YEAR FIRST TERM

Course No.		Course Title	Prerequisite	Hours/Week		Credit
				Theory	Sessio-nal	
CSE	2101	Data Structures	(CSE 1203 CSE 1204) Or (CSE1103 CSE1104)	3	0	3.00
CSE	2102	Data Structures Laboratory	(CSE 1203 CSE 1204) Or (CSE1103 CSE1104)	0	3	1.50
CSE	2105	Numerical Methods	(CSE 1203 CSE 1204) Or (CSE1103 CSE1104)	3	0	3.00
CSE	2106	Numerical Methods Laboratory	(CSE 1203 CSE 1204) Or (CSE1103 CSE1104)	0	1.5	0.75
CSE	2111	Digital Logic Design		3	0	3.00
CSE	2112	Digital Logic Design Laboratory		0	3	1.50
CSE	2113	Advanced Programm-ing	Any two of (CSE 1203 CSE 1204),	2	0	2

			(CSE1103 CSE1104), (CSE 1201 CSE 1202)			
ECE	2151	Digital Electronics		3	0	3.00
Math	2153	Vector Analysis and Matrix		3	0	3.00
Total:		**6 Theory + 3 Sessional**		**17**	**7.5**	**20.75**

SECOND YEAR, SECOND TERM

Course No.		Course Title	Pre-requisite	Hours/Week Theory	Sessional	Credit
CSE	2201	Algorithms	CSE2101 CSE2102	3	0	3.00
CSE	2202	Algorithms Laboratory	CSE2101 CSE2102	0	3	1.50
CSE	2203	Computer Architecture	CSE2111	3	0	3.00
CSE	2205	Operating System and Systems Programming		3	0	3.00
CSE	2206	Operating System and Systems Programming Laboratory /Project		0	3	1.50
CSE	2208	Assembly Language Laboratory		0	3	1.50
CSE	2211	Information System Design		2	0	2.00
CSE	2212	Information System Design Sessional		0	1.5	0.75
Math	2253	Statistics and Complex Variable		3	0	3.00
Econ	2251	Economics		2	0	2.00
Total:		**6 Theory + 4 Sessional**		**16**	**10.5**	**21.25**

THIRD YEAR, FIRST TERM

Course No.		Course Title	Pre-requisite	Hours/Week Theory	Sessional	Credit
CSE	3100	Technical Writing and Presentation		0	3	1.50
CSE	3101	Database Systems		3	0	3.00
CSE	3102	Database Systems Project/Fieldwork		0	3	1.50
CSE	3103	Software Engineering		2	0	2.00
CSE	3106	Software Development Project		0	3	1.50
CSE	3111	Microprocessors and Microcontrollers	CSE 2203	3	0	3.00
CSE	3112	Microprocessors and Microcontrollers Laboratory/Project	CSE 2203	0	1.5	0.75
ECE	3151	Data Communication		3	0	3.00
Math	3153	Mathematical Analysis for Computer Science		3	0	3.00
Psy	3151	Psychology		2	0	2.00
Total:		**6 Theory + 4 Sessional**		**16**	**10.5**	**21.25**

THIRD YEAR, SECOND TERM

Course No.		Course Title	Pre-requisite	Hours/Week Theory	Sessional	Credit
CSE	3200	Web Programming Project/Fieldwork		0	3	1.50
CSE	3201	Artificial Intelligence	CSE 2201 CSE 2202	3	0	3.00
CSE	3202	Artificial Intelligence Laboratory/Project	CSE 2201 CSE 2202	0	3	1.50
CSE	3203	Computer Networks		3	0	3.00
CSE	3204	Computer Networks Laboratory/Fieldwork		0	3	1.50
CSE	3205	Compiler Design		3	0	3.00
CSE	3206	Compiler Design Laboratory/Project		0	1.5	0.75
ECE	3251	Electrical Drives and Instrumentation		3	0	3.00
ECE	3252	Electrical Drives and Instrumentation Laboratory		0	1.5	0.75
Option I					0	3.00
Option I Seasonal					3	1.50
Total:		**5 Theory + 5 Sessional**		**15**	**15**	**22.50**

List of Optional Courses

Option I with Sessional should be selected from the following Courses

Course No.	Course Title	Hours/Week Theory	Hours/Week Sessional	Credit
CSE 3221	Simulation and Modeling	3	0	3.00
CSE 3222	Simulation and Modeling Laboratory/Fieldwork	0	3	1.50
CSE 3223	Neural Networks and Fuzzy Systems	3	0	3.00
CSE 3224	Neural Networks and Fuzzy Systems Laboratory	0	3	1.50
CSE 3225	Digital Image Processing	3	0	3.00
CSE 3226	Digital Image Processing Laboratory/Project	0	3	1.50
CSE 3227	Geographical Information System	3	0	3.00
CSE 3228	Geographical Information System Laboratory/Fieldwork	0	3	1.50

FOURTH YEAR, FIRST TERM

Course No.	Course Title	Prerequisite	Hours/Week Theory	Hours/Week Sessional	Credit
CSE 4100	Project /Thesis I	Completion of Minimum 90 Credits in Previous Terms	0	6	3.00
CSE 4103	Computer Graphics		3	0	3.00
CSE 4104	Computer Graphics Laboratory/Project		0	1.5	0.75
CSE 4105	Computer Security		3	0	3.00
BA 4151	Accounting		2	0	2.00
Soc 4153	Government and Sociology		2	0	2.00
Option II			3	0	3.00
Option III			1 to 3 weeks		0.00
Total :	**5 Theory + 2 Sessional+ 1 Non Credit Training**		**13 1 to 3**	**7.5 weeks**	**16.75**

List of Optional courses

Option II and Option III should be selected from the following Courses

Course No.	Course Title	Hours/Week Theory	Hours/Week Sessional	Credit
CSE 4121	Applied Probability and Queuing Theory	3	0	3.00
CSE 4123	Parallel and Distributed Processing	3	0	3.00
CSE 4125	Computational Geometry	3	0	3.00
CSE 4127	Human Computer Interaction	3	0	3.00
CSE 4129	Distributed Database System	3	0	3.00
CSE 4131	Graph Theory	3	0	3.00
CSE 4133	Theory of Computation	3	0	3.00
ECE 4151	Digital Signal Processing	3	0	3.00
ECE 4153	VLSI Design and Testability	3	0	3.00
ECE 4155	Wireless and Optical Networks	3	0	3.00

Option III should be selected from the following Courses

Course No.	Course Title	Hours/Week	Credit
CSE 4160	Industrial Training/Study Tour	3 weeks	0.00
CSE 4170	Advanced Business Venture	3 weeks	0.00

FOURTH YEAR, SECOND TERM

Course No.	Course Title	Hours/Week Theory	Hours/Week Sessional	Credit
CSE 4200	Project/Thesis II	0	6	3.00
BA 4251	Industrial Management and Law	3	0	3.00
Option IV		3	0	3.00
Option IV Sessional		0	1.5	0.75
Option V		3	0	3.00
Option V Sessional		0	1.5	0.75
Option VI		3	0	3.00
Total:	**4 Theory + 3 Sessional**	**12**	**9**	**16.50**

List of Optional Courses

Option IV with Sessional and Option V with Sessional should be selected from the following Courses

Course No.	Course Title	Hours/Week		Credit
		Theory	Sessional	
CSE 4221	Pattern Recognition	3	0	3.00
CSE 4222	Pattern Recognition Laboratory/Project	0	1.5	0.75
CSE 4223	Data Mining	3	0	3.00
CSE 4224	Data Mining Laboratory/Fieldwork	0	1.5	0.75
CSE 4231	Digital System Design	3	0	3.00
CSE 4232	Digital System Design Laboratory/Project	0	1.5	0.75
CSE 4233	Client Server Technology	3	0	3.00
CSE 4234	Client Server Technology Laboratory/Fieldwork	0	1.5	0.75
CSE 4235	Computer Peripherals and Interfacing	3	0	3.00
CSE 4236	Computer Peripherals and Interfacing Laboratory/Project	0	1.5	0.75
CSE 4237	Computer Animation and Virtual Reality	3	0	3.00
CSE 4238	Computer Animation and Virtual Reality Laboratory/Project	0	1.5	0.75

Option VI should be selected from the following Courses

Course No.	Course Title	Hours/Week		Credit
		Theory	Sessional	
CSE 4241	Knowledge Engineering	3	0	3.00
CSE 4243	Machine Learning	3	0	3.00
CSE 4245	Robotics and Computer Vision	3	0	3.00
CSE 4247	E-Commerce	3	0	3.00
CSE 4249	Decision Support System	3	0	3.00
CSE 4251	Multimedia	3	0	3.00

6.3 Course profiles:

FIRST YEAR, FIRST TERM

Course: CSE 1103: Structured Programming I	**Credit Hour: 02**	**Year: First**	**Term: First**
Rationale: This course is designed to provide knowledge and expertise on structured programming language to solve various problems.			
Course Objectives • To give a general understanding of how a computer works • To provide knowledge and experience about structured programming • To help students to develop programming skills to solve different problems • To make students able to understand and implement various concepts and structures of C programming language			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: • Explain the different devices of a computer and how they are related in computer programming. • Understand the basic terminology used in computer programming and structured programming concept. • Construct algorithms and flow charts as the part of problem analysis. • Write, compile and debug programs in C language. • Use different data types, operators and expressions in a computer program. • Design and implement programs involving decision structures, loops, arrays, structures and unions.	**Section A** Introduction to Computer, Number systems and Code; Input, output and memory devices;Computer languages and software; Programming Algorithms and flow chart construction; Background of C; Structured Programming Concepts; Identifiers, variables, constants, operators and expressions; Memory models; Program control statements: if-else, switch-case. **Section B** Program control statements: loops; Arrays; String; Function: User defined functions; Structure and Union.		

Course: CSE 1104: Structured ProgrammingLaboratory I	Credit Hour: 1.5	Year: First	Term: First
Rationale: This course is designed to improve skill and expertise on structured programming language by solvingvarious problems.			
Course Objectives • To help students to develop programming skills to solve different problems • To assist student to implement various concepts and structures of C programming language			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: • Construct algorithms and flow charts as the part of problem analysis. • Write, compile and debug programs in C language. • Use different data types, operators and expressions in a computer program. • Design and implement programsinvolving decision structures, loops,arrays, structures and unions.		Based on CSE 1103 (Structured Programming I)	

Course: CSE 1105: Discrete Mathematics	Credit Hour: 03	Year: First	Term: First
Rationale: This course covers mainly the following major areas of discrete mathematics namely i) prepositional and predicate calculus, ii) sets, relations and functions, iii) graph theory, iv) algorithms and complexity, v) proof techniques and vi) combinatories.			
Course Objectives • To develop logical thinking and its application to computer science and engineering • To emphasize the importance of proving statements correctly and de-emphasize the hand-waving approach towards correctness of an argument • To enhance students' ability to reason and ability to present a coherent and mathematically accurate argument			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: • Solve different problems of prepositional and predicate calculus. • Solve problems which involve discrete data structures such as sets, relations and functions. • Learn about the data structure *graph* and solve various problems associated with graph theory. • Construct valid mathematical arguments (proofs) and understand/apply mathematical statements (theorems) • Solve problems which require computation of permutations and combinations of a set • Analyze a problem to create relevant recurrence equations and solve the equations • Apply the mathematical concepts learned to various areas of CSE.		**Section A** Mathematical logic: Prepositional calculus, Predicate calculus; Set theory: Sets, Relations, Partial Ordered Sets, Lattices and Functions; Mathematical reasoning and proof techniques; Counting: permutations, combinations, principles of inclusion and exclusion. **Section B** Discrete probability; Recurrence relation and recursive algorithms; Complexity of algorithms; Growth functions; Graph Theory: graphs, paths and trees; Algebraic Structures.	

Course: ME 1151Mechanics and Heat Engineering	Credit Hour: 03	Year: First	Term: First
Rationale: This course aims to build upon the ideas of mechanics and heat engineering specifically motion, force and energy studies, different types of engines etc.			
Course Objectives This course is designed to introduce a basic study of the phenomena of mechanics and heat engineering, to develop methodologies for solving a wide variety of practical engineering problems, and to provide useful information concerning the performance and design of particular systems and processes.			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: • Understand the basic laws of heat transfer. • Account for the consequence of heat transfer in thermal		**Section A** Resultant and components of forces. Equilibrium of coplanar forces. Centroids. Moment of inertia of area and mass. Kinetics of absolute	

analyses of engineering systems. • Analyze problems involving steady state heat conduction in simple geometries. • Develop solutions for transient heat conduction in simple geometries. • Obtain numerical solutions for conduction and radiation heat transfer problem.	motions. Kinetics of relative motions. Frictions. Maximum and minimum forces. Kinetics of plane motion of rigid bodies. Principles of work and energy. **Section B** Working principles of a few representative boilers. Introduction to the principle of operation of steam turbine. Introduction to internal combustion engine, working principle of petrol engine, diesel engine and gas turbine. Basic concepts of refrigeration and air conditioning.

Course: ME 1152: Engineering Drawing and CAD Project	**Credit Hour: 0.75**	**Year: First**	**Term: First**
Rationale: The course aims to train the students in practical session in order to make them confident and competent in Engineering Drawing and CAD project.			
Course Objectives • To learn sketch and take field dimensions • To take data and transform it into graphic drawings • To earn basic engineering drawing formats • To Prepare the student for future engineering positions			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: • Perform basic sketching techniques • Draw orthographic projections and sections. • Use engineering scales • Produce engineered drawings • Convert sketches to engineered drawings • Develop good communication skills and team work		Introduction, Scale drawing, Sectional views, Isometric views. Missing line, Auxiliary view, Detail and assembly drawing Project on Engineering Drawing and CAD using contemporary packages.	

Course: ECE 1151: Electrical Circuits	**Credit Hour: 3.0**	**Year: First**	**Term: First**
Rationale: This course is designed to develop the fundamental concepts regarding the analysis of electrical circuits.			
Course Objectives • To acquaint students with the basic concepts and properties of electrical circuits and networks. • To teach students how to analyze both DC and AC electrical circuits. • To teach students how to use the concept of phasors and impedance to calculate power and explain frequency response of a circuit. To prepare students for follow-up courses in the Circuits area of the Electrical Engineering program.			
Intended Learning Outcomes (IOLs)		**Course Content**	
At the end of the course the students will be able to: • Describe the generation and characteristics of sinusoidal alternating waveform. • Calculate the instantaneous and r.m.s values for different alternating waveforms. • Determine the phase difference between two sinusoidal alternating waveforms. • Distinguish between average, apparent, and reactive power and calculate for different combinations of resistive and reactive elements. • Manipulate Phasor algebra to calculate sinusoidal voltage, current, power, phase difference in a convenient way. • Choose proper analysis methods and use them to solve single phase AC circuits. • Explain the frequency responses of series and parallel resonant circuits. • Calculate the quality factor, bandwidth, and power levels of a		**Section A** Fundamental electric concepts and measuring units, D.C. voltage, Current, Resistance and power, Laws of electrical circuits; $\Delta - Y, Y - \Delta$ conversion and Network Theorems; Methods of Network Analysis, Principles of D.C. measuring apparatus, Laws of magnetic fields and circuits and methods of solving simple magnetic circuit. **Section B** 1. **Alternating Current**: Instantaneous and r. m. s. current, voltage and power, average power various combinations of R, L and C circuits 2. **Phasor representation of sinusoidal quantities**. 3. **Single phase AC circuit analysis:**Seriesand parallel AC circuits, Series-Parallel AC networks, source conversions, Mesh analysis, Nodal analysis, AC bridge	

tuned network at important frequency levels.	networks, Δ-Y and Y-Δ conversions, Network theorems for AC circuits. 4. **Resonance:** Series and parallel resonance circuits.

Course: ECE 1152: Electrical Circuits Laboratory	**Credit Hour: 0.75**	**Year: First**	**Term: First**
Rationale: This course is designed to develop the practical skills to design electrical circuits using basic components and teach the students how to use instruments and devices to measure different circuit parameters.			
Course Objectives • Develop practical skills required to design electrical circuits • Teach the techniques to use some commonly used electrical instruments • Make aware of safety requirements in laboratory environment			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of this course the students will be able to: • Construct simple resistive circuits, sinusoidal RC, RL, RLC - circuits. • Verify the basic electrical circuit laws experimentally. • Troubleshoot the electric circuits built on the trainer board. • Use measuring instruments and devices like ammeter, voltmeter, multimeter, and Oscilloscope. • Use simulation software Multisim to simulate simple electrical circuits. • Perform experiments with safety skills necessary for electric circuit laboratory.	Based on ECE 1251 (Electrical Circuits) 1. Verification of Ohm's Law. 2. Verification Kirchhoff's Voltage Law. 3. Study of Mesh Analysis. 4. Study of Nodal Analysis. 5. Study and Analysis of Thevenin's Theorem. 6. Study and Analysis of Norton's Theorem. 7. Study of AC waveforms using Oscilloscope. 8. Observing the response of RL, RC, and RLC circuits using Multisim.		

Course: MATH 1153:Calculus	**Credit Hour: 03**	**Year: First**	**Term: First**
Rationale: As a student of Computer Science and Engineering, the student must have a very sound knowledge on Mathematics. This course provides in detailed knowledge on calculus (differential and integral calculus).			
Course Objectives Students will be provided a clear understanding of the ideas of Calculus as a solid foundation for subsequent courses in mathematics and other disciplines as well as for direct application to real life situations**.**			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: • Solve algebraic equations and inequalities involving the square root and modulus function • Understand the difference between equations and identities, and be able to prove simple identities and inequalities • Know addition and double-angle formulas for trigonometric functions and use them to express values of trigonometric functions in the surds form • Recognize odd, even, periodic, increasing, decreasing functions • Understand the operation of composition of functions and the concept of functional inverse • Recognize linear, quadratic, power, polynomial, algebraic, rational, trigonometric, exponential, hyperbolic and logarithmic functions and sketch their graphs • Calculate limits by substitution and by eliminating zero	**Section A** Differential Calculus: Limit. Continuity and differentiability. Differentiation of explicit and implicit function and parametric equations. Significance of derivatives. Differentials. Successive differentiation of various types of functions. Leibnitz's theorem. Rolle's Theorem, Mean value theorems. Taylor's theorem in finite and infinite forms. Maclaurin's theorem in finite and infinite forms. Langrange's form of remainders. Cauchy's form of remainder, Euler's theorem. Tangent, Normal, Sub-tangent and subnormal in Cartesian and polar coordinates, Determination of maximum and minimum values of functional and points of inflection, Applications, Evaluation of indeterminate forms by L'Hospitals rule, Curvature, Circle of curvature, center of curvature and chord of curvature, Evaluate and inviolate, Asymptotes, Envelopes, Curve tracing. **Section B** Integral Calculus: Definitions of integration, Integration by method of substitution. Integration by parts, Standard integrals, Integration by the method of successive reduction. Definite integrals, its properties and use in summing series. Vallis's formulae. Improper Integrals, Beta function and		

denominators • Calculate limits at infinity of rational functions • Understand the concept of definite integral and know the basic properties of definite integrals • Know the fundamental theorem of calculus and be able to use it for evaluating definite integrals and derivatives of integrals with variable limits of integration • Understand and apply the concept of area of regions with curvilinear boundaries.	Gamma function, application of Beta and Gamma function. Area under a plane curve in Cartesian and Polar coordinates. Area of the region enclosed by two curves in Cartesian and Polar coordinates. Elements of numerical integration, Trapezoidal rule, Simpson's rule. Arc lengths of curves in Cartesian and Polar coordinates, parametric and pedal equations. Intrinsic equation. Volumes of solids of revolution. Volume of hollow solids of revolution by shell method. Area of surface of revolution.

Course: Phy1153: Physics	**Credit Hour: 03**	**Year: First**	**Term: First**
Rationale: This course is consisting of four important branches of physics. The first portion of this course deals with heat and temperature and their relation to energy and work. These portions will lead students to an understanding of macroscopic variables, such as internal energy, entropy, and pressure that partly describe a body of matter or radiation. Its laws are explained by statistical mechanics, in terms of the microscopic constituents. So with the study of this course students will be able to get the fundamental idea about statistical mechanics and other relevant branches of physics. The second portion of this course deals with optics and from this part student will be able to know about the fundamental behavior of light, image defect, interference, diffraction and the Particle and wave nature of light. The third portion deals with wave and oscillation.			
Course Objectives The objective of this course is to assist the students to: • Understand the kinetic theory of gas properly and deduction of laws of gas from it; • Gain the basic concept about transmission process of heat; • Learn about laws of thermodynamics and their significances and applications; • Learn how interference and diffraction patterns demonstrate that light behaves like a wave; • Analyze how interference and diffraction patterns occur in nature and how they are used; • Evaluate different types of oscillations and effect and application of sound wave.			

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: • Explain kinetic theory of gas and hence can be able to deduce the laws of gases ; • Explain equation of state and its significances ; • Understand physical significance of vanderwaal's equation and its derivation for real gas; • Explain different heat transfer processes; • Appreciate that the first law of thermodynamics is more than the law of conservation of energy because it asserts that the total energy is a thermodynamic property; • Understand that the magnitude of heat and work depend on the path followed by the process i.e. A path function; • Understand that the work transfer can change the energy content of an adiabatic System; • Understand internal energy and calculate the boundary work using $w_b = \int pdv$; • Explain specific heat of gas and its significance and thus can be able to find out relation and ratio between c_p and c_v ; • Define the kelvin and clausius statements of second law of thermodynamics;	**Section A** Heat and Thermodynamics: Kinetic theory of gases: Deduction of gas law, Principle of equi-partition of energy, Equation of state- Andrew's experiment, Vander Waals equation, Critical constants, Transmission of heat - Conduction, Convection and Radiation. Laws of thermodynamics: First law of thermodynamics, Internal energy, Specific heats of gases, Work done by expending gas, Elasticity of a perfect gas, second law of thermodynamics, Carnot's cycle, Efficiency of heat engines. Absolute scale of temperature, Entropy and its physical concept, Maxwell's thermodynamic relations, Statistical mechanics. Optics: Combination of lenses: Equivalent lens and equivalent focal length. Defects of images formed by lenses: Spherical aberration, Astigmatism, Coma, Distortion, Curvature of the image, Chromatic absorption. Theories of light: Huygen's principle and construction. Interference of light: Young's double slit experiment, Bi-prism, Newton's rings, Interferometers, Interference by multiple reflection. Differentiation of light: Fresnell and Fraunhofer diffraction gratings. Polarization: Production and analysis of polarized light, optical activity, Optics of

• Understand Carnot cycle and find out the efficiency of a heat engine; • Derive Maxwell's thermodynamic relation; • Handle different optical instruments and know about their working principle ; • Know about different principles of propagation of light; • Understand young's experiment; • Explain interference phenomena produced by various optical mechanism and thus can be able to find out the origin of newton's ring ; • Know about types, production and applications of diffraction; • Understand construction and mechanism of diffraction grating and hence can be able to explain dispersive and resolving power of gratings; • understand simple harmonic motion and its combination; • Get idea about different types of oscillatory motions; • Describe physical significance of wave and can be able to classify them according to their nature, properties and origin; • Explain superposition principle and get initial idea about group and phase velocity; • Understand audible, ultrasonic and infrasonic sound waves; • Get idea about propagation and speed of sound waves and their dependence on temperature, pressure and humidity; • Understand Doppler effect and Sabine formula;	crystals. **Section B** Waves and Oscillation: Oscillation: Simple harmonic motion, Combination of S. H. M. and Lissajous figures, Damped Oscillations, Forced Oscillations, Resonance, Vibrations of membranes and columns. Waves: Traveling waves, the principle of superposition, Wave velocity, Group velocity and phase velocity, Power and intensity in wave motion, Interference of waves, Diffraction of waves, Reflection and transmission of waves at a boundary, Standing waves. Sound waves: Audible, Ultrasonic, Infrasonic and supersonic waves; Propagation and speed of longitudinal waves, Traveling longitudinal waves, Standing longitudinal waves, Vibrating systems and sources of sound, Beats, The Doppler effect. Acoustics: Re-vibration, Noise insulation and reduction, Compound absorption, Sound distribution, Room acoustics, Room acoustics, Recording.

Course: Phy1154: Physics Laboratory	**Credit Hour: 0.75**	**Year: First**	**Term: First**
Rationale: This course is to introduce one to the proper methods for conducting controlled physics experiments, including the acquisition, analysis and physical interpretation of data. The course involves experiments which illustrate the principles of heat and thermodynamics, waves and oscillations and optics.			
Course Objectives • To enhance students' knowledge in experimental physics for higher study and research activities. • To provide an opportunity to students with utilizing their theoretical knowledge. • To enable students to operate the instruments of Physics. • To make students capable of using the ideas of Physics course to perform experiments.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: • Measure the specific heat of a liquid by the method of cooling. • Observe the co-efficient of thermal conductivity of a metal using Searle's apparatus. • Determine the thermal conductivity of a bad conductor. • Find the variation of the frequency of a tuning fork with the length of a sonometer and hence can be able to determine the unknown frequency of a tuning fork. • Verify the laws of transverse vibration of a stretched string by sonometer. • Determine the refractive index of a liquid by pin method using a plane mirror and a convex lens. • Observe the radius of curvature of a lens by Newton's rings.	1. Determination of the specific heat of a liquid by the method of cooling. 2. Determination of the co-efficient of thermal conductivity of a metal using Searle's apparatus. 3. Determination of the thermal conductivity of a bad conductor by Lees and Chorlton's method. 4. Finding the variation of the frequency of a tuning fork with the length of a sonometer (n-l curve) under given tension and hence determination of the unknown frequency of a tuning fork. 5. Verification of the laws of transverse vibration of a stretched string by sonometer. 6. Determination of the refractive index of a liquid by pin method using a plane mirror and a convex lens. 7. Determination of the radius of curvature of a lens by Newton's rings.		

FIRST YEAR, SECOND TERM

Course: CSE 1201: Object Oriented Programming	**Credit Hour: 03**	**Year: First**	**Term: Second**
Rationale: This course is designed to provide grounding in object-oriented design and implementation, programming environments, and object-oriented programming.			
Course Objectives This course • Aims to introduce students the basic elements of object oriented programming • Teaches students how to design, develop and program computer systems using an object oriented programming language such java • Familiarizes students with the tools that streamline object-oriented development • Helps students develop their critical and creative thinking for lifelong learning			
Intended Learning Outcomes	**Course Content**		
At the end of the course the students will be able to: • Describe the essential concepts of object-oriented technology and carry out the object - oriented approach for programming. • Design object-oriented programs using object-oriented modelling techniques. • Use an object-oriented programming language to solve computer problems and build computer systems. • Implement graphical user interface and event handling in an object-oriented fashion. • Build computer systems in groups and develop group work. • Work responsibly, effectively and appropriately as an individual and as part of group efforts.	**Section A** Basic Principles: Object-oriented (OO) programming; Concept of objects and classes; Correspondence between software objects and real-world objects; Concept of class hierarchies; Object-oriented modeling; Unified Modeling Language (UML). Programming Basics: Program types; Source files and class files; Packages; Basic OO program components. Language Fundamentals: Identifiers; Variables; Values; Data types and operators; Arrays; Strings; Control structures; Classes and objects; Data abstraction. Classes: Constructors and destructors; Methods; Attributes; Class and member scope; Library classes; Programmer-defined classes; "Has-a" relationships; Encapsulation; Data hiding and protection. Inheritance, Interfaces, and Abstract Classes:"Is-a" relationships and inheritance; Overriding of methods; Polymorphism; Run-time binding; Abstract classes and methods; Interfaces. **Section B** Graphics and Event Handling: AWT; Swing; Event-driven programming; Components and containers, Layout managers and menus, Applet programming. Concurrent Programming: Threads, States of Java Threads, Runnable interface, Race conditions, Critical sections File I/O: Streams, Binary versus text files; Reading and writing text files; Reading/Writing an array of objects from/to a file. Exception Handling: Types of exceptions, Exception class, creating customized exceptions and throwing them. Advanced Topics: Introduction to Java Beans; Database connectivity with java; Socket programming with java.		

Course: CSE1202: Object Oriented Programming Laboratory	**Credit Hour: 1.5**	**Year: First**	**Term: Second**
Rationale: This course is designed to provide the fundamentals of Object-Oriented Programming (OOP) concept and OOP-based software development methodology.			
Course Objectives Objectives of this course is to help students to: • Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc. • Be aware of the important topics and principles of software development. • Have the ability to write a computer program to solve specified problems. • Get familiarized with the tools that streamline object-oriented development • Be able to use the Java SDK environment to create, debug and run Java programs			
Intended Learning Outcomes	**Course Content**		
• Understand better the object-oriented approach in programming. • Analyze and design a computer program to solve real world problems based on object-oriented principles.	1. **Introduction:** Introduction to java application and applets, Control structures, Methods, Arrays 2. **Object based Programming :** Creating packages, Using overloaded constructors, Static class variables, Data abstraction and information hiding, Relation between super class objects and subclass objects, Composition verses inheritance,		

• Implement graphical user interface and event handling in an object-oriented fashion • Develop efficient Java applets and applications using OOP concept • Build computer systems in groups and develop group work. • Work responsibly, effectively and appropriately as an individual and as part of group efforts.	Polymorphism, Dynamic method binding, Abstract super classes and concrete super classes, Inheriting interface, Use of inner classes and wrapper classes 3. **Designing GUI :** Graphs and Java, Overview of swing, Event handling, Adapter classes and layout managers 4. **Exception handling and multithreading:** When exception handling should be used, Java exception handling exceptions and inheritance, Multithreading in java, Thread synchronization, Runnable interface, Files and streams 5. **Network and Database handling:** Using JOSC, Processing queries, Overview of servlet, Introduction to networking, Establishing a simple server and a client, Introduction to RMI, Implementing the remote interface

Course: CSE 1203: Structured Programming II	**Credit Hour: 02**	**Year: First**	**Term: Second**
Rationale: This course is designed to provide advanced knowledge and expertise on structured programming language to solve various problems.			
Course Objectives • To provide advanced knowledge and experience on structured programming • To help students to develop programming skills to solve different problems • To make students able to understand and implement various concepts and structures of C programming language			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: Design and implement programs involving recursion, pointers and functions. Explain the difference between call by value and call by reference. Understand the dynamics of memory by the use of pointers. Create and update basic data files. Understand and use basic graphics functions.	**Section A** Conditional Statements: Decision Making and Looping; Recursion; Iteration Versus Recursion; Searching and Sorting; Preprocessors, Pointers; **Section B** File Managements: Files Handles, File Tests, Directory Operations, Manipulating Files and Directories; Dynamic Memory Allocation and Linked Lists; Screen and Graphics Functions.		

Course: CSE 1204: Structured Programming Laboratory II	**Credit Hour: 1.5**	**Year: First**	**Term: Second**
Rationale: This course is designed to improve skill and expertise on structured programming language by solvingvarious problems.			
Course Objectives • To help students to develop programming skills to solve different problems. • To assist student to implement various advanced concepts and structures of C programming language			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: • Design and implement programs using recursion, pointers and functions. • Allocate dynamic memory locations using pointers. • Perform different operation on data files. • Use basic graphics functions.	Based on CSE 1203 (Structured Programming II)		

Course: ECE 1251: Electronic Devices and Circuits	**Credit Hour: 03**	**Year: First**	**Term: Second**
Rationale: This course is designed to give knowledge about basic electronic devices i.e. various Unipolar & bipolar devices, oscillators, power supplies, amplifiers, Op-Amps, pnpn devices and their workings.			
Course Objectives • To introduce constructions, workings, characteristics, models, and practical applications of basic unipolar and bipolar devices. • To give knowledge about how amplification of signals is performed, devices used to amplify signals, problems related to signal amplification, and practical amplifier circuits. • To introduce feedback concepts in electronic circuits, various practical feedback circuits, oscillators and its' types. • To provides basic concepts of power supplies & voltage regulations, problems related to voltage regulation, and types of voltage regulations.			

- To provide concepts about present fabrication technologies used in making IC, types of IC, factors of miniaturization.

Intended Learning Outcome (ILO)	Course Content
At the end of the course the students will be able to: • Explain basic operation and characteristics of a diode in the no-bias, forward-bias, and reverse-bias regions; Construct the equivalent circuit of a diode. • Understand the series-parallel arrangement of diode circuits and design various types of rectifier circuits. • Explain Bipolar Junction Transistor with properties; analyze different configurations for BJT to design new BJT based circuits. • Illustrate the equivalent model to find the important ac parameters for BJT AC analysis and become aware of the general ac characteristics of a variety of important BJT configurations. • Explain Operational Amplifier with basic properties, use the explanation to analyze the application of Op-Amp, and design new Op-Amp based circuits. • Differentiate between power amplifiers. • Design power amplifier circuits. • Explain FET, MOSFET and their properties, use the explanation to analyze the application of FET & MOSFET, and design different FET & MOSFET based circuits. • Explain the importance of biasing, draw and explain biasing circuits of FET and MOSFET, demonstrate mathematical analysis, and construct FET & MOSFET based biasing circuits. • Distinguish between bipolar and unipolar devices, justify their applications, and plan to use these in different dimensions. • Analyze and explain pnpn based circuits and their applications, design new multilayered devices based on the explanations and probable applications. • Explore practical power supply circuits, concepts of voltage regulations, draw and design application oriented regulated power supply circuits.	**Section A** Semiconductors, Junction Diode Characteristics, Bipolar Transistor Characteristics, C.E., C.B. and C.C. analysis, Transistor Biasing, Small-Signal Low Frequency h-parameter model, Hybrid pie model, Amplifiers, High Impedance Transistor Circuits, Darlington Pairs, Introduction to Oscillators, Differential Amplifiers, Linear Application of op-amp, gain, input and output impedances, offset null adjustments, frequency response and noise. **Section B** Introduction to JFET, MOSFET, NMOS and CMOS, Biasing and application in switching circuits. SCR, TRIAC, UJT: Characteristics and applications, Introduction to rectifiers, active filters, regulated power supply, SMPS, Stabilizer and UPS, Basic Idea about IC Fabrication Techniques.

Course: ECE 1252: Electronic Devices and Circuits Laboratory	Credit Hour: 0.75	Year: First	Term: Second

Rationale: This course is designed to give hands on training about basic electronic devices, their workings, and troubleshooting techniques.

Course Objectives

- To explore the working principles of basic electronic devices: diode, transistor, rectifier, amplifier, power supply etc.
- To understand the building blocks/necessary devices to create these basic electronic devices based circuits in laboratory.
- To explore and troubleshoot the problems practically regarding these basic electronic devices based circuits.
- To design new circuits using these basic electronic devices for specific applications in laboratory.

Intended Learning Outcome (ILO)	Course Content
At the end of the course the students will be able to: • Synthesize the workings of basic electronic devices, draw and design the practical circuits used in signal rectification, amplification, basic logic gates, regulated power supply etc. • Troubleshoot problems related to these circuits. • Design new circuits based on the specific requirements.	Laboratory based on the course ECE 1251

Course: MATH 1253:Geometry and Differential Equations	Credit Hour: 3.00	Year: First	Term: Second

Rationale: The course covers the basic theory of Geometry and Ordinary Differential Equations (ODEs) in details.

Objectives

- To create the ability of solving problems by using techniques from calculus, linear algebra, differential equations, probability and statistics
- To provide the knowledge of mathematics to construct, analyze and interpret mathematical models

- To make capable to apply mathematics to the solutions of problems

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: • Understand how a mathematical system, like geometry, is formed • Learn the basic terms and postulates of geometry • Determine where a point is on a line • Understand the measure of segments • Learn special relationships between pairs of angles • Use algebra to find angle measures • Determine whether segments are congruent • Use segment postulates and algebra to find segment lengths • Provide an understanding the concept of odes • Select the appropriate method to solve differential equations with constant coefficients • Understand the behavior of the solutions of differential equations with discontinuous non-homogeneous parts, use Laplace transforms to solve that kind of equations • Use power series to solve odes • Find the solutions of systems of first order linear equations	**Section A** Coordinate Geometry: Coordinate Geometry of two dimensions: Change of axes, Transformation of coordinates, simplification of equations of curves. Coordinate Geometry of three dimensions: System of coordinates. Distance of two points, Section formula, Projection. Direction cosines. Equation of planes and lines, Sphere, cone, cylinder, paraboloid, hyperboloid and general equation of second degree and reduction to standard forms. **Section B** Ordinary Differential Equations: Degree and order of ordinary differential equations. Formation of differential equations. Solutions of first order differential equations by various methods. Solutions of general linear equations of second and higher orders with constant coefficients. Solution of homogeneous linear equations. Solution of differential equations of the higher order when the dependent of independent variables are absent. Linear equation with variable co-efficient.

Course: CHEM 1251:Chemistry	Credit Hour: 03	Year: First	Term: Second

Rationale: This course provides some basic but solid ground of chemistry including the chemical reactions, various kinds of solutions with the properties, kinetic and chemical equilibrium etc.

Course Objectives

- To provide a brief idea of various types of chemical solutions with their properties and applications, evolution and absorption of heat.
- Illustrate the kinetic and chemical equilibrium; rate of a reaction, different factors influencing the rate of chemical reactions

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: • Demonstrate broad knowledge of chemical concepts; • Predict and analyze the effects of chemical changes; • Manipulate expressions of chemical quantities to derive higher-order relationships;	**Section A** Aqueous Solution: Types of solution, Factors influencing the solubility of a substance, The Lechatelier's principle, Mechanism of dissolution, Evolution and absorption of heat. Different units of concentration, Problems involving acid base titration. Solution of gases in liquids. Distribution of solute between two immiscible solvent, Application of distribution law. Properties of dilute solution, Vapor pressure, Raoult's law - its application. Elevation of boiling point, Depression of freezing point and osmotic pressure. Colloids and properties of Colloidal system. Chemical Bond: Different types of chemical bond, General properties of ionic and covalent compounds. Modern approach of covalent bond. **Section B** Physical Chemistry: Kinetic and chemical equilibrium; rate of a reaction, Factors determining the rate. Law of mass action, Evaluation and characteristics of equilibrium constant of reaction. Thermo-chemistry: Types of energy, Enthalpy Heat of reaction, heat of combustion, Heat of formation and heat of neutralization. Electrolytes, Mechanism of electrolytic conduction, Transport number and electrolytic conductance.

Course: ENG 1251: English	Credit Hour: 02	Year: First	Term: Second

Rationale: For effective communication competence in language skills is essential. The course offers the students an opportunity to know the skills of English Language and their proper uses.

Course Objectives

This course is designed to:

- Help students learn about the major skills of English language and their proper applications in everyday life
- Develop students' communicative competence

Intended Learning Outcomes (ILOs)	Course Content
After the end of the course the students will be able to: • Know how to develop vocabulary scientifically • Learn about the proper use of parts of speech • Apply how to transform one part of speech into another part • Verify the structures of basic sentences • Identify different clauses and phrases • Differentiate between clauses and phrases • Know how to join different sentences into one • Become skilled at how to transform sentences from one structure into another one • frame w/h questions • Know about the perspectives on reading comprehension • Learn about the elements of reading • Understand the reading strategies • Become skilled at the process of note-taking • Understand the art of good speaking • Apply practically different notions of speaking • Learn about intonation and stress • Know about the process of writing • Differentiate between academic writing and non-academic writing • Identify the mechanics in writing • Learn how to generate ideas for a writing task • Know about the modes of writing • Apply practically different structures of writing • Become skilled at how to develop listening skill • Learn about the role of a good listener	**Section A** Development of Vocabulary: Processes of Word Formation and Transformation; Proper use of parts of speech Sentence Structure: Structures of Basic Sentences, Identification of Clauses and Phrases, Joining sentences, Transformation of Sentences, Framing W/H Questions Reading and Understanding: Perspectives on reading comprehension; Elements of reading: vocabulary, syntax and meaning; Reading strategies: intensive and extensive reading; scanning and skimming; prediction and inference; reader's expectation and interpretation; contextual understanding and understanding the whole text; effective note-taking. **Section B** Development of Speaking skills: Art of Good Speaking, Notions and Functions, Speaker-listener Rapport, Intonation and Stress Development of Writing Skills: Process of writing, Understanding Academic Writing: features and elements, Mechanics in Writing: Capitalization and Punctuation; Generating ideas for a writing task; Drafting and Supporting ideas with evidence; Integrating data and graphics in texts; Modes of writing, Writing tasks: Paragraph, Essay, Summary, Précis, Report, Abstract, Letter of Application, Assignment, Examination Paper Development of Listening Skills: Guide Lines for Developing Listening Skills, Role of a Good Listener, Listening Comprehension

Course: ENG 1252: English Skills Laboratory	Credit Hour: 0.75	Year: First	Term: Second
Rationale: TheEnglish Skills Laboratory focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations and contexts.			
Course Objectives This course is designed to: • Facilitate computer-aided multi-media instruction enabling individualized and independent language Learning • Sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm • Bring about a consistent accent and intelligibility in their pronunciation of English by providing an opportunity for practice in speaking • Improve the fluency in spoken English and neutralize mother tongue influence • Train students to use language appropriately for interviews, group discussion and public speaking			
Intended Learning Outcomes (ILOs)	**Course Content**		
After the end of the course the students will be able to: • Understanding of nuances of language through	Introduction to Phonetics – Speech Sounds – Vowels and Consonants; Ice-Breaking activity; Situational Dialogues – Role-Play- Expressions in		

audio- visual experience and group activities • Speak with clarity and confidence thereby enhancing employability skills of the students	Various Situations – Self introduction and Introducing Others – Greetings – Apologies – Requests – Social and Professional Etiquette - Telephone Etiquette; Word accent and Stress Shifts- Listening Comprehension; Intonation and Common errors in Pronunciation; Public Speaking; Neutralization of Mother Tongue Influence and Conversation Practice;

SECOND YEAR FIRST TERM

Course: CSE -2101: Data Structure	**Credit Hour: 03**	**Year: Second**	**Term: First**
Rationale: This course introduces fundamental data structures and explains abstract data types and their representations based on arrays, pointers and Link list. It also discusses the advantages and disadvantages of the different types of representations of data types. It introduces algorithms for efficient searching, insertion and deletion using data structures stored in internal memory.			
Course Objectives: • Introduce the subject with the explanation of how data can be stored and manipulated in computer's memory in an optimized way. • Organize data using different types of data structures. • Perform major operations such as addition, deletion and location of data items in each of data structures. • Solve some problems using appropriate data structures. • Design and analysis of elementary algorithms to perform operations on data structures.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course, the students will be able to- 1. Know the importance of data structures and algorithm as well as the program. 2. Explain how different types of data can be organized in a structure. 3. Organize a list of data in an array and perform an operation on the element of an array. 4. Analyze of different types of linked list, do operations like location, insertion and deletion of a node in linked list.	**Section – A** **Introduction:** concept and importance of data, data structure,relation between the data structure and algorithm (program), major operations on the data structure. **Array**: Definition of one dimensional and two dimensional arrays and their representations, different operations using an array. **Linked List**: Concept of pointers, linear linked list, doubly linked list, circular linked list. Operation on each type of liked list. **Stack:** Definition of the stack, its implementation using an array and linked list. Prefix to postfix conversion using the stack. Evaluation of mathematical expression using the stack. **Queue:** Concept of the queue, representation of queue using an array and linked list with implementation. Drawbacks for array based queue and application of queue in the network, the internet etc.		

5. Implement Stack and Queue, and implementation of them using an array as well as linked list. 6. Use of recursion and organize data in different types of Trees, perform operations using array based and linked list based trees and describe the necessity of it. 7. Get the concept of a graph, its representation in memory and some specific operations using graph. 8. Apply some searching and sorting algorithms where data structures are used. 9. Analyze hashing, study different types hash functions and how to organize data in a hash table for efficient searching and retrieving of data. 10. Organize data using an appropriate data structure in an efficient way and perform necessary operations using data structures.	**Section – B** **Tree**: definition of different types of trees. Representation of binary tree using an array and linked list. Binary tree traversal methods using recursive functions. Binary search tree and different operations on it, Balance binary search trees, AVL trees. The concept of the heap, Fibonacci heaps, binomial heaps and different operation on the heap. **Graph**: The concept of different types of graphs. Representation of graphs using an array and linked lists. Graph traversal methods. Definition of spanning tree and minimum cost spanning tree. Kruskal's and Prim's algorithms. Single source shortest path problem and related algorithm. **Searching and Sorting:** Definition of searching and algorithms related to searching. The concept of internal and external sorts. Some elementary sorting algorithms (quick sort, merge sort, head sort). **Hashing**: Concept of hashing. Definition of the hash function, hash table. Different types of hash functions, hash collision and its resolution schemes.

Course: CSE -2102: Data Structure Sessional	**Credit Hour: 1.5**	**Year: Second**	**Term: First**

Rationale: This course concerns with practical lessons based on the theoretical knowledge from the course CSE-2101. The lessons demonstrate the practical knowledge by performing operations on different fundamental data structures using any widely used programming language such as C, C++, Java etc.

Course Objectives:

- Introduce the practical knowledge with the operation of how data can be stored and manipulated in computer's memory in an optimized way.
- Practically organize data using different types of data structures.
- Perform major operations such as addition, deletion and location of data items in each of data structures.
- Design and develop programs to solve problems using appropriate data structures.
- Design and analysis of elementary algorithms and implement them using programs to perform operations on data structures.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course, the students will be able to- • Gain practical knowledge about the importance of data structure and algorithm as well as the program. • Develop their thinking and achieve the ability to practically organize different types of data using appropriate a structure. • Organize a list of data in an array and perform operations on the element of an array and implement it. • Perform operations like location, insertion and deletion of a node in linked list. • Develop programs using the concept of Stack and Queue, and implementation of them using an array as well as linked list.	**Section – A** **Introduction:** implementation of some elementary programs where different types of data are used. **Array**: Implementation of searching, insertion, merging operations using one dimensional array. Implementation of some algorithms where two-dimensional arrays are used. Implementation of algorithms where one dimensional and two dimensional dynamic arrays are used. **Record (Structure):** Development of programs where different types of data are organized using structure. **Linked List**: implementation of algorithms to add node to different place of linear linked and doubly linked list. Similarly development of programs to delete node from different places of linear and doubly

• Develop program using recursion and organize data in different types of Trees, perform operations using array based and linked list based trees and do practical. • Represent graph using two dimensional array and linked list to do practical operations on the graph data. • Implement some searching and sorting algorithms. • Create a hash table using array and linked list; store data using hash function, resolve collision using collision resolution scheme.	linked lists. **Stack:** Development of programs to evaluate a mathematical expression using the stack, to convert prefix to postfix expression and evaluate the expression using the stack. **Queue:** Do practical using array based and linked list based queues. **Section – B** **Tree**: Development of programs to represent of binary tree using an array and linked list. Implementation of Binary tree traversal methods using recursive functions. Create Binary search tree and perform different operations on it. Create heap and perform different operations such as addition of a node and deletion of root node from the heap. **Graph**: Develop program to store data of the graph and implement BFS and DFS traversal methods. **Searching and Sorting:** Implementation of searching and sorting algorithms. **Hashing**: Development of the program to create a hash table to store data in it and implementation of some hash collision resolution schemes.

Course: CSE 2105: Numerical Methods	**Credit Hour: 03**	**Year: Second**	**Term: First**
Rationale: This course is intended as an introduction to techniques for carrying out numerical computation on computers. Emphasis is given to programming techniques and style, and techniques for numerical methods.			
Course Objectives: • To help students the basic numerical techniques with the underlying mathematical notions, • To assist students acquire the ability to interpret the reliability of numerical results, To provide programming skills to implement simple numerical algorithms			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to- • Determine the errors of computations resulting from computer limitations, and estimate their size. • Solve non-linear equations using numerical algorithms. • Solve systems of linear equations using numerical algorithms. • Analyze the sensitivity of a system of linear equations by using its conditioning number. • Interpolate data points using spline methods. • Fit models to data using the methods of linear least squares. • Numerically approximate derivatives and integrals	**Section – A** Numerical Approximations and Round-off errors **Roots of Equations**: Bracketing Methods, Open Methods, Roots of Polynomials **Solving Simultaneous Set of Linear Equations**: Gauss Elimination, LU Decomposition and Matrix Inversion, Special Matrices and Gauss-Seidal Curve Fitting: Least-Squares Regression. **Section – B** **Optimization**: One Dimensional Unconstrained Optimization, Multidimensional Unconstrained Optimization **Interpolations**: Newton's Divided-Difference Interpolating Polynomials, Lagrange Interpolating Polynomials, coefficients of an Interpolating Polynomial, Inverse Interpolation **Integration:** the Trapezoidal rule, Simpson's rule Ordinary Differential Equations: Newton-cotes Algorithm for Equations, Romberg Integration, Gauss Quadrature, Euler's method, Runge-Kutta Methods, Systems of Equations.		

Course: CSE 2106: Numerical Methods Laboratory	**Credit Hour: 0.75**	**Year: Second**	**Term: First**
Rationale: This course is intended as an introduction to techniques for carrying out numerical computation on computers. Emphasis is given to programming techniques and style, and techniques for numerical methods.			

Course Objectives:

- To help students the basic numerical techniques with the underlying mathematical notions,
- To assist students acquire the ability to interpret the reliability of numerical results,
- To provide programming skills to implement simple numerical algorithms.

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to- • Determine the errors of computations resulting from computer limitations, and estimate their size. • Solve non-linear equations using numerical algorithms. • Solve systems of linear equations using numerical algorithms. • Analyze the sensitivity of a system of linear equations by using its conditioning number. • Interpolate data points using spline methods. • Fit models to data using the methods of linear least squares. • Numerically approximate derivatives and integrals	Laboratory work is based on the course **CSE 2105**

Course: CSE 2111: Digital Logic Design	Credit Hour: 03	Year: Second	Term: First
Rationale: This course provides the students with the basic concepts of logic gates and digital circuits.			
Course Objectives: • Describe number systems, Boolean algebra, Boolean function minimization, fault diagnosis in circuits etc. • Identify and describe the different logic gates, combinational circuits, flip flops and sequential circuits including counter, register, state recognizer etc.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course students will be able to: 1. Describe the number system and Booleanalgebra in details. 2. Identify and describe the basic logic gates, logic gates combination, universal gates 3. Minimize Boolean functions and design the circuits for the minimized functions. 4. Describe different data handling logic circuits like decoder, encoder, multiplexer etc and implementing Boolean functions using those. 5. Detect the fault in combinational circuits and correct that. 6. Define and describe the purpose and characteristics of different flip-flops. 7. Analyze and design different synchronous and asynchronous sequential circuits including counter, register, finite state recognizer etc. 8. Minimize sequential machine.	**Section – A** Number Systems and Codes, Review of Set theory, Boolean Algebra, Boolean Function, Canonical Forms, Minimization of Boolean Functions, Logic Gates and their Truth Tables, Combinational Logic Design, Arithmetic and Data handling logic circuits – Decoders, Encoders, Multiplexer and Demultiplexer. NAND and NOR circuits. Reliable Design and Fault Diagnosis Hazards. Fault Detection in Combinational circuits, Fault Location Experiments, Threshold Logic. **Section – B** Flip-flops, Introduction to synchronous sequential circuits and iterative networks. Sequential machine state equivalence and machine minimization. Asynchronous Sequential Circuits. Finite State Recognizer - regular expressions, Transition Graphs, Counters, Asynchronous Counters, Synchronous counter, Registers.		

Course: CSE 2112: Digital Logic Design Laboratory	Credit Hour: 1.50	Year: Second	Term: First
Rationale: This course makes students adept in basic concepts involved in digital logic design. The lab contributes a lot to the basic learning of digital logic design.			
Course Objectives: • To make student enable to implement both combinational and sequential circuits using IC and Flip-Flops.			
Intended Learning Outcomes (ILOs)	**Course Content**		

At the end of the course students will be able to: • Verify the Behavior of Logic Gates using Truth Table and Familiarization with Digital Integrated Circuits • Implement combinational circuit using ICs for basic logic gates such as Adder, Subtractor, Multiplier, BCD adder, Comparator, Decoder, Multiplexer etc. • Implement different circuit through the Development of Dedicated IC(ASIC) • Implement different sequential circuits like counter, shifter etc.	Based on CSE 2111 (Digital Logic Design)

Course: CSE 2113: Advanced Programming.	**Credit Hour: 2.00**	**Year: Second**	**Term: First**
Rationale: This course aims to introduce students to .NET Programming, PHP, Visual C++, Android, C#, Ruby, Python, Game Programming etc.			
Course Objectives: • To help students in understanding not only the syntactical features of the above mentioned languages, but also how to effectively use the design of the language to develop robust software. • Provide the students a deep understanding of advanced programming concepts such as encapsulation, polymorphisms and generic data types using the above mentioned languages.			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course students will be able to: • Discuss software design and development strategies and explore underpinning concepts as related to practical projects using advanced programming techniques • Organize separate source files, with larger programs in mind, so that they reflect the use of Abstract Data Types wherever required		**Section A** **Frameworks:** .Net Framework, PHP frameworks, Java frameworks, Django, Ruby on Rails, Graphical User Interface (GUI) libraries. **Environment**: Java Development Kit (JDK), Visual C++, Android, C#, Development environment – Python, Ruby, PHP.	
• Demonstrate how computer memory works in the context of the advanced programming languages • Employ good programming style, standards and practices, during program development • Analyze and solve computing problems, develop suitable algorithmic solutions which are then coded in the programming language • Discuss and use appropriate strategies to develop bug free software including debugging skills, including identifying appropriate debugging tools.		**Section B** **Programming:** Game Programming, modular design, exception handling, Reflection, distributed programming, multi-threading, GPU, Computer Socket Programming, Network Programming: Protocols, IP, TCP and URL.	

Course: ECE 2151: Digital Electronics	**Credit Hour:** 3.0	**Year:** Second	**Term:** First
Rationale: This course is designed to develop the skills to analyze and design various digital electronics circuits and systems.			
Course Objectives: ▪ Make the students familiarize with the structure and operation of basic units of digital systems. ▪ Develop their skill to design and simulate a number of digital electronic circuits. • Prepare the students for follow-up courses in digital electronics..			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: 1. Distinguish between digital logic families. 2. Perform basic logic operations using diode, BJT, and MOS transistor. 3. Describe the operation of TTL, ECL, IIL and CMOS logic and calculate fan-outs, propagation delays and noise margins for universal gate (XOR) of these logic families. 4. Design Flop-flops, counters and		**<u>Section A</u>** **Logic Gates:** Diode Logic Gates, Transistor Switches, Transistor Gates, MOS Gates. **Logic Families:** TTL, ECL, IIL and CMOS Logic with operation details. Propagation Delay, Product and Noise Immunity. Open Collector and high impedance Gates. Electronic Circuits for Flip-Flop, Counter and Register. Memory System, PLAs and PLDs,	

registers using ICs. 5. Apply memory expansion technique to expand memory size. 6. Describe the operation of S/H circuits and design D/A converter circuits. 7. Design wave shaping circuits using OP-AMPs. 8. Learn different types of clipping and clamping circuit. 9. Learn the effects of bulk resistance and non-linear behavior of diode. 10. Design the circuits. 11. Have an idea of different types of comparator, their VTC (Voltage transfer curve), design and applications. 12. Have basic idea of pulse transformer and transmission line to transmit pulse. 13. Learn Schmitt trigger, functional block diagram, operation, design and applications of different multivibrators. 14. Describe the operation of different time-base generators and different sweep errors.	D/A Converters with applications. S/H Circuits, LED, LCD and optically coupled oscillators. Nonlinear application of OP-AMP, Analog Switches. **Section B** **Linear wave shaping**: diode wave shaping techniques, clipping and clamping circuits. Comparator circuits, switching circuits. Pulse Transformer, pulse transmission. **Pulse generator:** Monostable, bistable and astable multi-vibrators. Schmitt trigger. **Blocking oscillators and time-base circuits:** Simple voltage sweeps, Linear current sweeps.

Course: Math2153: Vector Analysis and Matrix	**Credit Hour: 03**	**Year: Second**	**Term: First**
Rationale: The purpose of the course is to provide an understanding of the basic relations of vector analysis, to demonstrate practical applications of vector analysis and to train the student in problem formalization and in methods of solution.			
Course Objective: • The objective of the module is to introduce and develop the methods of vector analysis. These methods provide a natural aid to the understanding of geometry and some physical concepts. They are also a fundamental tool in many theories of Applied Mathematics.			
Intended Learning Outcomes (ILOs)	**Course Content**		
By the end of the course, students will be able to: • Calculate scalar and vector products. • Find the vector equations of lines and planes. • Understand the parametric equations of curves and surfaces • Differentiate vector functions of a single variable. • Calculate velocity and acceleration vectors for moving particles. • Understand and be able to find the unit tangent vector, the unit principal normal and thecurvature of a space curve. • Find the gradient of a function. • Find the divergence and curl of a vector field and prove identities involving these. • Use the gradient operator to calculate the directional derivative of a function. • Calculate the unit normal at a point on a surface. • Recognize irrotational and solenoidal vector fields. • Evaluate line and surface integrals. • Understand the various integral theorems relating line, surface and volume integrals.	**Section A:** **Vector Analysis:** Definition of Vectors. Equality of Vectors. Addition and Multiplication of Vectors. Dependence and independence of Vectors. Differentiation and Integration of Vectors together with elementary applications. Definitions of line, surface and volume integrals. Gradient of a scalar function. Divergence and Curl of a Vector Function. Physical Significance of Gradient, Divergence and Curl, Various Formulate. Integral Forms of Gradient, Divergence and Curl Divergence Theorem. Stoke's Theorem, Green's Theorem and Gauss's Theorem, Curvillinear coordinates. **Section B:** **Matrix:** Definition of Matrix, Equality of two Matrices, Addition, Subtraction and Multiplication Matrices, Transpose of Matrices, Inverse of Matrices, Rank of Matrices. System of Linear Equations.		

SECOND YEAR, SECOND TERM

Course: CSE 2201: Algorithms	Credit Hour: 03	Year: Second	Term: Second

Rationale: This course is about the basic fundamental data structures and algorithms which form the basis of large complex software systems.

Course Objectives:

- To become familiar with the tools and techniques necessary to propose practical algorithmic solutions to real-world problems which still allow strong theoretical bounds on time and space usage.
- To introduce broad variety of important and useful algorithms and data structures in different areas of applications, and to concentrate on fundamental algorithms.
- To know the importance of studying the complexity of a given algorithm.
- To study some techniques for solving hard problems.

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to- 1. Understand the purpose and mathematical background of algorithm analysis and be able to apply this to determine the run time and memory usage of algorithms; 2. Compare the abstract data types of stacks, queues and dequeues; 3. Analyze the methods for design of efficient algorithm 4. Apply various sorting algorithms and the run-time analysis required to determine their efficiencies; 5. Develop and evaluate numerous algorithm design techniques including greedy, divide-and-conquer, dynamic programming, and backtracking; 6. Illustrate various search and traversal technique algorithms. 7. Apply and analyze various search and graph algorithms. 8. Demonstrate concepts such as decision problems, the question of P = NP, NP completeness and the halting problem.	**Section – A** Introduction to algorithms, Correctness proof and techniques for analysis of algorithms,Asymptotic Analysis: growth of functions, O, Ω and Θ notations, Methods for designing of efficient algorithms, Divide and Conquer, Greedy Method, Dynamics Programming, Backtracking. **Section – B** Basic Search and Traversal Techniques, Graph Algorithms, DFS, BFS, application of DFS and BFS, Definition of spanning tree and minimum cost spanning tree;Kruskal's and Prim's algorithms, Single source shortest path problem and related algorithm, maximum flow and minimum flow, bipartite matching, Branch and Bound, approximation algorithm, string matching algorithm, FFT and its application; Algebraic Simplification and Transformations, Lower Bound Theory, NP Hard and NP Complete Problems.

Course: CSE 2202: Algorithms Laboratory	Credit Hour: 1.5	Year: Second	Term: Second

Rationale: Practical implementation of the algorithms that are learned from the course CSE 2201: Algorithms.

Course Objective:

- The objective of this lab course is to design and develop programs, debug and test their executions with realistic and challenging data, as well as conduct experiments to get a sense of the time and storage (memory) efficiency of the program codes.

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: 1. To have a collection of usable programs and data structures technique that could make their future programming tasks/projects easier. 2. Understand how algorithms and the implemented programs can be applied in a broader context. 3. Develop an understanding of the value and appreciate the skills of algorithm and program performance analysis. 4. Will have knowledge to convert a written algorithm or pseudo-code to a high level programming languages like C++, JAVA etc.	Laboratory based on the course CSE 2201.

Course: CSE 2203: Computer Architecture	Credit Hour: 03	Year: Second	Term: Second

Rationale: This course aims to provide a strong foundation to understand modern computer system architecture and to apply these insights and principles to future computer designs. The course is structured around the three primary building blocks of general-purpose computing systems: processors, memories, and parallel processing.

Course Objectives:

- To understand the internal architecture of processors.

- To analyze and evaluate CPU and memory hierarchy performance
- To understand the design of a pipelined CPU and cache hierarchy
- an understanding of trade-offs in modern CPU design including issues affecting superscalar and dynamically scheduled architectures

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Understand the internal architecture of single and 3-bus processors. 2. Understand how an instruction executes using instruction sequence. 3. Convert instruction to hardware connection of components. 4. Understand how micro routines are used to execute variable instruction using same control word. 5. Measure the performance for multilevel cache 6. Evaluate the virtual memory technique. 7. Understand how to improve performance using TLB 8. Understand how single step instruction can be divided into multiple stages. 9. Understand the issue of multiple hazards. 10. Understand how various types of hazards can be avoided or minimized using various techniques. 11. Combine all the improved techniques 12. Applying multiple processors for improving performance 13. Compare between polling and interrupt 14. Implement daisy chain connection of i/o devices.	**Section – A** **Introduction:**Information representation, performance measurements, instruction and data access method, operation and operand of computer hardware, representing instruction, addressing styles. **Basic Processing Unit:**Arithmetic logic unit (ALU) operations, floating point operations, designing ALU, Single Bus Architecture, 3-Bus Architecture, Fetching a word from memory, Control Sequence of an instruction, Implementation of Control Sequence in Hardware, Branch Instructions, Hardwired Control, Micro programmed Control, Microinstructions, Micro routine, Control word. **Control Unit:** Hardwired and Micro-programmed, Hazards, exceptions. **Memory**: Memory Hierarchy, Register, cache memory, primary memory, secondary memory, Multiple Level Cache Memory, performance measure for first, second and third level cache memory, virtual memory, page fault, translation look a side buffer **Section – B** **Pipelining**: Parallel processing using pipelining, improved performance for pipelining, Various types of Hazards, Data Hazard, Instruction Hazard, Control Hazard, Avoiding data hazard, avoiding instruction hazard, avoiding structural hazard. Instruction queue, branch folding, static and dynamic branch prediction, superscalar operation, precise and imprecise exception, out of order execution **Input Output Devices**: Types of i/o devices, how they connected to computer, interrupt, use of interrupt to control the i/o devices, daisy chain connection, interrupt priority

Course: CSE 2205: Operating Systems and Systems Programming	**Credit Hour: 03**	**Year: Second**	**Term: Second**

Rationale: This course is designed to teach the design of operating systems and other systems.

Course Objectives:

- To give students Knowledge and practice of operating system concepts
- To prove assistants to understand the underlying principles, techniques and approaches which constitute a coherent body of knowledge in operating systems
- To make students able to evaluate understand the services provided by and the design of an operating system
- To develop students skill in synchronizing and scheduling processes.
- To prepare students in applying different approaches to memory management

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to- 1. Program at the operating systems level. 2. Understand the internal structure of an operating system and be able to write programs using system calls. 3. Understand and explain the basic structure of a computer operating system.	**Assembler:** General Design procedures, Table Processing, Macro Language and Microprocessors. **Loaders:** Design of absolute loader and direct link loader, Linkers, Translators**.** **Evolution of Operating Systems:** Early Operating Systems, Improvements in System Utilization, Spooling, Interrupts and Interrupt Handling. **Multiprogramming and Time Sharing:** Sharing of Space and Time, Protection and Integrity.

4. Comprehend the basic concepts of file system and management, process control, scheduling and communication, as well as memory management. 5. Reason abstractly about the structure and behavior of computer systems. 6. Identify and evaluate the services provided by operating systems. **7.** Interpret the principles and practice of operating systems design, development, resource sharing and management.	**Section – B** **Systems:** Microcomputer and Microcomputer Systems, Distributed Computing and Network Based Systems. **Virtual Systems:** Virtual Memory, Paging and Segmentation, Virtual Devices and Generalization to Virtual Systems. **Concurrency Management:** Erroneous Results from concurrent Accesses, Concurrency on the basis of an Operating System, Cost Evaluation of Spooling, Long and Short Term Scheduling, Round Robin and Other Scheduling Policies. **State Space Description of Operating System:** Process Creation and Removal, Samples of Process Life Cycle and Bootstrapping, Layered Concepts in Operating Systems, Kernel, Memory Manager, I/O systems, File Manager, Resource Manager, Command Interpreter and Application Programs.

Course: CSE 2206: Operating Systems and Systems Programming Laboratory - Project	**Credit Hour: 1.5**	**Year: Second**	**Term: Second**
Rationale: This course is designed to give hands on experiences of OS implementation and abstractions (processes, file system, etc.) of the underlying hardware.			
Course Objectives: • To understand concept of Operating System such as Process Concept/management, CPU scheduling, Memory and file management • To understand & acquire hand-on experiences with OS in both user and system/kernel modes. • Implementation of system interface, protection and security mechanisms • Understanding of the various features of distributed OS like UNIX, Linux, windows etc. • to use system calls for managing processes, memory and the file system etc.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: 1. Compare and contrast various CPU scheduling algorithms 2. Service implementation at the operating systems level. 3. Write programs using system calls. 4. Understand the concepts of process, address space, and file 5. Solve problems involving key concepts and theories in operating systems, including process control, mutual exclusion, deadlock and synchronization. 6. Review, compare and evaluate different operating systems.	Laboratory/Project works based on CSE 2205		

Course: CSE -2208: Assembly Language Laboratory	**Credit Hour: 1.5**	**Year: Second**	**Term: Second**
Rationale: This course aims to provide a strong foundation to understand modern computer system architecture and code the computer with the low level assembly language. The course is structured to work with memories and registers and logic operations.			
Course Objectives: • To understand the internal architecture of processors. • To control CPU with memory in low level languages • Understand how high level language works based on low level language			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: 1. Describe the IBM PC architecture 2. Examine or change the contents of memory and the major registers 3. Write, enter, test, and run assembly language code for an IBM PC 4. Develop instructions that will	1. Describe the operation of various logic gates and the theory (Boolean algebra) behind them. 2. Distinguish between combinational and sequential logic and discuss the function of the clock. 3. Describe how a CPU performs instructions during the fetch-decode-execute cycle and how the memory supports its actions. 4. Design simple digital logic to		

perform the following operations: a. Bit manipulations b. Multiple precision integer arithmetic c. Initialization of an array and access of array elements d. Implementation of recursive algorithms e. BCD arithmetic and I/O operations 5. Use the single step mode to debug assembly language programs 6. Develop assembly language code to perform video and keyboard operations 7. Create and implement assembly language code to perform advanced input/output effecting the mouse and disk storage	produce a specific result from given inputs and/or simplify digital logic to improve the efficiency of producing a result. 5. Describe how information of various data types are represented in a computer. 6. Explain how standard arithmetic operations (+, -, *, and /) are performed by the hardware. 7. Read, write, and debug programs in assembly language. 8. Explain the uses of various machine addressing modes and why they are used. 9. Use system services in a program. 10. Explain the internal workings of the machine on a procedure call and describe the structure of the call frame. 11. Distinguish between situations in which procedures or macros are appropriate.

Course: CSE 2211 Information System Design	**Credit Hour: 02**	**Year: Second**	**Term: Second**
Rationale: This course is designed to provide basic knowledge on the application of the software engineering practices to information system development.			
Course Objectives: • To give an overview of various methods for requirement gathering. • To provide skills for applying various components related to information system development. • To prepare students for more advanced level courses and practical job.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to- 1. Know the SDLC and the role of a system analyst in SDLC. 2. Know about different types of information systems. 3. Apply different types of requirement gathering tool. 4. Express the system requirements using formal language and tools. 5. Model data in a system. 6. Design suitable user interface for an information system. 7. Design database for an information system. 8. Apply system implementation best practices for software development. 9. Distinguish different types of test strategies and apply them in software development.	**Section A** **Information System Development Environment**: Information System Analysis, Role of System Analyst, SDLC, Modern Approaches to System Development, Different Types of IS. **System Planning and Selection**: Project Feasibility Analysis, BPP, SOW, SOPS **Determining System Requirements**: Interview, Questionnaires, Directly Observing Users **Structuring System Requirements**: Process Modeling, Context DFD, 0-Level DFD, n-Level DFD, Primitive DFD, DFD Decomposition, DFD Balancing, Logic Modeling, Structured English, Decision Tables, Use Cases **Section B** **Data Modeling**: Entity, Relationships, ERD, Degrees of Relationships, Cardinalities, Selecting Best Alternative Design Strategy **Designing Human Interface**: Forms and Repots, Dialogs **Designing Databases**: Schema, Table, Meta Data, Relational Database, Normalization **System Implementation and Operation**: Coding **Testing**: unit testing, Integration Testing, System Testing, Acceptance Testing, Installation, maintenance.		

Course: CSE 2212: Information System Design Sessional	Credit Hour: 0.75	Year: Second	Term: Second
Rationale: This course is designed to provide practical knowledge of software engineering principle and practices to the intermediate level students of Computer Science and Engineering discipline.			
Course Objectives: • To apply software design and development models in real software development • To applyvarious components related to information system development in practice. • To prepare students for practical job.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to- • Apply the knowledge acquired in CSE 2211 in practical software development.	Project works based on CSE 2211.		

Course: MATH 2253: Statistics and Complex Variable	Credit Hours: 03	Year: Second	Term: First
Rationale: The course has two parts-Statistics and Complex Variable. In the first part, the introduction to the statistics is given in detail with the practical applications domain and the later part provides one of the important parts of Mathematics i.e. complex variable.			
Course Objectives: • Select, analyze, and interpret appropriate numerical data used in everyday life in numerical and graphical format. • Identify and apply appropriate strategies of quantitative problem solving in theoretical and practical applications. • Construct a conclusion using quantitative justification. • Calculate the derivative of a complex function.			
Intended Learning Outcome (ILO)	**Course Content**		
At the end of the course students will be able to: • It=Interpret complex statistical findings and graphs in the context of their level of statistical significance, including the influence of effect size, and explain these findings • Communicate quantitative data in statistics, graphs, and tables. • Find all complex solutions of a simple polynomial • Calculate the derivative of a complex function, explaining where this is well-defined. • Explain what is meant by entire, holomorphic and harmonic functions. • Derive the Cauchy-Riemann equations for a given function • Calculate the Taylor and Laurent series of a function about a given point. • Interpret the terms residue and pole, locate them for a given function and calculate their orders. • Explain what is meant by a simple pole, a pole of order m and an essential singularity. • Illustrate the contour integral of a complex function and evaluate it along a simple contour. • State the Residue Theorem and apply it when appropriate to calculate a contour integral.	**Section A** **Statistics:** Frequency Distribution. Mean Median Mode and Other Measure of Central Tendency. Standard Deviation and Measures of Dispersion. Moments. Skewness and Kurtosis. Elementary Probability Theory, Characteristics of Distribution. Elementary Sampling Theory, Estimation, Hypothesis testing and Regression Analysis. **Section B** **Complex Variable:** Complex Number System, General Functions of a Complex Variable. Limits and Continuity of a function of Complex Variable and Related Theorems. Complex Differentiation and the Cauchy – Rieman Equation. Infinite Series. Convergence and Uniform Convergence. Line Integral of a Complex Function. Cauchy Integral Formula. Liouville's Theorem. Taylor's and Laurent's Theorem. Singular Points Residue, Cauchy's Residue Theorem.		

Course: Econ 2251: Economics	Credit Hour: 2.0	Year: Second	Term: Second
Rationale: Understanding principles of economics has immense importance for scientifically solving the problems of resource allocation. By conducting this course students will be acquainted with a thorough grounding in the basic principles of economics and an exposure to a range of applications of the theory in real world problems.			
Course Objectives: • To provide a self-contained introduction to economics principles. • To develop an understanding of fundamental concepts in micro and macroeconomic analysis. • To equip students with a range of appropriate analytical skills including descriptive and graphical methods for solving real world problems.			

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to ▪ Understand the key ideas that define the economic way of thinking as a computer engineer and policy advisers. ▪ Acquire familiarity with a range of micro and macroeconomic issues. ▪ Demonstrate substantial knowledge on fundamental economic question of allocating scarce resources, principles of demand, supply, market price and quantity determination. ▪ Grasp the knowledge of how consumers make choices and understand the production theory and firm behavior ▪ Explain the measurement of macroeconomic aggregates and realize the functions of money, central bank and commercial bank. ▪ Evaluate the major development problems, policy instruments and their applicability in Bangladesh and other developing countries.	**Section – A** **Basic Concepts:** Definition of Economics, Nature and scope of Economics, Micro versus macro economics, Positive versus normative economics, scarcity, choice, want, commodity, utility, wealth, value, price, welfare, production, exchange, distribution, consumption, economic good versus free good, economic system, basic economic problems, solution of these problems, Production Possibility Curve. **Demand and supply:** Concept of demand and supply, law of demand and supply, determinants of demand and supply, movement along demand and supply curves, shifting of demand and supply curves, market demand curve, market equilibrium, consumer's surplus and producer's surplus, shift of equilibrium, various concepts of demand elasticities-price, income and cross elasticity, supply elasticity. **Economics of Consumer Behaviour and Utility Analysis**: Cardinal versus ordinal measurement of utility, concept of total and marginal utility, Marshallian utility analysis, indifference curve analysis, budget constraints, consumer's equilibrium, substitution effect, income effect and price effect. **Economics of Production:** Factors of production, production function, total , average and marginal products, stages of production, law of diminishing return, law of variable proportion, returns to scale, isoquants, isocost lines and producer's equilibrium. **Theory of Cost and Revenue:** Short run and long run costs, fixed and variable cost, average, total and marginal cost, envelope curve, concept of total, average and marginal revenue.
	Section – B **National Income:** Definition, concepts, roles, GDP, GNP, NNP, personal income, disposable income, nominal versus real GNP, methods of measuring national income – product, expenditure, income and value added approach, circular flow of income and expenditure – two sector economy. **Money and Banking:** Definition and functions of money, kinds of money, money and the price level, velocity and quantity equation, transition from Goldsmith banking o modern banking, central bank and its function, commercial bank and its function, money stock, money supply, open market operation, high powered money. **Economics of Development and Planning:** Basic concepts, growth versus development, per capita income as an index of economic development, policy instruments of development, fiscal policy, trade policy and the relative applicability in Bangladesh, planning in Bangladesh-five year plans of Bangladesh.

THIRD YEAR, FIRST TERM

Course: CSE 3100: Technical Writing and Presentation	**Credit Hour:** 1.50	**Year:** Third	**Term:** First

Rationale: In this course, students will develop the scientific and technical reading and writing skills they need to understand and construct research articles.

Course Objectives:

- Identify the structure of technical research papers in specialist fields.
- Understand research journal Call for Papers and Instructions for Authors.
- Write the title, abstract, introduction, materials/methods, results, discussion/conclusion sections of a research paper in a specialist field.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Analyze tools to identify differences in the audience, purpose, structure, style, and presentation of technical texts in different fields. 2. Know how to strengthen or weaken the interpretation of research findings. 3. Understand the importance of references, citations, and avoidance of plagiarism. 4. Follow common conventions for citing and referencing information in a research article. 5. Explain information in figures and tables. 6. Explain methods and processes and develop the title, abstract, introduction, materials/methods, results, discussion/conclusion sections of a research paper in a specialist field.	**Overview of Technical Research and Technical Writing:** Technical Writing, Why Technical Writing, Role of a Technical Writer. Information Structure/Techniques in Technical Writing, Types of Technical Report, Business Letters, Graphic Aids, Software Development Life Cycle, DDLC, **Documentation Process, and Technical Writing Process:** Writing from rough draft, Audience Analysis, Task Analysis, Libraries, documentation and cross-referencing, Grammar and Editing, **Technical Writing Software Tools:** Microsoft Word, Macromedia Robohelp, Adobe Framemaker, MS Visio, Microsoft PowerPoint, and Adobe Photoshop. **Contemporary communication**

Course: CSE 3101 : Database Systems	**Credit Hour:** 03	**Year:** Third	**Term:** First

Rationale: This course focuses on the fundamentals relational database management systems, and the current developments in database theory and their practice.

Course Objectives:

- Understand the different issues involved in the design and implementation of a database system.
- Study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- Understand and use data manipulation language to query, update, and manage a database
- Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and Data Warehousing.
- Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Intended Learning Outcomes (ILOs)	**Course Content**
Upon completion of the course, students will be able to: 1. Describe fundamental elements of a relational database management system 2. Explain the basic concepts of relational data model, entity-relationship model, relational algebra, structured query language SQL and relational database design 3. Identify other data models such as object-oriented model and semi-structured model 4. Design entity-relationship diagrams to represent database application	**<u>Section – A</u>** **Introduction:** Preliminary concepts on Purpose of Database Systems; Database Languages; Object-based logical model, Record-based Logical Model, Relational Databases; Database Design; Data Models; Database Internals; Database Users and Administrators; and Overall Structure **ER Model:** Basic Concepts, Design Issues, Mapping Constraints, ER Diagram, Extended ER Features, Design of an ER Database Schema, Reduction of an ER Schema to Tables. **Relational Model:** Structures of Relational Database, Relational Algebra. **SQL:** Basic Operations, Set Operations and joined Relations. **Integrity Constraints:** Domain

scenarios and convert entity-relationship diagrams into relations 5. Populate a relational database and formulate SQL queries on the data 6. Work as a team with a professional attitude towards the development of database applications	Constraints, Referential Integrity and Functional Dependencies. **Relational Database Design:**Normalization using Functional Dependencies, Normalization using Multivalued Dependencies. **Section – B** **Query Processing:** Measures of Query Cost, Sorting, Join Operations and Evaluation of Expressions. **Object-Oriented Databases:** Object Oriented Data Model, Object Oriented Languages. **Indexing and Hashing:** Basic Concepts, Ordered Indices, B+ Tree Index Files, Static Hashing, Dynamic Hashing. **Transactions:** Basic Concepts, Transaction State, Concurrency Executions, Serializability and Recoverability. **Concurrency Control:** Different Control Protocols, Deadlock Handling. Recovery System: Failure Classification, Log-based Recovery, Shadow Paging. **Distributed Databases:** Distributed Data Storage, Network Transparency. Security and Integrity.

Course: CSE 3101 : Database Systems	**Credit Hour:** 03	**Year:** Third	**Term:** First
Rationale: This course focuses on the fundamentals relational database management systems, and the current developments in database theory and their practice.			
Course Objectives: • Understand the different issues involved in the design and implementation of a database system. • Study the physical and logical database designs, database modeling, relational, hierarchical, and network models • Understand and use data manipulation language to query, update, and manage a database • Develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and Data Warehousing. • Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.			

Intended Learning Outcomes (ILOs)	**Course Content**
Upon completion of the course, students will be able to: 1. Describe fundamental elements of a relational database management system 2. Explain the basic concepts of relational data model, entity-relationship model, relational algebra, structured query language SQL and relational database design 3. Identify other data models such as object-oriented model and semi-structured model 4. Design entity-relationship diagrams to represent database application scenarios and convert entity-relationship diagrams into relations 5. Populate a relational database and formulate SQL queries on the data 6. Work as a team with a professional attitude towards the development of database applications	**Section – A** **Introduction:** Preliminary concepts on Purpose of Database Systems; Database Languages; Object-based logical model, Record-based Logical Model, Relational Databases; Database Design; Data Models; Database Internals; Database Users and Administrators; and Overall Structure **ER Model:**Basic Concepts, Design Issues, Mapping Constraints, ER Diagram, Extended ER Features, Design of an ER Database Schema, Reduction of an ER Schema to Tables. **Relational Model:**Structures of Relational Database, Relational Algebra. **SQL:** Basic Operations, Set Operations and joined Relations. **Integrity Constraints:**Domain Constraints, Referential Integrity and Functional Dependencies. **Relational Database Design:**Normalization using Functional Dependencies, Normalization using Multivalued Dependencies. **Section – B** **Query Processing:**Measures of Query Cost, Sorting, Join

	Operations and Evaluation of Expressions. **Object-Oriented Databases:**Object Oriented Data Model, Object Oriented Languages. **Indexing and Hashing:**Basic Concepts, Ordered Indices, B+ Tree Index Files, Static Hashing, Dynamic Hashing. **Transactions:**Basic Concepts, Transaction State, Concurrency Executions, Serializabilityand Recoverability. **Concurrency Control:** Different Control Protocols, Deadlock Handling. Recovery System: Failure Classification, Log-based Recovery, Shadow Paging. **Distributed Databases:** Distributed Data Storage, Network Transparency. Security and Integrity.

Course: CSE 3102: Database Systems Project/Fieldwork	**Credit Hour:** 03	**Year:** Third	**Term:** First
Rationale: This course focuses on designing and implementing a database application, which will include a web-based user interface as its front-end and a supporting SQL Server database as its back end			
Course Objectives: • Identify an application area for which a DBMS may prove beneficial to store the data • Determine the functionalities and operations for the database application. • Design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS. • Design the web interface for the application by considering the various "screens" or "flow of control" and develop the web interface and write supporting code to access the data from the DBMS. • Test the system and check if the application works as desired.			
Intended Learning Outcomes	**Course Content**		
Upon completion of the subject, students will be able to: 1. Have a real hands-on experience by using a full-fledged databasemanagement system. 2. Describe fundamental elements of a relational database management system 3. Design entity-relationship diagrams to represent database application scenarios and convert entity-relationship diagrams into relations 4. Populate a relational database and formulate SQL queries on the data 5. Develop a functioning application that runs on the web and that uses an underlying database to enable useful functionality. 6. Work as a team with a professional attitude towards the development of database applications.	**Problem Identification:** Identifying an application area for which a DBMS may prove beneficial to store the data (factors such as the need to store and query large data volumes, support multiple users, concurrent access, maintain consistency, etc. have to be considered) **Functionalities Determination:** Determining the functionalities and operations for the database application. **Database Development:**Modelling the data to be stored in the database, designing, normalizing, and perfecting the relational database schema, writing the SQL commands to create the database, finding appropriate data, and populating the database. **User-Interface (UI) Design and Development:** Designing the web interface for the application by considering the various "screens" or "flow of control" for the application. Developing the web interface and writing supporting code to access the data from the DBMS. **Test:** Testing the system and checking if the application works as desired.		

Course: CSE 3103: Software Engineering	**Credit Hour:** 2.00	**Year:** Third	**Term:** First
Rationale: this course is designed to provide basic knowledge of software engineering principle and practices to the intermediate level students of Computer Science and Engineering. It also involves knowledge on the application of the software engineering practices to information system development.			
Course Objectives:			

- To provide the knowledge about practices of software engineering.
- To teach the software design and development models.
- To give an overview of various methods for requirement gathering.
- To prepare students for more advanced level courses and practical job.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Describe the software engineering principles. 2. Explain the steps in a software process model. 3. Apply software designing principles on a small software development project. 4. Specify software formally. 5. Know the SDLC and the role of a system analysts in SDLC. 6. Know about different types of information systems. 7. Apply different types of requirement gathering tool. 8. Express the system requirements using formal language and tools. 9. Model data in a system. 10. Design suitable user interface for an information system. 11. Design database for an information system. 12. Apply system implementation best practices for software development. 13. Distinguish different types of test strategies and apply them in software development.	**Section – A** **Software**: Its Nature and Qualities. **Software Engineering Principles**: Rigor and Formality, Separation of Concerns, Modularity, Abstraction and Incrementally. **The Software Process**: Process Models, Planning, Cost Estimation and Project Control, Software Design **Modularization**: Structure, Representation, Interface and Information Hiding, Design Notations **Object Oriented Design**: Object Paradigm, Introduction to a Specific Object-Oriented Design Techniques, Component Based Development. Software Specification, Operational Specification. **Section – B** **Information System Development Environment**: Information System Analysis, Role of System Analyst, SDLC, Modern Approaches to System Development, Different Types of IS. **System Planning and Selection**: Project Feasibility Analysis, BPP, SOW, SOPS **Determining System Requirements**: Interview, Questionnaires, Directly Observing Users **Structuring System Requirements**: Process Modeling, Context DFD, 0-Level DFD, n-Level DFD, Primitive DFD, DFD Decomposition, DFD Balancing, Logic Modeling, Structured English, Decision Tables, Use Cases **Data Modeling**: Entity, Relationships, ERD, Degrees of Relationships, Cardinalities, Selecting Best Alternative Design Strategy **Designing Human Interface**: Forms and Repots, Dialogs **Designing Databases**: Schema, Table, Meta Data, Relational Database, Normalization **System Implementation and Operation**: Coding **Testing**: unit testing, Integration Testing, System Testing, Acceptance Testing, Installation, maintenance.

Course: CSE 3106: Software Development Project	**Credit Hour:** 1.5	**Year:** Third	**Term:** First
Rationale: This course involves a study of the principles and practice of Application Software Development. It will enable students to understand how object-oriented programming techniques can be used to produce powerful and effective information systems. The students will develop a 3-tier business application			
Course Objectives: • Independently design programs • Produce professional-quality code • Implement large programs of greater than 2.5k lines of code • Design and execute tests to identify software bugs • Repair software bugs, redesigning and refactoring code when necessary • Utilize, analyze, and critique code written by others			
Intended Learning Outcomes (ILOs)	**Course Content**		

At the end of the course the students will be able to: 1. Selecting a project that is capable to him/her. 2. Choose group partner 3. Break the work into parts and distribute the work load among group partners. 4. Set dead line for parts of projects and submit them 5. Make presentation of the work in general user understandable form. 6. Present the work in front of audience.	Illustrate selected software design techniques. Determine whether a coded module satisfies its specifications. Explain information hiding. Illustrate iterative enhancement. Explain cohesive, strength and coupling measures. Participate in a team project involving the organization, management, and the development of a large-scale software project in terms of a specific problem. Security planning Describe the roles of various organizational personnel. Implement NSTISS Planning and Management concepts into documentation and software project. Orally present the results of the group work project in accordance with specifications

Course: CSE 3111: Microprocessors and Microcontrollers	**Credit Hour:** 03	**Year:** Third	**Term:** First
Rationale: The primary goal of this course is to give you the fundamental skills needed to understand, use, and design microcontroller-based systems. This includes the following: (1) What is a microcontroller? (2) What can it do (and not do)? (3) How does one design (and program) a microcontroller-based system?			
Course Objectives: • Architect a microprocessor or microcontroller system and estimate the required hardware and software resources. • Select a microprocessor or microcontroller suitable to the application. • Perform the detailed hardware design of a microprocessor or microcontroller system. • Program the microprocessor or microcontroller using suitable techniques including use of allocation schemes and device drivers. • Find effective solutions to a wide range of real-world microprocessor and microcontroller applications.			
Intended Learning Outcomes (ILOs)	**Course Content**		

At the end of the course the students will be able to: 1. Know the history of first 16-bit microprocessor 2. Understand the timing diagram of memory(read/write) bus cycle 3. Understand how same pins are used for both address and data 4. Understand how 2 byte data can be loaded at a time while a ram can give 1 byte data at a time 5. Differentiate between 8086 and 80286. 6. Understand the protection provided by 80286 7. Understand the architecture of 32 bit processor 8. Understand how 4 byte data can be loaded at a time while a ram can give 1 byte data at a time 9. Differentiate between microprocessor and microcontroller 10. Understand where to use microprocessor and where to use microcontroller 11. Understands the different portions of the ram 12. Access different portions of ram. 13. Understand the addressing modes 14. Connect external devices to ports of 8051 and solve real world embedded problems; **15.** Perform various logic	**Section – A** **8086:** First 16 bit microprocessor, clock frequency, number of transistor, block diagram, read data bus cycle, write data bus cycle, pin diagram, description of each pin, multiplexed address and data line, use of latch and ALE signal to distinguish between address and data, addressing modes, instruction set, memory management technique, interrupts, predefined, user defined and hardware interrupts. **80286**: Difference between 8086 and 80286, real mode, protected virtual address mode, descriptor, 24 bit address generation using 16 bit registers **80486**: 32 bit microprocessor, call gate, difference between the descriptor of 80286 and 80486, memory management technique, pin diagram, multiple Vcc and GND pins **Section – B** **Introduction to Microcontroller**: What is microcontroller, difference between microprocessor and microcontroller, where to use microcontroller, example of use of microcontroller in daily life, which microcontroller to choose. **Introduction to 8051**: Block diagram of 8051, facilities of 8051, internal architecture of 8051, Addition using 8051, copy using 8051, Assembly code to Hex code conversion, Hex code placement in ROM **Internal Memory Management of 8051**: Registers of 8051, memory banks, switching among memory banks, default memory bank, position and size of stack, accessing of stack, different portions of ram, bit addressable ram, accessing bit addressable ram **Addressing Modes**: Different addressing

operations in machine level of 8051	modes for programming 8051, addressing mode for accessing stack, addressing mode for bit addressable ram, addressing mode for accessing data from on-chip ROM **I/O Port Programming**: Ports of 8051, dual functionalities of the ports, special instruction for make a port as input port, bit addressability of the ports, SFR's **Logic programming**: Shifting left and right, rotating with left and right with or without carry, AND, OR, NOT logical operations, addition with or without carry, subtraction with or without borrow

Course: CSE3112: Microprocessors and Microcontrollers Laboratory/Project	**Credit Hour:** 0.75	**Year:** Third	**Term:** First

Rationale: The primary goal of this course is to do projects using microprocessors and microcontrollers based on theory course

Course Objectives:

- Familiarize the architecture of 8086 processor, assembling language programming and interfacing with various modules.
- The student can also understand of 8051 Microcontroller concepts, architecture, programming and application of Microcontrollers.
- Student able to do any type of VLSI, embedded systems, industrial and real time applications by knowing the concepts of Microprocessor and Microcontrollers.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Selecting a project that is capable to him/her. 2. Choose group partner 3. Break the work into parts and distribute the work load among group partners. 4. List the hardware needed and manage them. 5. Set dead line for parts of projects and submit them	1. Introduction to microcontrollers, its assemblers, burner board etc 2. Ask students for a projects list with group members 3. Distribution of the projects among groups. 4. Weekly submission of the progress of the projects. 5. A presentation describing the project 6. Orally present the results of the group work project in accordance with specifications.
6. Make presentation to general users in understandable form.	

Course: ECE 3151:Data Communication	**Credit Hour:**3.00	**Year:** Third	**Term:** First

Rationale: Data communication, which is the transmission of digital data through a network or to a device external to the sending device, is the cornerstone of modern telecommunications. Giving importance of different communication systems, this course is designed for the Computer Science and Engineering students.

Course Objectives:

- Build an understanding of the fundamental concepts of data communication and computer networking.
- Familiarize the student with the basic taxonomy and terminology of data communication and computer networking area.
- Provide skills to the student to apply advanced networking concepts, preparing the student for entry advanced courses in computer networking.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course, the students will be able to: • Define and describe network architecture (layered approach and hierarchical approach). • Narrate wireless communications. • State analog and digital signals and their role in data transmission. • Explain transmission impairments (distortion and noise limitations on system performance). • Illustrate multiplexing of signals for data transmission. • Compare various modulation techniques. • Evaluate error detection and correcting codes.	**Section A:** Introduction to modulation techniques: Pulse Modulation, Pulse Amplitude modulation, Pulse Width Modulation and Pulse Position Modulation. Pulse code modulation: Quantization, Delta Modulation, TDM, FDM, OOK, FSK, PSK, QPSK, Constellation Diagrams **Section B:** Probability of error for pulse systems, Concept of Channel Coding and Capacity, Error Detection and Correcting Codes, Asynchronous Communications, Hardware Interfaces, Multiplexer, Concentrators and buffers, Communication Medium, Fiber Optics, WDN.

Course: MATH 3153: Mathematical Analysis for	**Credit Hour:**3.00	**Year**:Third	**Term**: First

Computer Science			

Rationale: The course aims to provide the students with different mathematical methods including differential equations and Laplace and Fourier transform.

Course Objectives:

- Formulate/devise a collection of mathematical laws (i.e., equations) that model the phenomena of interest.
- Analyze solutions to these equations in order to extract information and make predictions.
- Learning two new ways to represent certain types of functions, and these will help to solve linear time invariant (LTI) DE's with these functions as inputs. These two ways are Laplace transform and Fourier series.

Intended Learning Outcome (ILO)	Course Content
All the students will be able to: 1. Perform a diverse array of equations including • The Laplace and Poisson equations of electrostatics; • The diffusion equation, which models e.g. the spreading out of heat energy and chemical diffusion processes; • The wave equation, which models e.g. the propagation of sound waves in the linear acoustical approximation; • The Maxwell equations of electrodynamics. 2. Formulate Fourier series of a periodic function. 3. Design Fourier series on intervals. • EvaluateLaplacetransforma nd Fourier transform.	**Section A** **Differential Equations:**Solution of different equation by the methods based on the factorization of the operators. Cauchy Euler Equations. Frobenius Method. Bassel's and Legendre's differential Equations. Partial Differential Equations: Partial Differential Equations, Homogeneous, Non homogeneous, Linear equations, Mongis Method, Wave Equations. Particular solutions with boundary and initial conditions. **Probability:** Introduction to probability theory, expectation, Random Variables, Conditional Probability and conditional expectation. **Section B** **Laplace Transform & Fourier Series:**Definition of Laplace Transform, Laplace Transform of different functions, Inverse Laplace Transform, Convolution, Evaluation of improper integrals by Laplace Transform. Solution of different equation by Laplace Transform. Fourier Series: Convergence of Fourier Series, Fourier Analysis, Fourier Integral. Z-Transformation and its application. Laplace Transforms and Fourier Series in Circuits. Stochastic Process: Introduction to stochastic process and Markov Chains.

Course: Psy 3151:	**Credit**	**Year**: Third	**Term**: First

Psychology	**Hour:**2.00		

Rationale: This course aims at providing fundamental concepts of Psychology from sociological perspectives and relates the interdisciplinary knowledge of Psychology and Sociology.

Course Objective:

- To familiarize the definition, scope and basic concepts of the Social Psychology;
- To acquaint with theoretical approaches to Psychology and Social Psychology; and
- To introduce methods and perspectives of Psychology.

Intended Learning Outcome (ILO)	Course Content
All the end of course, students will be able to: • Demonstrate theoretical approaches to Social Psychology; • Analyze self-development, sensation, perception, motivation, social and biological behavior; and • Interpret the concepts and meaning of mass behavior.	**Section A** **Meaning and perspective of Psychology:** Definition, Nature and Scope of Psychology; Origin and Development of Psychology; Fields of Psychology and Application. **Social Psychology:** Meaning, Origin and Development of Social Psychology; Scope of Social Psychology to other Social Sciences. **Development of Self, Sensation and Perception:** Theories of Mead, Cooley, Erikson, Piaget, Freud; Perceptual Organizations- Sensation, Emotion and Perception; Development of Personality. **Motivation:** Motivation and Social Behavior; Biological and Social Motivation; Theories of Motivation; Motivation Cycle. **Section B** **Learning:**Nature, Types and Theories of Learning. **Social Attitude and Behavior:**Social Attitude; Formation and Change of Attitude; Instinct and Learned Behavior. **Personality and Leadership:**Personality and Culture; Impact of Culture on Personality Formation and Development; Theories of Personality; Process and Types of Leadership. **Mass Behavior:**Psychology of Collective Behavior; Role of Mind in Group Formation; Issues of Mass Behavior- Crowd, Audience, Mob, Rumor, Propaganda, Fashion, Fad, Craze, Public Opinion.

THIRD YEAR, SECOND TERM

Course: CSE 3200: Web Programming Project / Field work	**Credit Hour:** 1.5	**Year:** Third	**Term:** Second

Rationale: The course will provide an overview of Internet technology and will introduce to the current Web protocols, client side and server side programming, communication and design.

Course Objectives:

- Understand the principles of creating an effective web page, including an in-depth consideration of information architecture.
- Learn the language of the web: HTML and CSS.
- Implement and understand how to interpret basic web analytics.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Create websites using a variety of strategies and tools. 2. Create standards-based websites that are accessible and usable by a variety of users. 3. Install and use software appropriate to a given situation. 4. Use variables, objects, and event-driven concepts in a computer program. 5. Demonstrate proficiency with software used by computer professionals.	Internet and World Wide Web Applications, HTML, SGML, CGI Programming, Active Server Page Programming, Electronic Commerce, Internet Database, Javascript, VB Script, PHP, ASP.NET, Jquery, XML Programming, Flex, WCF, WPF, AJAX, MVC, Silverlight, CMS, Cold Fusion, Python, Mobile web applications.

Course: CSE 3201: Artificial Intelligence	**Credit Hour:** 03	**Year:** Third	**Term:** Second

Rationale: This course introduces the basic concepts and techniques of Artificial Intelligence (AI). AI is the sub-area of computer science devoted to creating software and hardware to get computers to do things that would be considered intelligent as if people did them.

Course Objectives:

- To The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the AI is.
- To have an appreciation for and understanding of both the achievements of AIand the theory underlying those achievements.
- To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.
- To have a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Apply artificial intelligence techniques, including search heuristics, knowledge representation, planning and reasoning. 2. Solve problems by applying a suitable search method. 3. Describe and list the key aspects of planning in artificial intelligence 4. Evaluate the key aspects of intelligent agents 5. Design and implement appropriate solutions for search problems and for planning problems (such as determining a sequence of actions for a robot). 6. Compare Minimax search and alpha-beta pruning in game playing 7. Analyze and apply knowledge representation 8. Analyze and apply probability theorem and Bayesian networks 9. Differentiate the key aspects of evolutionary computation, including genetic algorithms and genetic programming 10. Describe the key aspects	**Section – A** **Introduction:** Definition of Al, Historical Development of Al, Applications of Al, AT Techniques. **Logic:** Prepositional Logic, First-Order Logic, Resolution Principle. **Problems Representation:** State-Space Representation, Problem- Reduction Representation. **Production Systems:** PS Structure, Recognition-Action Cycle, Inference Directions, Blackboard Systems, PS Implementation. Relational Data Model: Relational Database Model, Entity and Relationship, Generalization and Aggregation. **Search:** Blind and Non-Blind Searches, Depth-First Search, Breadth-First Search, Heuristic Search, Best-First Search, Optional Search, A search, Implementation Complexity, Constraint Satisfaction Problems. **Section – B** Predicate Logic, Game Playing, Natural Language Processing, Syntactic Semantics and Pragmatics, Top-Down Parsing, Bottom - Up Parsing, Lexicon. **Programming Languages for AI Research:** Historical Overview, Features of AI Programming Languages, Major AL Programming Languages LISP, PROLOG).

of machine learning 11. Write program in AL Languages (PROLOG, LISP)	

Course: CSE 3202: Artificial Intelligence Laboratory/Project	**Credit Hour:** 1.5	**Year:** Third	**Term:** Second
Rationale: Practical implementation of the theories and knowledge gathered from the course CSE 3201: Artificial Intelligence.			
Course Objectives: • The main purposes of this course to familiar different AI knowledge and implement and analysis those methods in a programming language. • Students are expected to develop some familiarity with current research problems and research methods in AI by working on a research or design project.			

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Implement different intelligent system in high level languages and analysis the performance from AI perspective. 2. Implementdifferent informed and uninformed search technique in real world problems. 3. Write program in AL Languages (PROLOG, LISP)	Laboratory works based on CSE 3201. Students will complete three Projects with proper documentation as assigned by teacher.

Course: CSE 3203: Computer Networks	**Credit Hour:** 03	**Year:** Third	**Term:** Second
Rationale: This subject aims to introduce the basic concept and essential knowledge in computer communications and networks.			
Course Objectives: • To provide a solid foundation to the students about architectural concepts of data communications and computer networking • To enable the students to master the knowledge about communications and computer networking in the context of real-life applications • To prepare the students for understanding, evaluating critically, and assimilating new knowledge and emerging technology about computer networks			

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Describe the services, functions, and inter-relationship of different components with an architectural model such as Open System Interconnection (OSI) seven layer model and TCP/IP model. 2. Describe how components and subsystems in the physical layer, data link layer, and network layer inter-operate and analyze their performance. 3. Evaluate critically the performance of some common computer networks. 4. Design solutions to solve engineering problems that require the applications of computer network technology. 5. Appreciate the principles and operations of various network applications. 6. Take up new knowledge by reading related magazines, journal papers, and trade brochures, and by analyzing new situations while taking into account various constraints. 7. Describe how rapid progress of computer and network technology can impact on the society in various aspects, such as culture and economics. 8. Present ideas and findings effectively 9. Think critically 10. Learn independently	**Section – A** **Network Architecture - layered architecture and ISO- OSI reference model:** Protocol Layering Concept; Standards Organizations; OSI Reference Model; Modulation Techniques; Data Rate; Bandwidth; Communication; Devices; Topologies. **Data link protocols: :** Utopian Simplex Protocol , A Simplex Stop-and-Wait Protocol for an Error-Free Channel, A Simplex Stop-and-Wait Protocol for a Noisy Channel, SLIDING WINDOW PROTOCOLS, A One-Bit Sliding Window Protocol, A Protocol Using Go-Back-N, A Protocol Using Selective Repeat **Error control:** The main causes of errors and their effects on transmission, Single bit and burst errors, Various error detection and correction strategies including parity, block sum, Hamming Codes, Cyclic Redundancy Checks and Forward versus Backward error control. Statistical analysis of the effectiveness of error detection and correction code. **HDLC , X 25** **Flow and congestion control**: Flow and congestion control algorithms **Virtual terminal protocol** **Data security:** Principles of cryptography: Symmetric Key and Public Key, RSA Algorithm, Digital Signatures, Securing e-mail, Securing TCP connections (SSL), Network layer security (IPsec,

	VPN), Securing wireless LANs (WEP), Firewalls: Application Gateway and Packet Filtering, **Section – B** **Local area networks:** Types of LAN covering standards, topology and performance. Example architectures such as ethernet and fast ethernet, ATM, and WiFi. The operation of LAN switches and the configuration of virtual LANs. Satellite networks Packet radio networks Introduction to ARPANET, SNA and DECNET Topological design and queuing models for network and distributing computing systems.

Course: CSE 3204: Computer Networks Laboratory/ Fieldwork	**Credit Hour:** 1.50	**Year:** Third	**Term:** Second
Rationale: This subject aims to teach an understanding of networks and systems design through hands-on construction and experimentation with real-world implementations. Students will perform weekly projects in building, analyzing, evaluating, and deploying the communication protocols and server software that make up widely used network infrastructures.			
Course Objectives: • To build a network using PCs, routers, cables • To configure them properly • To run the experiment • To observe real network protocol behavior • To gather data • To analyze and evaluate • To explore how abstract concepts are designed to work in real life and to observe how they really behave			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course the students will be able to: 1. Describe the services, functions, and inter-relationship of different components with an architectural model such as Open System Interconnection (OSI) seven layer model and TCP/IP model. 2. Describe how components and subsystems in the		Laboratory works based on **CSE3203.** Fieldwork within and around Khulna City.	

	physical layer, data link layer, and network layer inter-operate and analyze their performance. 3. Evaluate critically the performance of some common computer networks. 4. Design solutions to solve engineering problems that require the applications of computer network technology. 5. Appreciate the principles and operations of various network applications. 6. Take up new knowledge by reading related magazines, journal papers, and trade brochures, and by analyzing new situations while taking into account various constraints. 7. Describe how rapid progress of computer and network technology can impact on the society in various aspects, such as culture and economics. 8. Present ideas and findings effectively 9. Think critically 10. Learn independently

Course: CSE 3205 : Compiler Design	**Credit Hour:** 03	**Year:** Third	**Term:** Second
Rationale: This course is designed to provide details knowledge about a language compilation process and skills to develop a compiler.			
Course Objectives • To introduce the major concept areas of language translation and compiler design. • To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table. • To extend the knowledge of parser by parsing LL parser and LR parser. • To provide an ability to design and implement a significant portion of a compiler for a language			
Intended Learning Outcomes (ILOs)			**Course Content**
At the end of the course the students will be able to: 1. Describe a language processing system, design of a compiler including the phases of a typical compiler and its front- and back ends and role of a symbol table. 2. Identify lexemes and tokens of a typical high-level programming language, define regular			**Section A** Introduction to Compilers, lexical analyzer, regular expression, non-deterministic finite automata (NFA) and

expressions for tokens design and implement a lexical analyzer. 3. Explain the role of a parser in a compiler and relate the yield of a parse tree to a grammar derivation; design and implement a parser. 4. Apply an algorithm for a top-down or a bottom-up parser construction; construct a parser for a small context-free grammar. 5. Explain the role of a semantic analyzer and type checking; create a syntax-directed definition and an annotated parse tree; describe the purpose of a syntax tree. 6. Explain the role of different types of runtime environments and memory organization for implementation of typical programming languages. 7. Describe the purpose of translating to intermediate code in the compilation process. 8. Design and implement a compiler for a concise programming language.	deterministic finite automata (DFA), contexts free grammar, ambiguous grammar and basic parsing techniques. **Section B** Intermediate code, symbol table, data structure for symbol table, Run time storage administration, Error detection and recovery, code optimization, code generation.

Course: CSE 3206: Compiler Design Laboratory/Project	**Credit Hour:** 0.75	**Year:** Third	**Term:** Second
Rationale: This course is designed to improve skills to develop a compiler.			
Course Objectives: - To provide an ability to design and implement a significant portion of a compiler for a language			
Intended Learning Outcomes (ILOs)		**Course Content**	
At the end of the course, the students will be able to: 1. Design and implement a scanner and a parser. 2. Design and implement a compiler for a concise programming language.		Based on CSE 3205 (Compiler Design)	

Course: ECE 3251: Electrical Drives and Instrumentation	**Credit Hours:** 03	**Year:** Third	**Term:** Second
Rationale: This course is designed to give knowledge about ac power generation, transmission & management system, basic electrical drives i.e. motor, generator, transformers & their workings, coupling concepts of circuits, and transient behavior of simple circuits.			
Course Objectives: • To introduce basic ideas of ac power generation, transmission, factors related to ac power management, power distribution scenario in Bangladesh. • To introduce constructions, workings, characteristics, performance factors, and practical applications of basic electrical drives i.e. motor, generator, transformer. • To introduce coupling concepts in electrical circuits, applying coupling concepts in analyzing various practical coupled circuits. • To present basic concepts of polyphase circuits, its' types, power measurement techniques. • To analyze transients of basic electrical circuits.			
Intended Learning Outcome (ILO)		**Course Content**	
At the end of the course students will be able to: **1.** Understand circuit coupling concepts, its' types, problem solving, designing practical coupled circuits of various coupling co-efficients. **2.** Explore the techniques of ac power generation, transmission, management. **3.** Understand single phase and polyphase system, differences, types of polyphase system, power measurement of polyphase system, problem solving. **4.** Analyze transient behavior of simple circuits. **5.** Explain the basics of transformer, its' types, equivalent circuits of ideal and practical transformers, vector diagram. **6.** Understand the fundamental theories and technologies in electromechanical energy conversion. **7.** Explore about the structures and basic principle of different types of DC machines and induction machines (generators and motors). **8.** Understand the working principle and load characteristics of key devices such as DC		**SECTION A** Introduction to three phase circuits, alternators and transformers; Principles of operation of DC, synchronous, induction, universal, and stepper motors; Thyristor and microprocessor based speed control of motors. Instrumentation amplifiers: differential. Logarithmic, and chopper amplifiers; Frequency and voltage measurements using digital techniques. **SECTION B**	

machines and induction machines. **9.** Synthesis the different parameters of the equivalent circuit of DC machines and induction machines. **10.** Explore electromechanical devices, such as DC machines, induction machines and power devices for mechanical system design and development. **11.** Understand different load characteristics of DC machines by using special experimental module. **12.** Realize the utilization of electrical energy and create awareness of safety issues in use of electromechanical devices and power devices.	Recorders and display devices, spectrum analyzers and logic analyzers; Data acquisition and interfacing to microprocessor based systems; Transducers: terminology, types, principles, and application of photovoltaic, piezoelectric, thermoelectric, variable reactance and optoelectronic transducers Noise reduction in instrumentation.

Course: ECE 3252: Electrical Drives and Instrumentation Laboratory	**Credit Hours:** 0.75	**Year:** Third	**Term:** Second

Rationale: This course is designed to give hands on training about basic electrical drives, their workings, characteristics and troubleshooting techniques.

Course Objectives:

- To understand the concepts of circuit coupling, types of coupling, measuring co-efficient of coupling.
- To explore the working principles of basic electrical drives: motor, generator, transformer etc. and factors related to their performances.
- To explore and troubleshoot the problems practically regarding these basic electrical drives.
- Simulate transient of simple R-L, R-C, R-L-C circuits to explain transient phenomena noticeably.
- To measure various power of three-phase both balanced and unbalanced system.

Intended Learning Outcome (ILO)	Course Content
At the end of the course students will be able to: **1.** Students can synthesis the workings of basic electrical drives, factors affecting the workings of these drives. **2.** Draw and design the practical circuits to control various properties i.e. direction, speed, torque of motor and generator. **3.** Troubleshoot problems related to basic electrical drives. **4.** Able to measure power of both balanced and unbalanced three-phase system. **5.** Able to analyze coupling circuits and measure coupling co-efficient. **6.** Explore transformers practically and able to measure various properties of transformers using various practical methods in laboratory. **7.** Analyze transients in related softwares.	Laboratory based on the course ECE 3251.

Course: CSE 3221: Simulation and Modeling	**Credit Hour:** 03	**Year:** Third	**Term:** Second

Rationale: This course focuses on developing the simulation and modeling knowledge and skills of students, building on the concepts from Data Structures and Algorithms in developing data structures for specific simulation model applications.

Course Objectives:

The role and impact of simulation and modeling is evident in the development of virtually any complex, large-scale system. The course emphasizes the design and implementation of simulation models. Students will learn the conceptual aspects from the course material. After completing this course, students should be able to completely design the model of a system, and then work in a practical project that involves design and implementation of a simulation model, meeting the standards and requirements.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course, the students will be able to: 1. Describe the structure and dynamic behavior of various types of systems 2. Design the conceptual models for most of the properties of systems 3. Implement simulation models with an object oriented simulation language	**Section – A** Simulation Methods, Model Building, Random Number Generator, Statistical Analysis of Results, Validation and Verification Techniques, Digital Simulation of Continuous

4. Implement simulation models using a commercial integrated software tool such as Arena 5. Carry out general discrete-event simulation runs and provide basic analysis of results 6. Describe the types, role and value of formal Simulations and Modeling, and their various characterizations for application to systems management, particularly with regard to design, testing, training, production, cost estimation, manning, and logistical simulations 7. Understand the critical decisions in the acquisition lifecycle and how/what Simulation and Modeling is used to inform those decisions in order to reduce the time resources and risk associated with the acquisition process 8. Examine models and simulations used in a given phase of the acquisition process, their inputs and outputs, and their capabilities and limitations	Systems, Simulation and Analytical Methods for Analysis of Computer Systems and Practical Problems in Engineering, Introduction to Simulation Languages and Development of Simulation Packages. **Section – B** Modeling Methods: Different Methods for Curves and Surface Modeling, Solid Modeling, Polyhedral Modeling with Euler's Formula, Non-Polyhedral Modeling, Advanced Modeling, Procedural Models, Fractal Models and Physically Based Modeling.

Course: CSE 3222: Simulation and Modeling Laboratory/ Fieldwork	**Credit Hour:** 1.50	**Year:** Third	**Term:** Second
ationale: This course focuses on developing practical knowledge and skills for implementing the models of specific simulation based applications.			
Course Objectives: • To familiarize students with various real world complex systems so that they could completely design the model of a system. • Work in a practical project that involves design and implementation of a simulation model, meeting the standards and requirements.			
Intended Learning Outcomes (ILOs)		**Course Contents**	
At the end of the course, the students will be able to: 1. Design the conceptual models for most of the properties of systems 2. Implement simulation models with an object oriented simulation language 3. Implement simulation models using a commercial integrated software tool such as Arena 4. Carry out general discrete-event simulation runs and provide basic analysis of results		Laboratory/Fieldwork based on Course No. **CSE 3221**	

Course: CSE 3223: Neural Networks and Fuzzy Systems	**Credit Hour:** 03	**Year:** Third	**Term:** Second
Rationale: This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. It also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. This subject is very important and useful for solving complicated practical problems such as robotic control, data mining and recognition.			
Course Objectives: • To provide students with an understanding of the fundamental theory of neural networks and fuzzy systems. • To familiarize students with possible applications for applying neural networks and fuzzy systems.			
Intended Learning Outcomes (ILOs)		**Course Contents**	
At the end of the course the students will be able to: 1. Understand principles of neural networks and fuzzy logic fundamentals. 2. Explain the learning and adaptation capability of neural and fuzzy systems 3. Examine the learning and retrieval procedures of various neural networks 4. Apply the rules of fuzzy logic for fuzzy control 5. Design the required and related systems 6. Implement neural networks and fuzzy systems to solve practical problems		**Section – A** Introduction to Neural Networks, Neural and Fuzzy Machine Intelligence, Neuronal Dynamics: Activation and Signals, Activation Models, Synaptic Dynamics: Unsupervised and Supervised Learning, Architectures and Equilibrium, Kohonen Self-Organizing Networks, Hopfield Networks, Pattern Recognition by Neural Networks, Application of Neural Networks. **Section – B** Fuzziness vs. Probability, Fuzzy Associative Memory, Comparison of Fuzzy and Neural Trick Backer Upper Control Systems, Fuzzy Image Transform Coding, Comparison of Fuzzy and Kalman-Filter, Target Tracking Control Systems.	

Course: CSE 3224: Neural Networks and Fuzzy Systems Laboratory	**Credit Hour:** 1.50	**Year:** Third	**Term:** Second

Rationale: This course is very important and useful for developing practical knowledge and skills for solving neural networks and fuzzy systems based applications.

Course Objective:

- To familiarize students with possible applications for applying neural networks and fuzzy systems.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to- 1. Design the required and related systems 2. Implement neural networks and fuzzy systems to solve practical problems	Laboratory works based on Course No. **CSE 3223**

Course: CSE 3225: Digital Image Processing	**Credit Hour:** 03	**Year:** Third	**Term:** Second

Rationale: This course is designed to provide fundamental concepts of digital image processing with emphasis in image processing techniques, image filtering design and applications

Course Objectives:

- Develop a theoretical foundation of fundamental Digital Image Processing concepts.
- Develop knowledge with essential mathematical foundations from basic signal processing techniques to advanced image processing and analysis systems.
- To give students practical experience of utilizing digital signal processing on real world problems, through the provision of structured coursework assignments based upon using MATLAB

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: • Explain the concepts and techniques in the following areas of image processing. • Have a good understanding of the mathematical foundations for the topics mentioned above. • Understand the complex digital image processing algorithms as far as both the mathematical analysis and the applications related to each method are concerned • Develop programs in MATLAB for performing specified operations in the above areas of image processing. • Design, code and test digital image processing applications using MATLAB language. • Apply image processing algorithm or combinations of them, or modifications of them in a real life image-processing problem. Ability to decide which method is appropriate to tackle the problem. • Analyze a wide range of problems and provide solutions related to the design of image processing systems through suitable algorithms, structures, diagrams, and other appropriate methods.	**<u>Section – A</u>** Digital Image Fundamentals, Image Transforms Image Enhancement, Image Restoration Color Image Processing, Image Compression **<u>Section – B</u>** Morphological Image Processing, Image Segmentation Representation and Description Recognition and Interpretation

Course: CSE 3226: Digital Image Processing Laboratory/Project	**Credit Hour:** 1.50	**Year:** Third	**Term:** Second

Rationale: This course is designed to provide fundamental concepts of digital image processing with emphasis in image processing techniques, image filtering design and applications

Course Objectives:

- To make students capable of implementing any image processing algorithm
- To give students practical experience of utilizing digital signal processing on real world problems, through the provision of structured coursework assignments based upon using MATLAB

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Develop programs in MATLAB for performing specified operations in the above areas of image processing. 2. Analyze a wide range of problems and provide solutions related to the design of image processing systems through	Based on the course content of the course CSE-3225

suitable algorithms, structures, diagrams, and other appropriate methods. 3. Design, code and test digital image processing applications using MATLAB language.	

Course: CSE 3227: Geographical Information System	**Credit Hour:** 03	**Year:** Third	**Term:** Second

Rationale: Geographical Information System is designed to provide the students with an understanding of the methods and theories of spatial analysis that will allow students to apply GIS knowledge and skills to everyday life and their chosen careers.

Course Objectives:

- To understand the basic structures, concepts, and theories of GIS.
- To gain a hand-on experience with a variety of GIS operations.
- To learn how to compile, analyze, and present geospatial data while emphasizing the value of visual communication.
- To learn these basic geospatial concepts while working with ESRI's ArcGIS software.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Define geography and GIS, Understand the purpose of GIS and the kind of problem GIS is applied. 2. Use GIS to identify, explore, understand, and solve spatial problems. 3. Explain and perform spatial data retrieval tasks. 4. Use queries in GIS Analysis, design and implement a GIS project 5. Understand typical uses of GIS in business, government, and resource management. 6. Demonstrate competency with the ArcMap software to enhance and interpret data 7. Acquire awareness of geographic information that is available on the World Wide Web. 8. Understand vector and raster data structures and the appropriate use of each of these data structures 9. Use GIS operators to perform anumber of kinds of analyses. 10. Understand the importance of scale, projection, and coordinate systems in GIS. 11. Apply GIS to support personal and professional decision making. 12. Evaluate Geographic information systems and geographic data in general.	**Section – A** 1. **Introduction:** Definition, Purpose (Organization, Visualization, Analysis: Spatial Query, Prediction), Components of Geography Based Information Systems, Application of GIS in private and The Evolution of Approaches to their Development. 2. **Data Input to Spatial Information**: Basic Hardware, Software (Available in the market), types of Data Entry System, Criteria of Choosing Types of Input, Digitizer, Problems with Digitizing Maps, Error Shooting, Geographical Data Types and Methods of Representation. 3. **Data management and processing system:** Spatial Database: Database Concepts, Point, Line and Polygon Features, Continuous Surfaces. 4. The Organizational Role of GIS and Emerging Trends in GIS Development. 5. Script Language in GIS (For example, Arc Avenue Development by ESRI). **Section – B** 6. **Spatial Data Models**: Vector and Raster Data Model, Format Conversion. **7. Spatial Data Structures**: Data Structures Conversion, Data Medium Conversion, Data Organization. 8. **Spatial Referencing and Positioning**: Coordinate Systems and Geo-referencing, Concepts of Map Projection including suitability and Classification. 9. GIS Data Modeling and Statistical Analysis. 10. **3D GIS**: Point to Line Interpolation, Line to TIN and TIN to Lattice to GRID Conversion, Simulation with 3D.

Course: CSE 3228: Geographical Information System Laboratory/Fieldwork	**Credit Hour:** 1.5	**Year:** Third	**Term:** Second

Rationale: Geographical Information System is designed to provide the students with an understanding of the methods and theories of spatial analysis that will allow students to apply GIS knowledge and skills to everyday life and their chosen careers.

Course Objectives:

- To understand the basic structures, concepts, and theories of GIS.
- To gain a hand-on experience with a variety of GIS operations.
- To learn how to compile, analyze, and present geospatial data while emphasizing the value of visual communication.
- To learn these basic geospatial concepts while working with ESRI's ArcGIS software.

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: 1. Navigate a popular commercial GIS software platform. 2. Create maps that clearly and effectively communicate datasets and analytical results. 3. Locate and create accurate geospatial datasets. 4. Creatively solve spatial problems using a variety of GIS tools. 5. Become proficient in the use of GIS tools to conduct spatial analyses and build maps that are fit-for-purpose and effectively convey the information they are intended to. 6. Become effective in building maps that can be shared with non-GIS users (e.g. PDF maps and interactive webGIS maps)	**Introduction:** Purpose (Organization, Visualization, Analysis: Spatial Query, Prediction), Components of Geography Based Information Systems, Application of GIS in private and The Evolution of Approaches to their Development. **Data Input to Spatial Information**: Basic Hardware, Software (Available in the market), types of Data Entry System, Criteria of Choosing Types of Input, Digitizer, Problems with Digitizing Maps, Error Shooting, Geographical Data Types and Methods of Representation. **Data management and processing system:** Spatial Database: Database Concepts, Point, Line and Polygon Features, Continuous Surfaces. The Organizational Role of GIS and Emerging Trends in GIS Development. Script Language in GIS (For example, Arc Avenue Development by ESRI). **Spatial Data Models**: Vector and Raster Data Model, Format Conversion. **Spatial Data Structures**: Data Structures Conversion, Data Medium Conversion, Data Organization. **Spatial Referencing and Positioning**: Coordinate Systems and Geo-referencing, Concepts of Map Projection including suitability and Classification. GIS Data Modeling and Statistical Analysis. **3D GIS**: Point to Line Interpolation, Line to TIN and TIN to Lattice to GRID Conversion, Simulation with 3D.

FOURTH YEAR, FIRST TERM

Course: CSE 4100: Project and Thesis I	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: The students of Computer Science and Engineering Discipline have to complete total 6 credit course of Project and Thesis of which Project and Thesis I bears 3 credit and Project and Thesis II (in 4th year 2nd semester) carries 3 credits. A student can either choose project or thesis.			
Course Objectives: • To study a field of interest under a supervisor and find out a specific topic for thesis or a project to be carried out through 4th year. • To get clear idea of the related work/project accomplished by different authors. • To learn how to do good research that can get their work published in renowned journal/conference.			
Intended Learning Outcomes (ILOs)	**Course Content**		
	Section – A		
The student will be able to: • Have insights of a specific topic and the previous works done by others. • Write the proposal of the thesis/project he/she is going to perform throughout 4th year. • Present orally the proposal he/she prepares.	Study of problems in the field of Computer Science and Engineering. **N. B.** The Project and thesis topic selected in this course is to be continued in the CSE 4200 Course.		

Course: CSE 4103: Computer Graphics	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: This course is designed to provide fundamental concepts of vector and raster graphics and practices involved in Digital Device like Computer.			
Course Objectives: • To identify and explain the core concepts of computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends. • To apply graphics programming techniques to design, and create computer graphics scenes. • To create effective OpenGL programs to solve graphics programming issues, including 3D transformation, objects modeling, color modeling, lighting, textures, and ray tracing. • To learn about the interdisciplinary nature of computer graphics through a wide variety of examples and applications.			
Intended Learning Outcomes (ILOs)	**Course Content**		
	Section – A		
1. Describe the basic structure of modern computer graphics systems. 2. Explain the basic principles of implementing computer graphics primitives. 3. Compare contemporary graphics hardware and software. 4. Explain various 2D geometrical transformations, program functions to implement visibility detection. 5. Analyze techniques, algorithms and programs that demonstrate 2D image processing techniques. 6. Evaluate the methods of vector and raster graphics and methods of conversion from analog primitive to digital one. 7. Describe and analyze three dimensional transformations, their visibility detection, and 3D image processing techniques. 8. Identify, evaluate and solve problems related to 3D objects and their solution.	**Introduction to Computer Graphics**: History, Applications of Computer Graphics (Computer Aided Design, Animation), A Survey of Graphics I/O Devices and Types. **Graphics Software Design**: Survey of Desired Functions, Toward a Universal Graphic Language, Display Files, Data Bases for Pictorial Applications. **Graphics Techniques**: Point-Plotting Techniques, Line-Drawing Geometric Transformations, Windowing and Clipping, Raster Graphics. **Hardware for Computer Graphics**: Typical Small and Large System, Graphic Terminals, Plotters, Graphic Display Processors, Device Independent Graphics Systems. **Graphics Software:** A simple Graphic Package, Segmented Display Files, Geometric Models, Picture Structure. **Interactive Graphics**: Input Techniques, Event Handling, Scan Conversion, Two Dimensional Graphics, 2D transformation, 2D viewing and Clipping.	
	Section – B		
	Three dimensional Graphics: 3-D Transformation, 3D viewing and Clipping, Curves and		

	Surfaces. **Hidden Surface Problem**: Back Face Removal, Hidden line Removal, Texture Mapping. **Fractal Geometry:** Basics **Ray Tracing:** Basics

Course: CSE 4104: Computer Graphics Laboratory /Project	**Credit Hour: 0.75**	**Year: Fourth**	**Term: First**

Rationale: This course is designed to provide practical concepts of vector and raster graphics and the practices involved in Digital Device like Computer.

Course Objectives:

- To identify and explain the practical concepts of computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends.
- To apply graphics programming techniques to design, and create computer graphics scenes.
- To create effective OpenGL programs to solve graphics programming issues, including 3D transformation, objects modeling, color modeling, lighting, textures, and ray tracing.

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course, students will be able to do: 1. Explain the implementation of computer graphics primitives. 2. Interpret the algorithm and programming concept of various 2D and 3D geometrical transformations, their viewing, clipping, program functions to implement visibility detection. 3. Apply and analyze the algorithm and programming concept of vector and raster graphics and methods of conversion from analog primitive to digital one.	**Introduction to Computer Graphics**: History, Applications of Computer Graphics (Computer Aided Design, Animation), A Survey of Graphics I/O Devices and Types. **Graphics Software Design**: Survey of Desired Functions, Toward a Universal Graphic Language, Display Files, Data Bases for Pictorial Applications. **Graphics Techniques**: Point-Plotting Techniques, Line- Drawing Geometric Transformations, Windowing and Clipping, Raster Graphics. **Hardware for Computer Graphics**: Typical Small and Large System, Graphic Terminals, Plotters, Graphic Display Processors, Device Independent Graphics Systems. **Graphics Software:** A simple Graphic Package, Segmented Display Files, Geometric Models, Picture Structure. **Interactive Graphics**: Input Techniques, Event Handling, Scan Conversion, Two Dimensional Graphics, 2D transformation, 2D viewing and Clipping. **Three dimensional Graphics**: 3-D Transformation, 3D viewing and Clipping, Curves and Surfaces. **Hidden Surface Problem**: Back Face Removal, Hidden line Removal, Texture Mapping.

Course: CSE 4105: Computer Security	**Credit Hour: 03**	**Year: Fourth**	**Term: First**

Rationale: This course introduces the concepts and issues related to securing information systems and the development of policies and mechanisms to implement information security controls.

Course Objectives:

- To explain how data can be secured at the station as well as in transition.
- To protect data using appropriate security mechanisms.
- To maintain confidentiality, authenticity and integrity of data in storage as well in transition.
- To control unauthorized access and availability of data to legitimate users.
- To analyze system and design security policy and mechanism for it.

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course, the students will be able to- 1. Know the importance of Information Security (IS). 2. Explain the goals of information security, and describe the policy, prevention mechanisms of IS. 3. Interpret concepts of data privacy using private and public key cryptography. 4. Create digital signature as measures of authenticity and non-repudiation. 5. Know about cryptographic hash function for data	**1. Introduction:** concept and importance of information security. Definition of some Terminologies related to IS. **2. Goals of IS**: Description of goals of security such as confidentiality, integrity and availability. Definition security policy and the concept of prevention, detection and recovery mechanisms. **3. Cryptography:** Definition plain text, cipher text, encryption and decryption. Description of symmetric and asymmetric cryptosystems. Description of standard cryptographic schemes.

integrity. 6. Describe user authentication using ID and password. 7. Maintain data integrity as well as authenticity using Message Authentication Code (MAC). 8. Apply the concept of access control schemes. 9. Describe key management through Public Key Infrastructure (PKI) and certification. 10. Explain and examine authentication application Kerberos and PGP for E-mail security. 11. Apply Digital certificate, SSL (Secure Socket Layer) and firewall for network security.	**4. Digital Signature**: Concept of the digital signature using public key cryptography. Description of the well known digital signature scheme. **5. Cryptographic hash function:** Definition of the hash function. Characteristics of the hash function. Description of standard cryptographic hash functions. **6. Password authentication scheme:** Necessity of password and Concept of password authentication scheme using a hash function. **Section – B** 7. **Message Authentication Code (MAC)**: Definition of MAC and description of standard MAC schemes. 8. **Access Control**: the concept of .access control, matrix based access control scheme, Access Control List (ACL) and Capability Based List (CBL), Role Based Access Control (RBAC). 9. **Key Management:** Necessity ofkey management, key management through PKI and certification. Description of Diffie Hellman Scheme. Concept Elliptical Curve Cryptography (ECC) 10. **Authentication Service:** Description of working process Kerberos. 11. **E-mail security**: Description of PGP and SMIME. **12. Network Security:** Description of SSL, Digital certificate and firewall.

Course: BA 4151: Accounting	**Credit Hour: 02**	**Year: Fourth**	**Term: First**
Rationale: The rationale of this course is to provide the basic concepts and standards underlying financial accounting systems. The course emphasizes the construction of the basic financial accounting statements - the income statement, owner's equity statement and balance sheet as well as their interpretation. It also deals with the behavioral aspects of accounting. The course presents the theory, procedures & practice relating to product costs, including job order, process & standard cost systems.			
Course Objectives: • To provide intelligent interpretation and use of financial statements in managing and analyzing business operations. • To further this objective, students will gain a firm understanding and working knowledge of basic accounting terminology and the process by which transactions are analyzed and transformed into financial statements. • To emphasize the concept of "different costs for different purposes," and to focus on cost accounting strategy and the decision making process. • To acquire knowledge and understanding of the concepts, techniques and practices of cost and management accounting and to develop skills for decision making.			
Intended Learning Outcomes (ILOs)		**Course Content**	
		Section A	
At the end of the course, students will be able to: • Explain what accounting is,generally accepted accounting principles, • Explain what an account is and how it helps in the recording process, to identify the basic steps in the recording process, explain journal, ledger and trial balance and how they help in the recording process. • Prepare financial statements. • Conduct Cost Accounting Evolution, Meaning, Objectives and Scope Concepts of Costs.		Basic accounting principles, Cash book, Trial balance, Balance sheet, Bank reconciliation statement, Cost accounts and objectives, Direct cost, Overhead allocation. **Section B** Preparation of a cost sheet/statement of cost, Computation of breakeven point, Standard costing, Job order costing, Process costing and Cost variance	
• Perform Classifications and Elements of Cost, Methods and Techniques of Costing.			

• Explain Establishment of Cost Accounting system • Perform Principles of double entry system of costing, integrated and interlocking cost accounts. • Evaluate Job costing and batch costing., Process Costing – Cost of Production Report, Process Costing – Average and FIFO method, Joint product and by-product.	

Course: Soc4153: Government and Sociology	**Credit Hours: 2.00**	**Year: Fourth**	**Term: First**

Rationale: This course is designed to introduce students to the basic concepts, theories, scholars and methods of Sociology. This course will pay attention to the meaning of 'think sociologically' and how this differs from other ways of observing the world around us. It will focus on the systematic understanding of social relations, social interaction, social structure, social organization, social institutions, culture and social change. This course will also introduce students to key issues addressed by contemporary sociologists; i.e. social class, social stratification and inequality, deviance and crime, economy and work, politics and media, population and environment and so on.

Course Objective:

The course aims to:

- provide students with a brief overview of Sociology as a distinct Discipline within the social sciences
- introduce students to the basic concepts, theories, and methods that sociologists use
- help students to develop their ability to understand the critical link among social structures, social forces and individual circumstances
- encourage students to develop a better understanding of how their own lives and significant relationships are shaped by larger social forces
- increase students' awareness of the social world and helps students to apply sociological knowledge to personal and social life

Intended Learning Outcomes (ILOs)	**Course Contents**
At the end of the course the students will be able to:	**Section A:**
• Explain basic sociological concepts, theories and methods logically and consistently • Think deeply and apply sociological perspectives to various issues and problems in contemporary society	**Government:** Some basic concepts of government and politics. Functions, Organs and forms of modern state and Government, Socialism, Fascism, Marxism, U.N.O. Government and pohtics of Bangladesh. Some major administrative systems of developed counties. Local self government.
	Section B: **Sociology:** Scope, Nature, Methods and relation with other branches of Social Science; Stages of Social development (primitive, slavery, feudalism, Capitalism and Socialism); Culture and civilization; Social structure of Bangladesh. Population and world resources. Occidental societies, Industrial revolution. Family - Urbanization and industrialization, Urban Ecology, Cooperative and socialist movements, Rural sociology.

Course: CSE 4121: Applied Probability and Queuing Theory	**Credit Hour: 03**	**Year: Fourth**	**Term: First**

Rationale: The probabilistic models are employed in countless applications in all areas of science and engineering. Queuing theory provides models for a number of situations that arise in real life. The course aims at providing necessary mathematical support and confidence to tackle real life problems.

Course Objectives:

- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.

Intended Learning Outcomes (ILOs)	**Course Contents**
	Section – A

At the end of the course the students will be able to- 1. Acquire fundamental knowledge of the probability concepts 2. Acquire knowledge of standard distributions which can describe real life phenomena 3. Acquire skills in handling situations involving more than one random variable and functions of random variables 4. Understand and characterize phenomenon which evolve with respect to time in a probabilistic manner 5. Be exposed to basic characteristic features of a queuing system and acquire skills in analyzing queuing models.	Probability Distribution and Expectations, Discontinuous Probability Distribution, e.g., Binomial: Positive and Negative Binomial, Continuous Probability Distribution, e.g., Normal and Exponential. Stochastic Processes, Discrete Time Markov Chain and Continuous Time Markov Chain. Birth-Death Process in Queuing. **Section – B** Queuing Models: M/M/1, M/M/C, M/G/I. M/D/I, G/M/I Solution of Network of Queues, Closed Queuing Models and Approximate Models, Application of Queuing Models in Computer Science.

Course: CSE 4123: Parallel and Distributed Processing	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: The course introduces essential foundations of parallel and distributed computing, including the principles of parallel algorithm design, analytical modeling of parallel programs, parallel computer architectures, forms of distributed processing, deign of distributed data etc.			
Course Objectives: • To provide a solid idea of different forms of parallelism and distributed computing • To design parallel and distributed algorithms.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course, students will be able to: • Identify and recognize fundamental aspects of parallel algorithms and parallel architectures. • Design and evaluate parallel algorithms. • Identify and recognize fundamental aspects of parallel computing languages. 7. Implement parallel algorithms using modern parallel computing languages.	**Section A** Parallel Processing: Importance, Architecture, Hardware and software issues; Architectures for parallel processing - Classifications, Comparative study of different architectures; Hardware issues in parallel processing, Parallel programming; Distributed Processing: Definition, Impact of distributed processing on organizations, pitfalls in distributed processing. **Section B** Forms of distributed processing: Function distribution, Hierarchical distributed systems, Horizontal distributed systems; Strategy: Strategies for distributed data processing control of complexity, problems of incompatibility, centralization vs. decentralization, cost and benefit analysis; Design of distributed data: Distributed data, location of data, multiple copies data, conflict analysis database management, distributed databases and applications; Software and Network Strategy: Software strategy, the ISO seven layers, architectural interfaces, physical link control, network management etc.		

Course: CSE 4125: Computational Geometry	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: This course is concerned with the development, analysis, and computer implementation of algorithms encountered in geometric modelling.			
Course Objectives: • To introduce students systematic study of algorithms and data structures for geometric objects, with a focus on exact algorithms that are asymptotically fast. • To teach students how to design, develop and implement algorithms for geometric problems. • To familiarize students with some existing algorithms for computing geometric problems like Convex Hull, Polygon Triangulation, Voronoi diagram, Delaunay Triangulation etc. • To help students develop their capability to compare efficiency of different algorithms for a given geometric problem.			
Intended Learning Outcomes	**Course Content**		
Upon completion of the subject,	**Section – A**		

students will be able to: 1. Understand how geometric algorithms are relevant in the applications areas of computer graphics, motion planning and robotics, geographic information systems, CAD/CAM, statistics, physics simulations, databases, games, multimedia retrieval etc. 2. Analyze geometric problems and develop efficient algorithms to solve them. 3. Implement algorithms of triangulation and of two-dimensional convex hull generation in geometric problems. 4. Characterize invariance properties of Euclidean geometry by groups of transformations. 5. Describe and construct basic geometric shapes and concepts by computational means. 6. Evaluate fundamental properties of Delaunay triangulation and sketch Voronoi diagrams.	**Introduction:** Historical perspective, Algorithmic background, Geometric preliminaries, Models of Computation **Line Segment Intersection:** Thematic Map Overlay, Line sweeping algorithm, Doubly-Connected Edge List, Computing the Overlay of Two Subdivisions **Geometric searching:** Point location problem and range searching problems, amortization, multi- dimensional search, space sweep, duality and randomization **Convex Hulls:**Definition of convex hull, Algorithms for computing convex hull for a given set of points, analyze the efficiency of those algorithms. **Section – B** **Polygon Triangulation:**Art Gallery guarding problem, Guarding and Triangulations, Partitioning a Polygon into Monotone Pieces, Triangulating a Monotone Polygon **Orthogonal Range Searching:** 1-Dimensional Range Searching, Kd-Trees, Range Trees, Higher-Dimensional Range Trees, General Sets of Points, Fractional Cascading. **Voronoi Diagrams**: The Post Office Problem, Definition and Basic Properties, Computing the Voronoi Diagram, Voronoi Diagrams of Line Segments, Farthest-Point Voronoi Diagrams **Delaunay Triangulations:** Height Interpolation problem, Triangulations of Planar Point Sets, Definition of Delaunay Triangulation, Computing the Delaunay Triangulation, Analysis of the algorithm

Course: CSE 4127: Human Computer Interaction	**Credit Hour: 03**	**Year: Fourth**	**Term: First**

Rationale: This course is designed to provide basic knowledge about human-computer interaction. It will discuss how to understand human cognition and human perspective by working with computers.

Course Objectives:

- To perform analysis, establish requirements, design and evaluate interactive computer-based systems and products.
- To cover a broad knowledge regarding the human-friendly interface design.
- To understand human cognition and human perspective while working with computers.

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to- 1. Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction. 2. Describe how technologies can be designed to change people's attitudes and behavior. 3. Use the information sources available, and be aware of the methodologies and technologies supporting advances in HCI. 4. Design mock ups and carry out user and expert evaluation of interfaces. 5. Explain how to do usability testing through examples. 6. Interpret the conceptual, practical, and ethical issues involved in evaluation.	1. Introduction to Human-Computer Interaction (HCI). 2. Human Information Processing Systems, Models of interaction. 3. Approaches to HCI. 4. User Interface. **Section – B** 1. User system interaction: analysis and design. 2. User Interface Design. 3. Interface Technique and Technology. 4. Case Studies.

Course: CSE 4129: Distributed Database Systems	**Credit Hour: 03**	**Year: Fourth**	**Term: First**

Rationale: This course is designed to introduce the fundamental concepts necessary for designing, using, and implementing distributed database systems and applications.

Course Objectives:

- To acquire knowledge on principles of distributed database systems including design and architecture, query processing, transaction management, locking, recovery, and Replication.
- To learn to know how a distributed database system works collaboratively.
- To acquaint with the latest advances in distributed database.

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to- • Explain architecture and design tradeoffs of all aspects of distributed database management systems. • Describe an application based upon the distributed database. • Interpret database management systems concepts. • Explain the principles and techniques of a number of application areas informed by the research directions of distributed database systems. • Provide hand-on experience programming portions of a distributed database management system. • Examine issues of distributed query execution, including optimization, transaction management, and fault tolerance. • Demonstrate efficient IT capabilities.	• Introduction to Distributed database systems • Database system architecture • Centralized system • Client-server systems • Parallel systems • Distributed systems • Network types • Distributed Data storage • Network Transparency Data Query Processing
	Section – B
	• Data Transaction model • Commit protocols • Coordinator selection • Concurrency control • Deadlock handle
	• Multi Database system • Design of Distributed Database • Location of Database • Multiple copies of Data Distributed Database and Applications

Course: CSE 4131: Graph Theory	**Credit Hour: 03**	**Year: Fourth**	**Term: First**

Rationale: The main objective of this course is to introduce graphs as a powerful modeling tool that can be used to solve practical problems in various fields. This is also serious introduction about properties and applications of graphs.

Course Objectives:

- To introduces the main concepts of graph theory
- To introduce graph representations and the basic classes of graphs
- To cover several famous graph problems and associated algorithms
- To apply graph theory in various computer-related algorithms
- To solve theoretical problems in graph theory and to apply this work to appropriate real world applications.

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to: 1. Understand the basics of graph theory and their relevance to the real world. 2. Define and create mathematical proofs. 3. Perceive the definition of and some construction techniques for balanced incomplete block designs. 4. Learn the fundamental concepts in graph theory, with a sense of some of its modern applications. 5. Apply the abstract concepts of graph theory in modeling and solving non-trivial problems in	**Basics of Graph Theory:**Structure and Basic Definition of Graph theory, methodology, proofs, basic properties of graphs. **Graph operation**: Graph operations and their symbolic designation, Orientation of graph; associated matrices and their relationships **Colouring graphs**: Groups graph coloring, five color problem, four color conjectures, Heawood map coloring theorem, critical graphs. **Elementary properties:** Homomorphism, automorphism graphs, symmetric graphs, graph enumeration.
	Section – B

different fields of study. 6. Implement algorithms of graph theory in area of problems. 7. Recognize if a graph-theoretic problem has a known efficient algorithmic solution or no. 8. Understand important concepts in graph theory such as Eulerian and Hamiltonian graphs, graph connectivity, spanning trees, graph factorization and planarity. 9. Analyze the concept of networks, flows in networks, and some algorithms used to calculate maximum flows. 10. Identify and evaluate the usage of graph to find out complexity of a problem.	**Basics of Graph Algorithms**: Trees, Ordered tree, Hoffman tree, Catalan numbers. **Connectivity and Matching Problems:** Maximum matching in bipartite graph, Network Flow: Maxflow problem and solutions, zero-one net flow. **Tours and Matchings:** Euler and Hamilton path and circuit. NP-complete problems.

Course Code: CSE 4133: Theory of Computation	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: The goal of this course is to provide students with an understanding of basic concepts in the theory of computation. Also to provide the students the concepts necessary to understand the theory of automata i.e. make them capable to understand and design a machine/system.			
Course Objectives: • To introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability. • To enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms.			
Intended Learning Outcomes (ILOs)	**Course Content**		
	Section – A		
At the end of the course the students will be able to 1. Construct finite state machines and the equivalent regular expressions. 2. Prove the equivalence of languages described by finite state machines and regular expressions. 3. Formulate pushdown automata and the equivalent context free grammars. 4. Prove the equivalence of languages described by pushdown automata and context free grammars. 5. Figure out the abstract definition of any regular language and also system. 6. Perceive advanced knowledge of formal computation and its relationship to languages. 7. Establish relations between classes of computational problems, formal languages, and computational models 8. Construct Turing machines and Post machines 9. Prove the equivalence of languages described by Turing machines and Post machines. 10. Demonstrate their understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving.	1. **Language Theory**: Alphabet, string, and languages, Finite representation of languages, Simplification of regular expression, Properties of regular languages, Chomsky hierarchy of languages Finite State Machines, Finite State Models, Finite Automation, Structure of Sequential Machines, Closure Properties of Regular Sets, 2. **Pushdown Automata** : Definition, moves, Instantaneous Descriptions, language recognized by PDA, deterministic PDA, acceptance by final state & empty stack, equivalence of PDA and CFL. **Context Free Grammars**: Introduction, definition, derivation trees, simplification, CNF & GNF. **Section – B** **1. Turing Machines**: basic machines, configuration. 2. Computing with Turing machines, Combining Turing machines. **3. Undecidability**: Decidable languages, the halting problem.		

Course: ECE 4151:Digital Signal Processing	**Credit Hour: 03**	**Year: Fourth**	**Term: First**
Rationale: Digital signal processing (DSP) is the numerical manipulation of signals, usually with the intention to measure, filter, produce or compress continuous analog signals. It is characterized by the use of digital signals to represent these signals as discrete time, discrete frequency, or other discrete domain signals in the form of a sequence of numbers or symbols to permit the digital processing of these signals. This course, thus provides in detailed knowledge of DSP.			
Course Objectives: • To develop ability so that the students can apply knowledge of mathematics and engineering to the analysis and design different systems			

of digital signal processing domain.

- To grow the ability to identify, formulate and solve engineering problems in the area signal processing.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course students will be able to: • Design and implement digital filters through pole-placement techniques, analog to digital conversion techniques such as the bilinear transformation, window method, and then analyze their sensitivity to finite precision effects such as input quantization, coefficient quantization, and multiplication roundoff. • Analyze signals using the discrete Fourier transform (DFT), understand circular convolution, its relationship to linear convolution, and how linear convolution can be achieved via the discrete Fourier transform. • Understand the Decimation in time and frequency FFT algorithms • Examine Z-transform with its application. • Evaluate different types of filtering.	**Section A** Discrete time description of signals and systems, Fourier transform of discrete time signals, Discrete Fourier Transform. **Section B** Z-transform, Digital filter structure, Infinite Impulse Response Filter design techniques. Finite Impulse Response Filter design techniques, Finite precision effects, Inverse filtering.

Course: ECE 4153:VLSI Design and Testability	Credit Hour: 03	Year: Fourth	Term: First

Rationale: This course is designed to develop the very basic concepts of VLSI design process. This course also focuses on the techniques and strategies applied in developing the leaf-cells (basic gates) and structured design based circuits (multiplexers, PLA, parity generator, etc.) to be used for advanced systems.

Course Objectives:

- To establish the relevant theoretical background for MOS devices.
- To introduce students with the overall design process of VLSI circuits.
- To make the students able to design basic gates, inverters and subsystems up to stick diagrams.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course the students will be able to: **1.** Describe the evolution of integrated circuits (ICs) and compare the general characteristics of different MOS technologies. **2.** Explain basic MOS transistor fabrication process and operation. **3.** Establish the relationships among the terminal voltage and currents of a MOS device. **4.** Examine various possible configurations of inverter circuits. **5.** Identify different layers in stick diagrams. **6.** Sketch stick diagrams using both nMOS and CMOS design style for basic gates and simple logic expressions. **7.** Calculate the resistance and capacitance values of MOS transistors and inverters using sheet resistance and area capacitance concepts. **8.** Estimate the inverter delays and pass transistor propagation delays. **9.** Discuss the effects of scaling on the performance of MOS circuits as well as the limitations of scaling. **10.** Design leaf-cell and structured design based circuits and sketch their stick diagrams	**Section A** Introduction to microelectronics and MOS technology, Basic electrical properties and circuit design processes of MOS and BiCMOS circuits, Scaling of MOS circuits, Subsystem design processes and layout. **Section B** Computational elements: Design of an ALU subsystem, Adder, Multipliers, Memory, Registers, and aspects of system timing. Practical aspects of design tools and testability, CMOS design: behavioral description, structural description, physical description and design verification, Introduction to GaAs technology: Ultra-fast VLSI circuits and systems.

Course: ECE 4155:Wireless and Optical Networks	Credit Hour: 03	Year: Fourth	Term: First

Rationale: This course unites concepts across both wireless and optical communication network to give students a better understanding of the technical challenges they will face after graduation.

Course Objectives:

- To gather sufficient theoretical and practical knowledge of fundamental concepts in wireless and optical networking.
- To gain the ability to understand the laws and concepts of Communication Systems and to solve the problems and to interpret the results.
- To acquire the ability to develop and analyze the mathematical models related to wireless and optical Networks.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course the students will be able to: • Develop a strong grounding in the fundamentals of communication systems and networks especially wireless and optical networks. • Understand attennas and propagation of Signal. • Understand band pass digital modulation and demodulation (binary and M-level; ASK, PSK and FSK), including their performance in noise. • Design and analyze the performance of digital modulations in noise. • Understand and design different multiple access techniques. • Use appropriate knowledge in digital communication systems and computer networks to describe, analyze, and understand the different wireless and optical communication systems. • Routing methodology of both the network.	**Section A** Overview of the wireless environment and wireless communication systems, Antennas and Propagation, Spread Spectrum, Coding and Error Control, IEEE 802.11, Mobile IP, Multi-hop ad hoc networks, Bluetooth, TCP for wireless, Cellular Wireless Networks, satellite communications. **Section B** Introduction to optical networks and network components, Routing and wavelength, Logical topology design, Traffic grooming, Dynamic lightpath establishment, Protection and restoration, Optical Burst switching, Optical packet switching.

Course: CSE 4160: Industrial Training	Credit Hour: Non Credit	Year: Fourth	Term: First
Rationale: When universities and industries work in tandem to push the frontiers of knowledge, they become a powerful engine for innovation and economic growth. This course focuses on developing collaboration between industry and academia to understand and respect each other's core objectives.			

Course Objectives:

- To give practical job-oriented experience to students and to give opportunities to put their skill into practical projects.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course the students will be able to- 1. Understand, apply and practice IT industries' rules, ongoing projects etc. from executives of different companies.	Students will take 3 weeks industrial training in an "Computer Science and Engineering related industry or establishment. Student will be evaluated on the basis of a report submitted by them after the completion of the training, oral examination and the report from the concerned industry or establishment. This training is to be organized during the inter - session break.

Course: CSE 4170: Advanced Business Venture	Credit Hour: Non Credit	Year: Fourth	Term: First
Rationale: When universities and industries work in tandem to push the frontiers of knowledge, they become a powerful engine for innovation and economic growth. This course focuses on developing collaboration between industry and academia to understand and respect each other's core objectives.			

Course Objectives:

- To give business experience to students and to give opportunities to put their skill into practical projects.

Intended Learning Outcomes (ILOs)	Course Contents
At the end of the course the students will be able to- • Understand, analyze and evaluate business ways, rules, ongoing projects etc. from executives of different companies.	Discipline will arrange workshops/seminars on IT Business Venture. IT Executives from different IT related companies will conduct lectures on their business ways, rules, ongoing projects etc. Students will be evaluated on the basis of a report submitted by them after the completion of these workshops/seminars.

FOURTH YEAR, SECOND TERM

Course: CSE 4200: Project and Thesis II	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: This course in the continuation of CSE 4100 course. Once the student completes CSE 4100 course successfully, he/she can register this course.			
Course Objectives: • To design one's own algorithm to solve a specific problem • To implement his/her proposal • To be oriented with the research/big project.			
Intended Learning Outcomes (ILOs)	**Course Content**		
	Section – A		
At the end of the course students will be able to: • Work in a team. • Have detailed insights of a specific topic and the previous works done by others. • Design and Implement the proposal he/she prepared in the previous term. • Compare the results he/she produced with previous works. • Write journal/conference paper.	Continuation of project and thesis topic undertaken in **CSE 4100.**		

Course: BA 4251: Industrial Management and Law	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: This course is intended to offer the concepts of Management fundamentals and Law (both commercial and industrial) and provide opportunity for the students to use this knowledge in their professional venue.			
Course Objectives: • To conceptualize the Management and Legal issues. • To acquire knowledge on fundamentals of management, management theories, human resource management, plant layout, inventory management and production control. • To understand the concept of commercial law which includes law of contract, sale of goods, negotiable instruments and industrial law includes working hour, leave, industrial relations. • To acquaint with how this knowledge can be used in practical life.			

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to: 1. Describe various aspects of management fundamentals. 2. Explain how HR operates. 3. Describe how an organization uses concepts of production management. 4. Describe how inventory can be controlled to reduce cost. 5. Understand major and valid part of contract. 6. Describe important and relevant legislations regarding sale of goods. 7. Define law relating to promissory notes, bill of exchange and cheques. 8. Explain the rights of workers and owners and how it can be secured.	**Fundamentals of Management:** Administration, Management and Organization, Authority and Responsibility. Scientific Management, Organization Structure, Organization chart, Span of Control **Human Resource Management**: Selection and Recruitment of employees, Training and its types, Promotion, Wage System and Incentives, Job Evaluation and Merit Rating **Production Management**: Plant Layout, Layout of Physical Facilities, Transportation and Storage, Material Handling, Maintenance, Maintenance Policy, Production Control in intermittent and Continuous Manufacturing Industry, Functions of Production Control, Purchasing Procedures **Inventory Management:** Inventory need and Methods of Control, Factors affecting Inventory building up, Economic Lot Size and Recorder Point.
	Section – B
	Law of Contract: **Law of Contract**, Elements of a valid Contract, Consideration, Parties component to contract **Sale of Goods Acts**: Sale of Goods, Hire and Purchase **Negotiable Instruments Act:** Negotiable Instrument Act, Patent Right and Validity **Industrial Law**: Industrial Laws in Bangladesh: Factories Act, Industrial Relations Ordinance, and Workmen's Compensation Act.

Course: CSE 4221: Pattern Recognition	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is designed to give students a broad knowledge on, and techniques used in contemporary research on pattern recognition.

Course Objectives:

- To develop a theoretical foundation of fundamental pattern recognition concepts.
- To give students practical experience of utilizing pattern recognition techniques on real world problems, through the provision of structured coursework assignments.
- To provide a base for practice and progress in topics related to research.

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
Upon completion of the course, students will be able to: 1. Understand and analyze methods for automatic training of classification systems based on typical statistical, syntactic and neural network approaches. 2. Understand common feature extraction methods for pattern recognition. 3. Design systems and algorithms for pattern recognition. 4. Implement typical pattern recognition algorithms in MATLAB. 5. Differentiate between the pattern recognition techniques. 6. Differentiate between the common neural network architectures and learning algorithms used in pattern recognition. 7. Present ideas and findings of pattern recognition effectively. 8. Think critically and learn independently to solve pattern recognition problems.	1. Introduction and General Pattern Recognition Concepts, Introduction to Statistical Pattern Recognition 2. Supervised Learning using Parametric and Non Parametric Approaches, Linear Discriminant Functions and The Discrete and Binary Feature Cases 3. Unsupervised Learning and Clustering, Syntactic Pattern Recognition: Syntactic Recognition Via Parsing and Other Grammars.
	Section – B
	1. Graphical Approach to Syntactic Pattern Recognition, Learning Via Grammatical Inference 2. Neural Pattern Recognition: Introduction to Neural Pattern Associates and Matrix Approaches and Unsupervised Learning in Neural Pattern Recognition

Course: CSE 4222: Pattern Recognition Laboratory/ Project	Credit Hour: 0.75	Year: Fourth	Term: Second

Rationale: This course is designed to give students practical knowledge on, and techniques used in contemporary pattern recognition techniques.

Course Objectives:

- To make the students capable of implementing any pattern recognition algorithm.
- To give students practical experience of utilizing pattern recognition techniques on real world problems, through the provision of structured coursework assignments.

Intended Learning Outcomes (ILOs)	Course Content
Upon completion of the course, students will be able to- 1. Design systems and algorithms for pattern recognition. 2. Implement typical pattern recognition algorithms in MATLAB. 3. Present ideas and findings of pattern recognition effectively. 4. Think critically and learn independently to solve pattern recognition problems.	Based on the course content of the course CSE-4221

Course: CSE 4223: Data Mining	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is designed to provide some advanced analysis techniques of large database systems to the senior students of computer science and engineering.

Course Objectives:

- To provide the concept of data mining
- To give a general concept about the data mining process
- To provide an overview of some commonly used data mining techniques
- To prepare students for more advanced level courses and research

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
At the end of the course the students will be able to- 1. Define data mining. 2. Describe the data mining process.	1. Introduction 2. Data preprocessing 3. Data mining primitives, languages and systems

3. Distinguish between various advanced data types. 4. Explain various statistical data analysis techniques for various types of data. 5. Describe the data pre-processing techniques. 6. Explain the knowledge discovery process. 7. Understand some real life applications involving data mining techniques. Apply data mining techniques depending on the nature of data and intended application.	4. Descriptive data mining, characterization and comparison 5. Association analysis, classification and prediction, cluster analysis, mining complex type of data, applications and trends in data mining
	Section – B
	6. The knowledge discovery process, data selection, cleaning, enrichment, coding, data mining, reporting, data warehousing and OLAP technology for data mining 7. Setting up a KDD environment Some real-life applications.

Course: CSE 4224: Data Mining Laboratory/ Fieldwork	**Credit Hour: 0.75**	**Year: Fourth**	**Term: Second**
Rationale: This course is designed to provide hands on experience in large database systems analysis techniques to the senior students of CSE discipline.			
Course Objectives: • To provide practical concept of data mining. • To provide practical experience of implementation of data mining algorithms. • To prepare students for more advanced level courses and research.			
Intended Learning Outcomes (ILOs)	**Course Content**		
At the end of the course the students will be able to: Implement real data analysis applications using data mining software like weka, R, octave, matlab or other.	Laboratory works based on **CSE 4223**. Students will complete three Projects with proper documentation as assigned by teacher.		

Course: CSE 4231: Digital System Design	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: This course is designed to provide fundamental concepts of analyzing and designing Digital Hardware Systems like Computer.			
Course Objectives: • To provide a working knowledge of different methods for logic representation, manipulation, and optimization, for both combinational and sequential logic. • To understand several fundamental concepts that can be applied to a wide variety of digital system problems. • To enhance the ability to formulate and solve problems in Digital Systems design and implementation.			
Intended Learning Outcomes (ILOs)	**Course Content**		
	Section – A		
1. Explain the details for a combinational and sequential logic circuit and analyze its timing properties (input setup and hold times, minimum clock period, output propagation delays). 2. Design and analyze circuits for various types of registers, counters, digital arithmetic. 3. Describe the operation of state-of-the-art components to design and build complex digital systems, such as memories, PLA, PALs and programmable logic devices (such as FPGAs); 4. Shows effective design with digital building blocks (such as memory chips, microprocessors, arithmetic circuits etc.) 5. Explain the concepts of datapaths, control units, and micro-operations and building blocks of digital systems.	1. Combinational logic with MSI and LSI circuits 2. Sequential Circuits, registers, counters and memory unit 3. Register transfer logic, micro-operations 4. Processor logic design.		
	Section – B		
	1. Control logic design, Micro-programmed control, 2. Pipeline and vector processing 3. Computer arithmetic 4. Microcomputer system design: Case study.		

6. Describe and evaluate the Interface to microprocessors and computers (from hardware point of view)	

Course: CSE 4232: Digital System Design Laboratory/ Project	**Credit Hour: 0.75**	**Year: Fourth**	**Term: Second**
Rationale: This course is designed to provide practical concepts of analyzing and designing Digital Hardware Systems like Computer.			
Course Objectives: • To provide a practical knowledge of different methods for logic representation, manipulation, and optimization, for both combinational and sequential logic. • To understand several practical concepts that can be applied to a wide variety of digital system problems.			
Intended Learning Outcomes (ILOs)	**Course Content**		
1. Explain the practical details for a combinational and sequential logic circuit and analyze its timing properties (input setup and hold times, minimum clock period, output propagation delays). 2. Design and analyze circuits for various types of registers, counters, digital arithmetic, memories, PLA, PALs and programmable logic devices (such as FPGAs); 3. Explain and implement the practical concepts of data paths, control units, the Interface to microprocessors and computers, micro-operations and building blocks of digital systems.	1. Combinational logic with MSI and LSI circuits 2. Sequential Circuits, registers, counters and memory unit 3. Register transfer logic, micro-operations 4. Processor logic design. 5. Control logic design, Micro-programmed control, 6. Pipeline and vector processing 7. Computer arithmetic 8. Microcomputer system design: Case study.		

Course: CSE4233: Client Server Technology	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: This course aims to provide an introduction to appropriate and relevant technologies used to create modern database-driven websites, current languages and their advanced features, toolkits, template engines, and server technologies. This subject will also explore advanced aspects of the HTTP protocol and issues of Client versus Server implementation.			
Course Objectives: • To acquire knowledge on Internet in facilitating a truly distributed, wide area and highly accessible computing environment. • To examine the analysis, design and implementation techniques required to develop the network, enterprise and Internet based information systems. • To review state-of-the-art technologies such as distributed client/server computing paradigm, middleware concepts and architecture, web-based client/server computing technologies, XML, wireless and intelligent Internet computing.			
Intended Learning Outcomes (ILOs)	**Course Content** **Section – A**		
At the end of the course the students will be able to- 1. Identify different components of distributed client/server on Internet Computing 2. Understand the basic concepts of Internet services and related technologies. 3. Be proficient in using Java Servlets and related Web development tools. 4. Design, develop and implement interactive Web applications. 5. Identify different components of XML and its related standards and technologies; 6. Understand latest and future Web technology, including wireless and intelligent Internet computing.	• Fundamentals of Client/Server systems, Client/server components, • Software and hardware requirements, • Software (e.g. database management systems communication servers, remote access services, application services); • Network and data communication: network models and topologies, data communication strategies. • Client-server implementation along with the analysis and design issues inherent to the client-server paradigm.		

7. Communicate effectively in project / system presentation and technical documents / reports. 8. Learn independently for problem solving and solution seeking. 9. Collaborate with other team members for project design and development, while exhibiting leadership in a project team whenever designated or necessary. 10. Think and reason in a critical and creative mind, especially in applying different computing technologies to interactive Web applications.	**Section – B** • Server and Network Operating systems, network operating systems to support the client-server paradigm • Client operating system, data management, middleware, DCE, RPC and COBRA • Role of remote procedure call • Inter-process communication and named pipes to provide remote execution and message passing capabilities client/server system design • Distributed system application architecture and process design, the theory behind each component, development tools, User interface design, security, future trends.

Course: CSE 4234: Client Server Technology Laboratory/Fieldwork	**Credit Hour: 0.75**	**Year: Fourth**	**Term: Second**
Rationale: This course aims to provide an introduction to appropriate and relevant technologies used to create modern database-driven websites, current languages and their advanced features, toolkits, template engines, and server technologies. This subject will also explore advanced aspects of the HTTP protocol and issues of Client versus Server implementation.			
Course Objectives: • To acquire knowledge on Internet in facilitating a truly distributed, wide area and highly accessible computing environment. • To examine the analysis, design and implementation techniques required to develop the network, enterprise and Internet based information systems. • To review state-of-the-art technologies such as distributed client/server computing paradigm, middleware concepts and architecture, web-based client/server computing technologies, XML, wireless and intelligent Internet computing.			

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to- • Identify different components of distributed client/server on Internet Computing • Understand the basic concepts of Internet services and related technologies. • Be proficient in using Java Servlets and related Web development tools. • Design, develop and implement interactive Web applications. • Identify different components of XML and its related standards and technologies; • Understand latest and future Web technology, including wireless and intelligent Internet computing. • Communicate effectively in project / system presentation and technical documents / reports. • Learn independently for problem solving and solution seeking. • Collaborate with other team members for project design and development, while exhibiting leadership in a project team whenever designated or necessary. • Think and reason in a critical and creative mind, especially in applying different computing technologies to interactive Web applications.	Laboratory works based on **CSE 4233.** Students will complete Projects with proper documentation as assigned by teacher.

Course: CSE 4235: Computer Peripherals and Interfacing	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: The course aims to give sufficient knowledge of computer hardware equipment (PC, peripheral and network) as well as multimedia and virtual reality devices			

Course Objectives:

- To become familiar with the operation of a sophisticated computer system, including high-performance peripheral interfaces, extensive signal processing and graphics software.
- To understand the principals of instruction set design.
- To be familiar with all types of semiconductor memory devices, and memory interface requirements.
- To be familiar with the different types of interrupt structures.
- To have a working knowledge of digital communication interface adapters

Intended Learning Outcomes (ILOs)	**Course Content**
	Section – A
At the end of the course the students will be able to: 1. Gather Knowledge about the input devices 2. Interface various input devices with computer 3. Know about the display devices 4. Interface with display devices 5. Interface with hard copy devices 6. Interface with various types of memory devices 7. Gather knowledge about multimedia devices	1. **Input devices**: Introduction, human factor considerations, keyboards, digitizers, input tables, mouse, track-balls and joy-sticks, voice input systems 2. **Output display devices**: Output display devices: CRT, LCD, Gas-plasma displays, controllers, software support. 3. **Output hard copy devices**: Output hard copy devices: Plotters, impact printing (line and matrix). Nonimpact printers (Electro-photographic, magneto and ionographic, thermal, ink-jet). Color printing, printer controllers.
	Section – B
	4. **Mass storage devices**: Semiconductor, flash, magnetic floppy, hard disk, magnetic tapes, standard cartridge, optical (CD-ROM, WORM), magneto-optical. 5. Multimedia and virtual reality devices Head mounted displays, data gloves.

Course: CSE 4236: Computer Peripherals and Interfacing Lab	**Credit Hour: 0.75**	**Year: Fourth**	**Term: Second**
Rationale: The course aims to give sufficient knowledge of computer hardware equipment (PC, peripheral and network) as well as multimedia and virtual reality devices based on the theory course			
Course Objectives:			

- To become familiar with the operation of a sophisticated computer system, including high-performance peripheral interfaces, extensive signal processing and graphics software.
- To understand the principals of instruction set design.
- To be familiar with all types of semiconductor memory devices, and memory interface requirements.
- To be familiar with the different types of interrupt structures.
- To have a working knowledge of digital communication interface adapters

Intended Learning Outcomes (ILOs)	**Course Content**
At the end of the course the students will be able to: 1. Select a project that is capable to him/her. 2. Choose group partner 3. Break the work into parts and distribute the work load among group partners. 4. List the hardware needed and manage them. 5. Set dead line for parts of projects and submit them 6. Make presentation of the work in general user understandable form. 7. Present the work in front of audience.	Introduction to interfacing devices, peripherals etc. Ask students for a projects list with group members Distribution of the projects among groups. Weekly submission of the progress of the projects. A presentation describing the project Orally present the results of the group work project in accordance with specifications

Course: CSE 4237: Computer Animation and Virtual Reality	**Credit Hour: 03**	**Year: Fourth**	**Term: Second**
Rationale: This course is designed to focus on fundamental techniques used in computer animation systems and current state-of-the-art in virtual reality.			
Course Objectives: • To develop an understanding of fundamental techniques used for computer animation • To provide an understanding of current practices in computer animation • To assist students to use the computational methods for modeling of motions in the physical and virtual world • To make students know the basic concept and framework of virtual reality • To teach students the principles and multidisciplinary features of virtual reality			

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: 1. Learn the theory and techniques involved in the creation of digital animation. 2. Understand basic animation, storytelling and design principles as they relate to specific animation projects. 3. Understand and explain knowledge of computer animation concepts such as pre-production, production, postproduction, key framing, in-betweens, character vs. effects animation, etc. 4. Develop a variety of animation techniques and apply them to actual animation production. 5. Understand the fundamental topics in virtual reality. 6. Evaluate the principles of 3D Systems and augmented reality. **7.** Apply the principles of human computer interaction to the evaluation and construction of virtual reality systems.	**Section – A** **Introduction:** Computer graphics, two and three dimensional geometry, vectors in graphics, representation and modeling of three dimensional objects, polygonal representation, parametric representation, constructive solid geometry. **Transformation and viewing:** frames of reference, viewing systems, 3D transforms, projections and clipping. Reflection and illumination models, theoretical considerations in reflection, geometric considerations, color, phong reflection model, surface rendering, incremental shading algorithms, rasterization, hidden surface elimination algorithms, hidden line removal methods. **Splines:** spline specification, cubic splines, Bezier curves, B-spline curves and surface, rendering parametric surfaces. **Shadows and textures:** function of shadows, shadow algorithms, textures, texture domain techniques. **Graphics Animation:** Real time graphics, graphics display and updates, key framing systems, motion specification. **Section – B** **Virtual reality**: virtual reality systems, real-time computer graphics, overview of application areas, the virtual environment, the computer environment, VR technology, Models of interaction**.** **Virtual reality hardware:** sensor hardware, display systems, acoustic hardware, integrated VR systems, virtual reality software, modeling of virtual words, simulation, VR toolkits**.** **3D computer graphics:** the virtual world space, perspective projection, stereo vision, 3D clipping, color theory, 3D modeling, illumination models, 3D transforms, instances, picking, flying, scaling the VE, collision detection, animating the virtual environment, introduction to animation, the dynamics of numbers, updating real-time graphics, shape and object inbetweening free-form deformation.

Course: CSE 4238: Computer Animation and Virtual Reality Laboratory/ Project	Credit Hour: 0.75	Year: Fourth	Term: Second
Rationale: Hands on Experiences on fundamental techniques used in computer animation systems and current state-of-the-art in virtual reality.			
Course Objectives: • To identify the techniques of computer animation fundamentals • To design and develop interactive animation objects and programs • To apply mathematics and physics in the design and development of animations • To exercise programs and frameworks of computer animation and virtual reality • To provide students with an introduction to the VR system framework and development tools			

Intended Learning Outcomes (ILOs)	Course Content
At the end of the course the students will be able to: 1. Use technical, conceptual and critical abilities, and appropriate technology tools of computer animation effectively. 2. Solve design problems, which contain change over time, 3D models, camera positions, lighting, and textures. 3. Implement the fundamental concepts of virtual reality. 4. Analyze and recognize the existing virtual systems. 5. Acquire knowledge of the hardware and software used in virtual reality applications. 6. Design and create a basic virtual environment.	Laboratory works based on CSE 4237. Students will complete at least three Projects with proper documentation as assigned by teacher.

Course: CSE 4241: Knowledge Engineering	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: to acquire solid knowledge on the theoretical aspects and application areas of knowledge engineering i.e., the languages and models for the representation of data, information and knowledge. This course is suitable for senior level Computer Science and Engineering students.

Course Objectives:

- To provide the concept of knowledge representation and reasoning.
- To give an overview of various type of logic systems.
- To provide concept of uncertainty reasoning techniques.
- To prepare students for more advanced level courses and research.

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
At the end of the course the students will be able to: 1. Define the process of knowledge engineering. 2. Express a system using various logical systems. 3. Explain how a partially observable system can be represented. 4. Explain how uncertainty is modelled in a system design. 5. Apply the knowledge engineering process to diagnose applications. 6. Acquire appropriate knowledge for a system. 7. Apply machine learning techniques in system development, 8. Use meta-knowledge and reasoning techniques in system development. 9. Evaluate the knowledge based system development environment.	Knowledge Engineering Basic **Knowledge Representation and Utilization**: Production Systems (PS), Semantic Networks, Frames, Logic, Object-Oriented Paradigm, Logic Programming, Neural nets. Incomplete Knowledge and Non-Monotonic Logic. **Uncertain Knowledge**: Bayesian Probability Theory, Dempster-Shafer Theory, Fuzzy Set Theory. **Section – B** Application Diagnosis. **Knowledge Acquisition and Machine Learning**: Problems of and Approaches to Knowledge Acquisition, Knowledge Acquisition Support Systems, Machine Learning. Meta-reasoning and Meta-knowledge. **Knowledge System Development Environment**: Al languages, Shells.

Course: CSE 4243: Machine Learning	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: The course provides an introduction to Machine Learning and its core models, algorithms and learning theories. It also introduces Fuzzy Logic and Genetic Algorithm. This subject is very important and useful for solving complicated practical problems such as robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

Course Objectives:

- To provide students with detailed knowledge of how Machine Learning methods work and how statistical models can be brought to bear in computer systems not only to analyze large data sets, but to let computers perform tasks that traditional methods of computer science are unable to address.

Intended Learning Outcomes (ILOs)	Course Contents
	Section – A
At the end of the course the students will be able to- 1. Explain the concepts of various machine learning algorithms. 2. Explain the learning and adaptation capability of neural and fuzzy systems 3. Describe the learning and retrieval procedures of various neural networks 4. Apply the rules of fuzzy logic for fuzzy control 5. Understand and explain the concept of genetic algorithms and show how and why these algorithms work 6. Illustrate the concepts of classification and clustering problems 7. Program the related algorithms and design the required and related systems **8.** Solve in the fields of as robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing	Introduction, Supervised and Unsupervised Learning in Propositional Logic, Induction of Decision Trees, Noise and Over-Fitting Issues, Minimum Description Length Principle, Conceptual Clustering, Version Space, Nearest Neighbor Classifier, Genetic Algorithm, Computational Learning Theory, Neural Network and Fuzzy Logic. **Section – B** Learning in First Order Logic, Top-Down Approaches for Inducing First Order Theory, Handing Noise, First Order Theory Revision, Predicate Invention, Application of Inductive Logic Programming, Multiple Predicate Learning, Different Types of Learning Bias, PAC Learnability, Knowledge Discovery in Database and Data mining, Text and Image Retrieval.

Course: CSE 4245: Robotics and Computer Vision	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is designed to give students a broad knowledge on the topics of computer vision with an emphasis on the concepts applicable to robotics

Course Objectives:

- To introduce the students to the principles of robotics and the major ideas, methods and techniques of Computer Vision.
- To provide the students with programming experience from implementing computer vision applications
- To help students to understand the basics of machine vision concepts applicable to robotics
- To prepare students to design techniques for controlling mechanical systems

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
Upon completion of the course, students will be able to- 1. Understand different robot design techniques and different types of robot control mechanisms. 2. Design and build a simple robot. 3. Move a robot arm using one or more control mechanism. 4. Integrate sensors and effectors into a robotic system 5. Understand the basic concepts, principles, techniques and problems involved in the acquisition of static and dynamic images for specific purposes. 6. Be familiar with the basic theory, techniques and algorithms for analyzing single and multiple images obtained either by a single static or moving camera, or by a stereo pair of cameras. 7. Select and deploy image processing algorithms to extract information from a visual image using a variety of mathematical and algorithmic approaches 8. To design program in popular computer vision software libraries	1. Robotics manipulation, direct kinematics: The Arm Equation 2. Inverse Kinematics: Solving the arm equation, work space analysis and trajectory planning 3. Differential motion and static, manipulator dynamics, robot control, task planning. **Section – B** 1. Relationship between image and world structure, image representation 2. Segmentation pattern, perspective transformation 3. Camera calibration, shape analysis 4. Object recognition and picture languages

Course: CSE 4247: E-Commerce	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is designed to provide fundamental concepts and essential analytical and practical skills in E-Commerce.

Course Objectives:

- To provide an understanding of e-commerce and its impact on the business environment.
- To understand the necessary infrastructure and functional components to develop e-commerce systems.
- To acquire knowledge on applied cryptographic technology and web security protocols.
- To understand the design and application of e-commerce systems.

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
At the end of the course the students will be able to: 1. Acquire a good knowledge of e-commerce, both the technical and business aspects. 2. Understand the principles and practices of e-commerce and its related technologies. 3. Understand the international nature of e-commerce and the challenges that arise in engaging in e-commerce on a global scale. 4. Analyze and evaluate the possible benefits and limitations of using e-commerce in a business setting. 5. Appraise various social issues associated with the conduct of e-commerce. 6. Design and implement a basic e-commerce application 7. Evaluate a variety of different e-commerce applications in the business to consumer sector and the business sector. 8. Explain how businesses can make use of Internet technologies to improve Supply Chain Management.	Foundations of Electronic Commerce, Internet and Extranet, Infrastructure for Electronic Commerce Internet Consumers and Market Research, Retailing in Electronic Commerce, Advertisement in Electronic Commerce, Electronic Payment systems Economics, Global and other issues in Electronic Commerce Business-to-Business Electronic Commerce, Electronic Commerce for Service Industries. **Section – B** Public policy: From legal issues to Privacy EC strategy and Implementation

Course: CSE 4249: Decision Support System	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is intended to develop an appreciation of the nature of managerial business decision making as well as a working knowledge of Decision Support Systems (DSS) for facilitating the process of semi-structured decision making.

Course Objectives:

- To understand the concepts of decision making, decision processes and decision support systems
- To understand the approaches of decision analysis and decision modeling
- To obtain the ability to identify decision problems and specify its properties and components
- To learn how to develop and apply a decision model in real-life decision problems
- To acquire basic skills for using decision support and decision modeling software

Intended Learning Outcomes (ILOs)	Course Content
	Section – A
1. Discuss the concepts and technologies of Decision Support Systems. 2. Describe the techniques to identify and select appropriate modeling 3. Appraise the general nature and range of decision support systems 4. Analyze, design and implement a DSS 5. Analyze the issues involved in the management and development of decision support systems. 6. Discuss the application of Decision Support Systems in real world decision making. 7. Compare and contrast the characteristics and roles of Enterprise Information Systems, Knowledge Management, Artificial Intelligence and Expert Systems.	1. Introduction to Decision Support System (DSS). 2. Decision making models, Underlying Framework for DSS. 3. Hardware and Software for DSS. 4. Use of decision tools. **Section – B** 5. Development of DSS. 6. Issues of model management and interface design. 7. DSS Applications: Executive Information System (EIS), Computer Mediated Communication within an Organization and special aspects.

Course: CSE 4251: Multimedia	Credit Hour: 03	Year: Fourth	Term: Second

Rationale: This course is concerned with the understanding of different types of media available in the multimedia systems. It will discuss media representations, various types of media usage, media storage format, data communications and media retrieval technologies.

Course Objectives:

- To introduce students with various types of multimedia data such as text, image/graphics, video, animation, etc.
- To teach students about popular media file types and explains their basics.
- To teach about audio and video media data details.
- To familiarize students about lossy and lossless media data compression.
- To explain the techniques used in the various media communication, while maintaining different quality of service.
- To teach about media storage techniques and their retrieval process.

Intended Learning Outcomes	Course Content
Upon completion of the subject, students will be able to: 1. Differentiate multimedia data types and their respective file formats. 2. Analyze text, image, audio and video data. 3. Apply compression techniques necessary for different media types based on the multimedia system context. 4. Distinguish among different media data storage models and their respective usage. 5. Describe various algorithms related to these multimedia operations. 6. Explain what type of communication model should be used for which type of multimedia data. 7. Publish multimedia content as animation, video or webpage.	**Section – A** **Introduction:** Definition of Multimedia System, Text, Images, Graphics, Animation, Multimedia Authoring. **Graphics and Image Data Representation**: Graphics/Image data types, File formats: GIF, JPEG, PNG. Basics of color science. **Audio:** Basic concepts, Music, MIDI, Speech; **Video and animation:** Basic concepts, video types, Computer base animation, **Section – B** **Data Compression Techniques:** Basics of lossy and lossless compression, JPEG; H.261 (px64); MPEG; Intel's DVI; Microsoft AVI; Audio compression; Fractal compression, Video compression, **Multimedia Storage and Retrieval Technology:** Magnetic media technology; optical media technology; CD Digital audio, CD-ROM, CD write only (CD-WO), CD-magnetic optical (CD-MO). **Multimedia Communications:** Quality of Multimedia data transmission, Multimedia over IP, Transport of MPEG-4. **Electronic Publishing:** Concepts and future of Electronic Publishing.

7. Teaching strategy:

Popular strategies followed are

- Lecture
- Case method
- Discussion
- Active learning (Apply what students are learning)
- Cooperative learning (small groups work together for achieving a common goal)
- Integrating technology etc.

8. Assessment strategy:

Distribution of Marks:

Marks distribution for theory courses:

Attendance	10%
Continuous Assessment	30%
Term Final Written Examination	60%

Marks distribution for sessional courses:

Attendance	10%
Sessional Assessment	60%
Viva-voce/Presentation	30%

Bases for class attendance marks (both for theory and sessional):

Attendance Percentage	Marks
90% or above	10
85% to below 90%	9
80% to below 85%	8
75% to below 80%	7
70% to below 75%	6
65% to below 70%	5
60% to below 65%	4
Below 60%	0