Department of Computer Science & Engineering
Faculty of Engineering

NPI University of Bangladesh (NPIUB)
(UGC & Govt. Approved)

Syllabus for B. Sc. in
Computer Science & Engineering (CSE)

1. Program Name: **Bachelor of Science in Computer Science & Engineering (CSE)**

2. Name of the Department: **Department of Computer Science & Engineering**

3. Name of the Faculty: **Faculty of Engineering**

4. Program Motivation:

The computer based technologies are the main driving force of the mordern society; and technologies are upgrading constantly and involving in different new aspects of society. To take leadership in such global prospect of 21 century, the main motivation of Bachelor of Science in CSE program is to build expert engineers.

5. Program Goal and Objectives:

The main goal of the CSE program is to develop analytical ability along with technical skills of the students. The program is also for acquisition of knowledge towards development of computer technology and to design computer systems with superior performance. The principal objectives of the program are as follows:

- To produce engineers equipped with the technical knowledge and skills in both theoretical and practical in the area of computer science and engineering with the ability to apply them correctly, efficiently and creatively.
- To enhance student's communication skills and their ability to use knowledge in a rapidly changing world
- To produce socially responsible, morally upright scientists and engineers.

6. Course Outline of the Program:

The program contain courses to cover major areas of CSE which will build students not just for today but to take on the developments that are likely to take place years ahead. The courses are structured to provide a foundation in both basic sciences, mathemetics and engineering. The program also has sufficient general education to enhance the cultural growth of the student and develop professionals with a strong social awareness. A number of elective cources in various specialties are available for students to pursue their particular interests. Necessary laboratory works are included in the syllabus so that students develop practical knowledge on the important topics. Project development in several courses and final Thesis / Project are included to enhance ability of students to solve real life problems from design to implementation.

7. Course Symbol and Numbering System:

Letter symbols for course categories are:

CSE – Computer Science and Engineering

EEE – Electrical and Electronic Engineering

ETE –Electronic and Telecommunication Engineering

IPE – Industrial Production and Engineering

ME – Mechanical Engineering

PHY – Physics

MAT – Mathematics

HUM – Humanities

As for numbering system, the rule is that all theoretical courses are odd numbered. If a theoretical course has a laboratory course, the laboratory course bears an (even numbered) ID adding one (01) with the ID of its theoretical course. For departmental courses, the three-digit figure in a course ID indicate the level and complexity of the course: the higher the number, more complex the course is. The text that follows the ID is the title of the course; the numeric figures after this are credit and lecture hours in a week for the course; and the codes that follow after this figure are the prerequisites for the course. The first digit usually indicates the year in which the course will be taught.

Example:

Course No.	**Course Title**	**Credit**	**Hours / Week**		**Pre-Req.**
			Theory	**Laboratory**	
CSE 105	Object Oriented Programming	3.00	3		CSE 101
CSE 106	Object Oriented Programming Laboratory	1.50		3	

CSE 105 is the code number for 'Object Oriented Programming' which is a 3.00 credit course with three (03) lecture hours per week. It has a prerequisite course which is CSE 101. CSE 105 has a lab course having code CSE 106. The credit of lab course is 1.50 and the course will be conducted through three (03) contiguous lecture hours in a week. The courses will be taught in the first year of the program. On the other hand, a lab course having 0.75 credit will be conducted through three (03) contiguous lecture hours in alternate weeks.

8. Semesters:

There will be three (03) semesters in an academic year, which are:

- Spring : January to April
- Summer: May to August
- Fall : September to December

09. Duration of the Program:

The duration for B.Sc. in Computer Science & Engineering (CSE)program will be four years divided into 12 semesters.

10. Degree to be Awarded:

Bachelor of Science in Computer Science & Engineering, abbreviated as B. Sc. Eng. (CSE)

11. Degree Requirement:

a) Completion of mimimum160.0 credit hours.
b) Passing of all courses individually and maintaining a minimum CGPA of 2.50.

12. Admission:

Minimum 2nd division in both S.S.C. and H.S.C. with science background or five subjects in O-level and three major subjects (Math, Physics and Chemistry) in A-level education are required. The students completed S.S.C. and H.S.C. under GPA system will have to have a minimum GPA of 2.5. OR S.S.C. and H.S.C. (2+4)= 6 OR H.S.C. and S.S.C. (4+2) = 6. OR S.S.C. and H.S.C. minimum two second division. The O- and A-level students must have an average grade of B. Those having Diploma engineering in Electrical/ Electronics/ Computer/ Telecommunication/ Power/ Mechanical are also eligible for admission with waivers in some courses as per guideline of UGC.
The applicant must pass the admission test (Physics, Mathematics and English) arranged by the University.

13. Admission on Transfer:

- There shall be no admission on transfer in the first year. In special cases, students may be admitted into a higher class.
- A student may be allowed to transfer a maximum of 50% of the required courses of this University completed by the student at other universities/institutions. Courses having minimum CGPA of 3.0 and completed not before than three academic years will only be considered for transfer.
- A candidate seeking admission on transfer should apply to the Registrar of this University. The Registrar will refer the case to the Equivalence Committee (EC) headed by the Dean of the Faculty. Other committee members of the EC are Head of the Dept. and one or two expert(s) from the Faculty / Department. On the basis of EC approval with specific courses for transfer, university procedures will be maintain to enroll the student.

14. Grading System:

Letter grading will be made to assess students' performance. The grade will be assigned on the overall evaluation of a student's performance on the basis of semester final examination, midterm exam, case studies, tutorial test, term papers, assignment and class attendance in aggregate and whatever is applicable for an individual program. The responsible teacher(s) of a course will determine Grades/GPA. The final result will be prepared by cumulating the grade point average over the courses. The UGC approved common grading system is adopted for assigning a letter grade and grade point. This is given in the following table:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50

45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00
	F * Failure I ** Incomplete W *** Withdrawal R **** Repeat Y***** Audit	

* "F" means failure. Credits for courses with this grade do not apply towards graduation.

** "I" grade is given to students who have fulfilled the majority of the course requirements but have been unable to complete the rest. The student is not required to register for the course in the next semester.

*** "W" means withdrawal. A student may decide to withdraw from a course by the deadline with the consent of the instructor and the Academic Advisor.

**** "R" means repeat. To improve grade say, F to D or better, more than two times repetition of a course is allowed.

***** "Y" means audit. An existing student or ex-student may decide to audit a course of his/her interest for improvement of his knowledge for the particular course. In this case, the student pays the full tuition fee for the course, attends the classes, but is not required to sit for the exams and no credit is earned.

15. Mark Distribution of Individual Courses:

Theory Course:

Class Participation (Test, Quiz, Assignments, etc.) - 30%
Midterm Examination - 30%
Final Examination - 40%

Laboratory Course / Project / Design:

Mark distribution of Labarotory or Pratical works will be decided by the conducting teacher depends on the nature of works. However, a general guideline is as follows:

Class Participation and Attendance - 20%
Lab Performance, Viva-Voce and Reports - 40%
Final Quiz, Viva-Voice and Lab Test - 40%

Project / Thesis of 4th Year

a) End of 4th year 2nd Semester 40% of total marks to be evaluated as follows:
Supervisor - 20%
Presentation and Viva-Voice - 20%

(Conducted by a Committee)

b) End of 4th year 3rd Semester 60% of the total marks to be evaluated as follows:

Supervisor	- 30%
External Examiner	- 10%
(Any other teacher of the Dept. / an expert from outside)	
Presentation and Viva-Voice	- 20%
(Conducted by a committee)	

16. Summary of Courses:

Summary of 1st Year Courses

1st Year 1st Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 1001	Introduction to Computer Systems	1.50		3	
EEE 1131	Basic Electrical Engineering	3.00	3		
EEE 1132	Basic Electrical Engineering Laboratory	0.75		3/2	
PHY 1151	Physics	3.00	3		
PHY 1152	Physics Laboratory	0.75		3/2	
HUM 1171	English and Human Communication	3.00	3		
HUM 1172	English Skills Laboratory	1.50		3	
Total		13.50	9	9	

1st Year 2nd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 1101	Structured Programming	3.00	3		
CSE 1102	Structured Programming Laboratory	1.50		3	
CSE 1103	Discrete Mathematics	3.00	3		
EEE 1233	**Analog Electronics**	**3.00**	**3**		**EEE 1131**
EEE 1234	**Analog Electronics Laboratory**	**0.75**		**3/2**	
MATH 1141	Differential and Integral Calculus	3.00	3		
Total		14.25	12	4.5	

1st Year 3rd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 1205	Object Oriented Programming	3.00	3		CSE 1101
CSE 1206	Object Oriented Programming Laboratory	1.50		3	
CSE 1115	Digital Logic Design	3.00	3		
CSE 1116	Digital Logic Design Laboratory	1.50		3	
ME 1251	Computer Aided Design Laboratory	1.50		3	
MATH 1243	Coordinate Geometry and Differential Equations	3.00	3		
Total		13.50	9	9	

Summary of 2nd Year Courses

2nd Year 1st Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 2101	Data Structures	3.0	3		
CSE 2102	Data Structures Laboratory	1.5		3	
CSE 2213	Computer Architecture	3.0	3		
CSE 2231	Digital Electronics	3.0	3		EEE 1233
CSE 2232	Digital Electronics Laboratory	1.5		3	
MATH 2141	Fourier Analysis and Linear Algebra	3.0	3		MATH 1243
Total		15.00	12	6	

2ndYear 2nd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 2120	Advanced Programming	1.5		3	
CSE 2103	Algorithm Analysis and Design	3.0	3		CSE 2101
CSE 2104	Algorithm Analysis and Design Laboratory	0.75		3/2	
CSE 2115	Microprocessors, Microcontrollers and Embedded Systems	3.0	3		
CSE 2116	Microprocessors, Microcontrollers and Embedded Systems Laboratory	1.5		3	
HUM 2171	Economics and Accounting	3.0	3		
Total		12.75	9	7.5	

2ndYear 3rd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 2230	Web Programming	1.5		3	
CSE 2205	Database Systems	3.0	3		
CSE 2206	Database Systems Laboratory	1.5		3	
CSE 2207	Numerical Methods	2.0	2		MATH 1243
CSE 2208	Numerical Methods Laboratory	0.75		3/2	
MATH 2243	Complex Variable, Vector Analysis and Statistics	3.0	3		
Total		11.75	8	7.5	

Summary of 3rd Year Courses

3rdYear 1st Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 3101	Mobile Application Development	3.0	3		
CSE 3102	Mobile Application Development Laboratory	0.75		3/2	
CSE 3107	Theory of Computation	3.0	3		
CSE 3115	Software Engineering	3.0	3		
CSE 3116	Software Engineering Laboratory	1.5		3	
ETE 3231	Data Communication	3.0	3		CSE 2231
Total		14.25	12	4.5	

3rd Year 2nd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 4100	System Development Project	1.5		3	
CSE 32103	Operating Systems	3.0	3		
CSE 32104	Operating Systems Laboratory	1.5		3	
CSE 3205	Applied Statistics and Queuing Theory	3.0	3		
CSE 3209	Compiler Design	3.0	3		CSE 3107
CSE 3210	Compiler Design Laboratory	0.75		3/2	
Total		12.75	9	7.5	

3rdYear 3rd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 3111	Computer Networks	3.0	3		
CSE 3112	Computer Networks Laboratory	1.5		3	
CSE 3217	Information System Design	3.0	3		
CSE 3218	Information System Design Laboratory	0.75		3/2	
CSE 4220	Technical Writing and Seminar	0.75		3/2	
HUM xxx	Course from **HUM Optional Group**	2.0	2		
Total		11.00	8	6	

HUM Optional Group

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
HUM 371	Sociology for Science and Technology	2.0	2		
HUM 373	Government	2.0	2		
HUM 375	Business and Industrial Law	2.0	2		
HUM 3177	Entrepreneurship for IT Business	2.0	2		
HUM 379	Professional Ethics and Moral Thoughts	2.0	2		

Summary of 4th Year Courses

4thYear 1st Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 4103	Artificial Intelligence	3.0	3		CSE 2103
CSE 4104	Artificial Intelligence Laboratory	0.75		3/2	
CSE 4111	Computer and Network Security	3.0	3		
CSE 4112	Computer and Network Security Laboratory	0.75		3/2	
CSE xxx	CSE Optional A1 from CSE Optional Group A	3.0			
CSE xxx	CSE Optional A1 Laboratory	0.75	3	3/2	
IPE 3171	Industrial Management	3.0	3		
Total		14.25	12	4.5	

4thYear 2nd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 4200	Project / Thesis	3.0		6	
CSE 4207	Machine Learning	3.00	3		
CSE 4208	Machine Learning Laboratory	0.75		3/2	
CSE 4115	Computer Graphics	3.0	3		
CSE 4116	Computer Graphics Laboratory	0.75		3/2	
CSE xxx	CSE Optional A2 from CSE Optional Group A	3.0	3		
CSE xxx	CSE Optional A2 Laboratory	0.75		3/2	
Total		14.25	9	11.5	

4th Year 3rd Semester

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 4200	Project / Thesis	3.0		6	
CSE 4117	Digital Image Processing and Computer Vision	3.0	3		
CSE 4118	Digital Image Processing and Computer Vision Laboratory	0.75		3/2	
CSE xxx	CSE Optional B1 from CSE Optional Group B	3.0	3		
CSE xxx	CSE Optional B2 from CSE Optional Group B	3.0	3		
Total		12.75	9	7.5	

NB: The Project / Thesis work of course CSE 4200 of 2nd semester is to be continued in the 3rd semester. The course CSE 4200 will be evaluated in both semester individually but final grade will be provided at the end of 3rd semester.

CSE Optional Group A

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 425	Modeling and Simulation	3.0	3		
CSE 426	Modeling and Simulation Laboratory	0 .75		3/2	
CSE 427	Pattern Recognition	3.0	3		
CSE 428	Pattern Recognition Laboratory	0.75		3/2	
CSE 429	Algorithm Engineering	3.0	3		CSE 203
CSE 430	Algorithm Engineering Laboratory	0 .75		3/2	
CSE 431	High Performance Computing	3.0	3		
CSE 432	High Performance Computing Laboratory	0.75		3/2	
CSE 433	Ubiquitous Computing	3.0	3		
CSE 434	Ubiquitous Computing Laboratory	0 .75		3/2	
CSE 435	Digital Signal Processing	3.0	3		
CSE 436	Digital Signal Processing Laboratory	0.75		3/2	
CSE 3237	Peripherals and Interfacing	3.0	3		CSE 1115
CSE 3238	Peripherals and Interfacing Laboratory	0 .75		3/2	
CSE 439	Real-time Embedded Systems	3.0	3		
CSE 440	Real-time Embedded Systems Laboratory	0.75		3/2	
CSE 441	Digital System Design	3.0	3		CSE 1115
CSE 442	Digital System Design Laboratory	0 .75		3/2	
CSE 4243	System Automation	3.0	3		
CSE 4244	System Automation Laboratory	0.75		3/2	
CSE 445	VLSI Design	3.0	3		
CSE 446	VLSI Design Laboratory	0 .75		3/2	
CSE 447	Robotics	3.0	3		
CSE 448	Robotics Laboratory	0.75		3/2	

CSE Optional Group B

Course No.	Course Title	Credit	Hours / Week		Pre Req.
			Theory	Laboratory	
CSE 451	Basic Graph Theory	3.0	3		
CSE 453	Computational Geometry	3.0	3		
CSE 455	Data Mining	3.0	3		
CSE 3257	Big Data Analytics	3.0	3		
CSE 459	E-Commerce	3.0	3		
CSE 461	Multimedia Technology	3.0	3		
CSE 463	Biomedical Engineering	3.0	3		
CSE 465	Bioinformatics	3.0	3		
CSE 471	Principles of Programming Languages	3.0	3		
CSE 473	Parallel and Distributed Processing	3.0	3		
CSE 475	Software Architecture	3.0	3		
CSE 477	High Performance Database System	3.0	3		
CSE 479	Natural Language Processing	3.0	3		
CSE 4281	Human Computer Interaction	3.0	3		
CSE 483	Fault Tolerant System	3.0	3		
CSE 485	Wireless Networks	3.0	3		
CSE 487	Communication Systems	3.0	3		

17. Summary of Credit Distribution:

Year and Semester Wise Summary

Year and Semester	No. of Courses		Credit		Contact Hours / Week	
	Theory	Lab.	Theory	Lab.	Theory	Lab.
1st Year 1st Semester	3	4	9.0	4.5	9.0	9.0
1st Year 2nd Semester	4	2	12.0	2.25	12.0	4.5
1st Year 3rd Semester	3	3	9.0	4.5	9.0	9.0
2ndYear 1stSemester	4	2	12.0	3	12.0	6.0
2nd Year 2nd Semester	3	3	9.0	3.75	9.0	7.5
2nd Year 3rd Semester	3	3	8.0	3.75	9.0	7.5
3rdYear 1st Semester	4	2	12.0	2.25	12.0	4.5
3rd Year 2nd Semester	3	3	9.0	3.75	9.0	7.5
3rd Year 3rd Semester	3	3	8.0	3	8.0	6.0
4thYear 1st Semester	4	3	12.0	2.25	12.0	4.5
4th Year 2nd Semester	3	4	9.0	5.25	9.0	10.5
4th Year 3rd Semester	3	2	9.0	3.75	9.0	7.5
Total	**40**	**34**	**118.0**	**42.0**	**-**	**-**

N.B.: Total Contact Hours = (Contact Hours / Week) × (Semester Duration in No. of Weeks)

Content Wise Summary

Year and Semester	No. of Courses		Credit		Hours / Week		% Measure on Credit (Theory + Lab)	
	Theory	Lab.	Theory	Lab.	Theory	Lab.	Credit	%
CSE (Compulsory)	23	26	68.0	33.75	68.0	67.5	101.75	63.59%
CSE (Elective)	4	2	12.0	1.5	12.0	3.0	13.50	8.44%
Other Engineering (EEE & IEM)	5	4	15.0	4.5	15.0	9.0	19.50	12.19%
Mathematics	4	-	12.0	-	12.0		12.00	7.50%
Basic Science (PHY)	1	1	3.0	0.75	3.0	1.5	3.75	2.34%
Humanities	3	1	8.0	1.5	8.0	3.0	9.50	5.94%
Total	**40**	**34**	**118.0**	**42.0**	**119.0**	**84.0**	**160.00**	**100%**

17. Syllabus of Courses

1st Year Courses

CSE 1001: Introduction to Computer Systems
(1.50 Credits, 3 hours in a week)

Introduction to Computers: Types and generation of computers, Basic organization and functional units of computers; **Number Systems:** Binary, Octal, Hexadecimal, codes and arithmetic operations; complements and its applications;**Hardware**: Operations and functions ofprocessor, memory, I/O devices; **Software and Its Applications:** Types of software and concept of operating systems, System software, Algorithms and Flow Charts, Programming Algorithms and flow chart construction; and Intranet; **Basic Programming:** Basicconcepts and techniques of programming;
Program Development Stages: Flow charts and pseudo code; **Programming Constructs:** Data types, operators, expressions, statements; **Computer Security Issues:**Viruses, Trojans, and passwords.

CSE 1101: Structured Programming
(3.00 Credits, 3 hours in a week)

Programming Concepts & Structured Programming Language: Data types, variables, operators, type of expressions, control structures; **Functions and Program Structures**: Function basics, parameter passing conventions, scope rules and storage classes, recursion; Header files; Preprocessor; Arrays; **String and Pointers:** Pointers and memory addressing. Arrays and pointer arithmetic, Strings; algorithms; **User Defined Data Type:** Structure, structure bit fields, structure padding, unions, enumeration; **Input and Output:** Standard input and output, formatted input and output, file access; Dynamic memory allocation; valgrind; garbage collection;Variable length argument list; Command line parameters; Error handling; Introduction to Graphics routines; Compiling; Makefile; debugging.

CSE 1102: Structured Programming Laboratory
(1.50 Credits, 3 hours in a week)

Laboratory works based on **CSE 1101**

CSE 1103: Discrete Mathematics
(3.00 Credits, 3 hours in a week)

Set Theory: sets, relations, and partial ordered sets; functions; **Mathematical Logic:** propositional calculus and predicate calculus; Mathematical reasoning and proof techniques; **Counting:** permutations, combinations, principles of inclusion and exclusion; Discrete Probability; Recurrence relations and recursive algorithms; Growth of functions; **Graph Theory:** graphs, paths, and trees; **Algebraic structures:** rings and groups.

CSE 1205: Object Oriented Programming
(3.00 Credits, 3 hours in a week)

Introduction: Philosophy of Object Oriented Programming (OOP); Features of OOP; Advantages of OOP over structured programming; Classes and Objects; Array of objects, object references; memory allocation of objects, Constructors, destructors and different types of constructors; Function Overloading; Operator Overloading and type conversion of objects;**Inheritance:** Types of inheritance; Composition and Aggregation;**Polymorphism:** Abstract classes, virtual and pure virtual functions overriding, Interface, Runtime Type Identification (RTTI); Exception Handling; Template functions and classes, Generics; Namespace, Package; Standard Template Library.

CSE 1206: Object Oriented Programming Laboratory
(1.50 Credits, 3 hours in a week)

Laboratory works based on CSE 1205

CSE 1115: Digital Logic Design
(3.00 Credits, 3 hours in a week)

Introduction: Digital systems, Codes, Code Conversion, Boolean Algebra and switching theory. Boolean functions; Canonical forms; Minimization of Boolean functions; Different types of logic gates;**Combinational Circuits:** Combinational Circuit Design Issues, Adder, Subtractors, Arithmetic and data handling logic circuits, Decoders, Encoders, Multiplexers, and Demultiplexers, Binary Parallel Adder, ROM, EPROM and PLA, PAL design, Digital display, Fan-in, Fan-out, propagation delay, power dissipation, Hazards in combinational circuit.**Sequential Circuits**: Flip flops; State diagram; timing diagrams, Mealy and Moor machines. State minimization and assignments. Design of Counters, Register, and the Memory Unit. Asynchronous counters and synchronous counters and their applications. Synchronous and asynchronous logic circuit design. Combinational Logic with MSI and LSI, Race around problems, and Races in sequential circuits.

CSE 1116: Digital Logic Design Laboratory
(1.50 Credits, 3 hours in a week)

Laboratory works based on CSE 1115

EEE 1131: Basic Electrical Engineering
(3.00 Credits, 3 hours in a week)

Direct Current: Voltage and current, resistance and power, Laws of electrical circuits and methods of network analysis, Principles of D.C. measuring apparatus.**Alternating Current:** Instantaneous and r.m.s. current, voltage and power, Average power for various combinations of R, L, and C circuits, Phasor representation of sinusoidal quantities, Introduction to three phase circuits.**Magnetism:**Laws of magnetic fields and methods of solving simple magnetic circuits.**Electrical Machines:** DC generators and alternators; Introduction to transformer and its operating principles; Operating principles of DC and stepper motors.

EEE 1132: Basic Electrical Engineering Laboratory
(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on EEE 1131

EEE 1233: Analog Electronics
(3.00 Credits, 3 hours in a week)

Introduction to Semiconductors: p-n Junction diode characteristics; Diode applications: half and full wave rectifiers, regulated power supply; **Bipolar Junction Transistor**: Operation principles, characteristics, Small-signal low frequency h-parameter model, hybrid pie model, Amplifiers, Switches, Darlington pairs; **Field Effect Transistor (FET)**: Introduction to different FETs such as JFET, MOSFET, NMOS, PMOS and CMOS; Biasing and applications.
Operational Amplifiers: Gain, input and output impedances; offset null adjustment, frequency response and noise; Introduction to Oscillators, rectifiers, active filters, regulated power supply, Stabilizer and UPS, Basic ideas about IC fabrication techniques; Linear and Nonlinear applications of Op-Amps.
Power Semiconductor Devices: SCR, TRIAC, DIAC, UJT and their applications.

EEE 1234: Analog Electronics Laboratory
(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on **EEE 133**

ME 1251: Computer Aided Design Laboratory
(1.50 Credits, 3 hours in a week)

Computer Aided Design (CAD)overview, Scale drawing, Isometric views, Orthographic view, Missing line, Solid works, Project on Engineering Drawing and CAD using AutoCAD or contemporary packages.

PHY 1151: Physics
(3.00 Credits, 3 hours in a week)

Quantum Mechanics: Inadequacy of classical concepts, History of quantum mechanics, Planck's quantum theory, Photoelectric effect, Compton effect, Wave-particle duality, de-Broglie waves, Uncertainty principle and its applications; Sommerfeld relativistic atomic model, Orbital angular momentum, Spin angular momentum, Total angular momentum, Orbital magnetic quantum number and spin magnetic quantum number, Magnetic moment of an electron, Pauli's exclusion principle; Time-dependent and time independent Schroedinger equation, Interpretation of wavefunction, Expectation values, Probability density and probability current density, energy eigen values and eigen functions, stationary states;

Optics: Aberrations: Spherical aberration, coma, distortion, astigmatism, curvature of the field, Chromatic aberration and dispersion; Interference of light, Huygen's principle and construction of wavefront, Young's double slit experiment, Fresnel's bi-prism, Interference due to multiple reflections, Newton's rings.

Solid State Physics: Crystal Structure: Periodic array of atoms, Fundamental types of lattices, Miller indices; Reciprocal lattices: Diffraction of waves by crystals, Scattered wave amplitude, Brillouin Zones, Fourier analysis of basis; Phonon: Vibration of Crystal with monoatomic basis, phonons and heat capacity, thermal inductivity, Enharmonic crystal interactions; Quantum theory of the harmonic crystal: High and low temperature specific heat, Models of Deby and Einstein, Comparison of lattice and electronic specific heat; Free Electron Fermi gas: Energy levels in 1 – D, Fermi – Dirac distribution, Heat capacity of the electron gas, Electrical conductivity and Ohm,s law, Motion in magnetic field, Thermal conductivity of metals; Breakdown of classical theory of conductors: Mean free path, specific heat of solids, construction of Fermi surfaces, Electron orbits, Hole orbits and open orbits, Wigner-Scitz method, Fermi surface of Copper, velocity of electron according to Band theory; LASER Physics: History of LASER, Population inversion and stimulated emission, Generation of coherent radiation, Time coherence, Spatial coherence, Ruby LASER, Model of Ruby LASER, Gas LASER, He-Ne LASER, Semiconductor LASER, Applications of LASER.

PHY 1152: Physics Laboratory
(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on **PHY 1151**

MATH 1141: Differential and Integral Calculus
(3.00 Credits, 3 hours in a week)

Differential Calculus: Limit, Continuity and differentiability; Significance of derivatives; Successive differentiation of various types of functions; Leibnitz's theorem; Rolle's theorem; Mean value theorem; Taylor's theorem in finite and infinite forms; Maclaurin's theorem in finite and infinite forms; Partial differentiation of different multi-variable functions; Evaluation of indeterminate forms; Tangents, Normals, Subtangents and subnormals in Cartesian and polar coordinates; Determination of maximum and minimum values of functions; Points of inflection with Applications; Curvature and radius of curvature; Asymptotes; Curve tracing.

Integral Calculus: Definitions of integration; Integration by the method of substitution; Integration by parts; Integration by the method of successive reduction; Definite integrals, its properties and use in summing series; Walli's formulae; Improper Integrals, differentiation and integration under sign of integration; Beta function and Gamma function; Jacobian, multiple integrals and their applications.

MATH 1243: Coordinate Geometry and Differential Equations
(3.00 Credits, 3 hours in a week)

Co-ordinate Geometry of Two Dimensions: Translation and rotation of axes; Identification of conics with their properties;**Co-ordinate Geometry of Three Dimensions:** Cartesian, Cylindrical polar and Spherical polar coordinates; distance of two points; Section formula; Projection; direction cosines and direction ratios; angle between two lines; distance of a point from a line; Planes: different forms of the equation of a plane, distance of a point from a plane, equations of bisector of planes; Straight line: different forms of equations of straight line, angle between a line and plane, coplanar lines, shortest distance between two lines; Sphere: General equation of the sphere, tangent plane, angle of intersection of two spheres; Cone: equation with vertex at origin; Standard equations of central conicoids.
Ordinary Differential Equations: Order and degree of ordinary differential equations; Formation of differential equations; Solutions of first order first degree differential equations by various methods; Solutions of general linear equations of second and higher orders with constant coefficients; Solution of linear homogeneous equations.
Partial Differential Equations (PDE): Linear PDE with constant coefficients; Solution by separation of variables.
Series Solution: Solution of differential equations in series by the method of Frobenius, Bessel's and Legendre's differential equations and their solutions.

HUM 1171: English and Human Communication
(3.00 Credits, 3 hours in a week)

Introduction: Vocabulary building, Rules of syntax, Grammatical principles, Sentence structure, Correction of errors, Transformation of sentences, Phrases and Idioms, Prefixes and suffixes; notions/functions of language, classes and antonyms & synonyms. **Written Communication:** Comprehension, Construction of paragraphs on scientific and other themes, Precis writing. Technical and official correspondence, Technical report writing, Research paper writing, Tender notice, free composition. Personal filing system; **Oral Communication:** Listening skills, Oral presentation, Audio-visual communication, interviewing skills.

HUM 1172: English Skills Laboratory
(1.50 Credits, 3 hours in a week)

Grammar: Tense, article, preposition, subject-verb agreement, clause, conditional and sentence structure. **Vocabulary Building:** Correct and precise diction, affixes, level of appropriateness, Colloquial and standard, informal and formal.
Developing Reading Skill: Strategies of reading – skimming, scanning, predicting, inferring; analyzing and interpreting variety of texts; practicing comprehension from literary and nonliterary texts. **Developing Writing Skill:** Sentences, sentence variety, generating sentences; clarity and correctness of sentences, linking sentences to form paragraphs, writing paragraphs, essays, and reports, formal and informal letters. **Listening Skill and Note taking:** Listening to recorded texts and class lectures and learning to take useful notes based on listening. **Developing Speaking Skill:** Oral skills including communicative expressions for personal identification, life at home, giving advice and opinion, instruction and directions, requests, complaints, apologies, describing people and places, narrating events.

2nd Year Courses

CSE 2101: Data Structures
(3.00 Credits, 3 hours in a week)

Internal data representation; abstract data types; Elementary data structures: arrays, linked lists, stacks, queues and its variants, recursion.Trees and its variants, graphs; Advanced data structure: Heaps, Fibonacci heaps, Multiway-tree, AVL and Splay Trees; sorting, searching and hash techniques; Memory Management.

CSE 2102: Data Structures Laboratory
(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 2101

CSE 2103: Algorithm Analysis and Design
(3.0 Credits, 3 hours in a week)

Analysis of algorithms: Time and space complexity analysis, correctness and loop invariants; Algebraic simplification and transformations; Lower bound theory; NP-completeness; NP-hard and NP-complete problems; **Algorithmic Techniques:** Divide-and-conquer, greedy method, dynamic programming, backtracking, branch and bound; Flow algorithms; Approximation Algorithms; Introduction to parallel and randomized algorithms.**Search and Traversal Techniques:** Basic search and traversal techniques; Topological sorting; Connected components; Spanning trees; Shortest paths.

CSE 2104: Algorithm Analysis and Design Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 203

CSE 2205: Database Systems

(3.0 Credits, 3 hours in a week)

Database System Concepts: Data Models, Schemas and Instances, DBMS Architectures. **Relational Model**: Entity Relationship Model, Keys, Relationships, ER Diagrams, Design Issues, ER to Relational Mapping;**Relational Algebra:** Basic Relational Algebra Operations, Additional relational Operations; SQL, QBE, Query Processing and Optimization, Triggers & Cursors. **Relational Constraints, Functional Dependencies:** Relational constraints and Relational Database Schema, Functional Dependencies;**Normalization:** Normal Form based on Primary Keys, General Definitions of Second and Third Normal Form, Boyce-Codd Normal form. **Database Indexing and Index Structures:** Types of Single Level Ordered Index, Multilevel Indexes, Dynamic Multilevel Indexes, Dynamic Multilevel indexes using B-Trees and B^+ Trees, Indexes on Multiple Keys.**Transaction Processing and Management:** Introduction to Transaction Processing, Transaction & System Concepts, Properties of transaction, Schedules & recoverability, Serializability of Schedules; **Concurrency Control Techniques:** 2PL, Serializability, and Recoverability, Lock Management, Lock Conversions, Dealing with Deadlocks, Specialized Locking Techniques, Concurrency Control without Locking; **Database Security and Authorization:** Introduction to Database Security, Access Control, Discretionary Access Control, Mandatory Access Control, Security for Internet Applications; **Information Retrieval & XML Data:** Introduction to Information Retrieval**,** Indexing for Text Search**,** Data Model for XML, Querying XML Data, Evaluation of XML Queries.

CSE 2206: Database Systems Laboratory

(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 2205

CSE 2207: Numerical Methods

(2.0 Credits, 2 hours in a week)

Numbers and Errors: Significant figures, Absolute and relative error, Rounding, Error in functional evaluation, Propagation of error in arithmetic process and Truncation errors (Taylor's series).**Single Non-linear Equation:** Method of iteration, Bisection method, False Position method, Secant method, Fixed point method, Newton Raphson method Convergence.**Interpolation:** Difference tables, Newton forward and backward interpolation formula with error, Divided difference and central difference formula, Lagranges Interpolation formula, Curve fitting by least squares, Cubic spline. **Solution of Systems of Linear Equations:** Gaussian elimination, Gauss elimination with Pivoting, Gauss-Jordan method.**Numerical Differentiation and Integration:** Trapezoidal rule; Simpson's rule; Rhomberg rule with error and Weddle's method.**Solution of Differential Equations:** Modified Euler method; Euler's method; Picard's method; Runge–Kutta method; Predictor corrector method, Linear algebraic systems, Direct and iterative methods, Matrix inversion;**Solution of Partial Differential Equations:** Introduction to partial differential equation; Geometric interpretation; Elliptic, parabolic and hyperbolic partial differential equation.**Least Squares Approximation of Functions:** Linear and polynomial regression, fitting exponential and trigonometric functions.

CSE 2208: Numerical Methods Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 2207

CSE 2213: Computer Architecture

(3.00 Credits, 3 hours in a week)

Introduction: Organization and Architecture, Structure and Function, Importance of studying Computer Architecture and Organization.**A Top-Level View of Computer Function and Interconnection:** Computer function, interconnection structure, bus interconnection; **Cache Memory:** Cache memory principle, elements of cache design; **Internal Memory:** Semiconductor main memory, error correction; **External Memory:** Magnetic disk, RAID, optical memory**;Input/Output:** I/O modules, programmed I/O, Interrupt-Driven I/O, Direct memory access, Input/Output Processor, Universal Serial Bus (USB).**Computer Arithmetic:** Arithmetic and logic unit, Integer representation, Floating-Point representation; **Instruction Sets:** Characteristics and Functions, addressing mode and formats; **CPU Structure and Function:** Processor Organization, Register Organization, Instruction Cycle, Instruction Pipelining; **Reduced Instruction Set Computers:** Reduced Instruction Set Architecture, RISC pipelining, RISC versus CISC; **Instruction-Level Parallelism and Superscalar:** Basic view, design issues; **Control Unit Operation:** Micro-operations, Control of the Processor; **Micro Programmed Control:** Basic Concepts, Microinstruction Sequencing and Execution; **Introduction to High Performance Techniques:** Multiple Processor Organization, Multithreaded Architectures, Architectures of multi-core processors, and Vector Supercomputers.

CSE 2115: Microprocessors, Microcontrollers and Embedded Systems

(3.0 Credits, 3 hours in a week)

Microprocessors: 8086 Internal Architecture, Processor status and Flag registers, Machine and assembly language programming: Instruction Format, Instruction Sets, Opcode, Addressing modes, Branching and Looping; Traps and Interrupts, I/O operation, Interrupt Controller; An overview of Intel 80186, 80286, 80386 and Pentium Processors; RISC processors; Parallelism in Microprocessor; Bit-slice processor; **Co-processors and DMA:** Arithmetic Co-processor; I/O processor; Programmable timer; DMA Data Transfer, DMA Controller;

Microcontrollers: Introduction to micro-controllers, Overview/review of Microcontroller Architecture, Data Representation and Memory Usage, Microcontroller Programming; Microcontroller Based System Design: Hardware design, Building, Debugging, Testing and Linking program modules, Hardware implementation and I/O support, Analysis of application examples: recursion and stack usage, and traffic light controller, Input / Output Architecture; Analysis of timing and memory requirements, Real time operation.

Embedded Systems: specifications and modeling; Standard components - Processor, Memory, I/O, Peripherals, Software, Algorithms; Processor types - Microcontrollers, Microprocessors, DSP, FPGA; Memory types - RAM, SRAM, etc; Peripherals - Parallel and Serial Ports, UART, Timers, Real time clocks, I2C bus, DMA controllers; Overview of software and hardware design tools such as VHDL, Verilog, etc.

CSE 2116: Microprocessors, Microcontrollers and Embedded Systems Laboratory

(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 215

CSE 220: Advanced Programming

(1.5 Credits, 3 hours in a week)

Object Oriented Design; Graphical User Interface(GUI); layout; animation; custom view; Scalable user interface; localization; User Experience(UX); multithreading; socket programming; activity; services; broadcast receiver; content provider; Basic networking; database manipulation and advanced APIs; Parsing (JSON, XML etc.) Students will submit individual small projects using advanced programming knowledge.

CSE 2230: Web Programming

(1.5 Credits, 3 hours in a week)

Communication protocols such as TCP/IP, FTP, SMTP and HTTP; Basicnetworking concepts; Advanced Web page development with Dynamic HTML,JavaScript, AJAX, JQuery, and Cascading Style Sheets; Server-side development technologies such as Perl, PHP, ASP.net, Java Servlets, JSP and JSP.net; Basic SQL for database interaction.

CSE 2231: Digital Electronics

(3.00 Credits, 3 hours in a week)

Logic Gates: Diode logic gates, 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-flops, counters and register, memory system, PLAs, PLDs; ADC, DAC design with applications; S/H circuits, LED, LCD and optically coupled oscillators.**Wave Shaping:** Diode wave shaping techniques, clipping and clamping circuits, comparator circuits, switching circuits; Pulse transformers, pulse transmission, pulse generation; Monostable, bistable and astablemultivibrators, schimitt trigger, blocking oscillators and time base circuit; Timing circuits; Simple voltage sweeps, linear current sweeps.**Instruments**: Digital meters, DMM, VTVM, Q meters; Statistical methods in measurements.

CSE 2232: Digital Electronics Laboratory

(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 2231

MATH 2141: Fourier Analysis and Linear Algebra

(3.0 Credits, 3 hours in a week)

Fourier analysis: Fourier series and Fourier co-efficient, dirichlet'scondition and Fourier expansion Convergence of Fourier series,Exponential form of Fourier series, Change of interval, Half rangeseries, parseval's identity, Fourier integrals; **Fourier Transforms:**General transforms, Fourier sine and cosine transforms and their usein boundary value problems.**Z-transform:** Discrete transform and Definition of Z-transform; Properties; Stability; Causality; Region of convergence; Inverse Z-transform.

Linear Algebra: Matrix Operations: Field and Matrices over a field, Product of matrices by partitioning, Symmetric, Diagonal and other special types of matrices with their properties, Elementary transformations and equivalent matrices, Rank, Inverse of a square matrix by elementary row operation.**Systems of Linear Equations:** Solutions of systems of homogeneous linear equations, existence of nontrivial solutions of set of homogeneous linear equations, consistency of system of linear equations, Solution of non-homogenous equations using matrix;**Vector Spaces:** General vector spaces, Column, row and Null Spaces, Basis and Dimension; **Eigen Systems:** Eigen values and Eigen vectors; Estimation of the size of Eigen values;**Inner-Product Vector Spaces:** Inner-Product Spaces, Orthogonality.

MATH 2243: Complex Variable, Vector Analysis and Statistics

(3.0 Credits, 3 hours in a week)

Complex Variable: Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variable and related theorems; Analytic functions, Complex differentiation, sufficient condition for analyticity and Cauchy-Riemann equations; Harmonic functions and conjugate harmonic functions, Construction of analytic functions when either part is given (Miline-Thomson method) ; Different types singularities; Line integral of a complex function; Cauchy's integral theorem and converse of Cauchy's theorem.

Vector Analysis: Transformation of vectors on a plane: scaling, rotation, translation; Linear dependence and independence of vectors; scalar and vector fields, Differentiation of vectors together with elementary applications; Gradient, divergence and curl of point functions and related forms; Green's, Stoke's and Gauss's theorem and their applications.

Statistics: Moment, skewness and kurtosis; Random variables, Probability mass functions and probability density functions; **Expectation:** Expected value and variance with their properties; **Discrete Probability Distributions:** The Bernoulli and Poisson process, Binomial and Poisson probabilities, distribution and properties;**Continuous Probability Distributions:** Normal variate and normal distribution, properties of normal distribution, standard normal variate and standard normal distribution, properties of standard normal distribution, Uniform distribution and it's properties.

HUM 2171: Economics and Accounting

(3.0 Credits, 3 hours in a week)

Economics: Nature of the economics theory, applicability of economic theories to the problem of developing countries; Some basic concepts - supply, demand and their elasticities; The relationship among average, margin and total and their derivation; Equilibrium - stable, straight and dynamic equilibrium;producer's equilibrium-isoquant; Production-factors of production, production possibility curve-equilibrium of a firm, fixed cost and variable cost, the short run and the long run; The cost curves and supply curves, law of returns, internal and external economics and diseconomies; Economics of development and planning, basic concept-saving, investment, GNP, NNP, pereapita income, growth rate, policy instruments of development; Fiscal policy, monetary policy and trade policy, their relative applicability in Bangladesh, Inflation and unemployment cost-benefit analysis, International Trade and comparative advantage.

Accounting: Definition of accounts, its need and importance, accounting and its environment, Users of accounting information, Generally Accepted Accounting Principles (GAAP), Relationship of accounting with engineering education; Business transactions, Step in the recording process, Rules of Debit and Credit, Double entry system of accounting; The journal, The ledger, Cash book, the trial balance, Financial statement; Cost accounting**:** Concept of cost, classification of cost, statement of cost, operating and service costing. Salary and wages/payroll Account.

3rd Year Courses

CSE 4100: System Development Project

(1.5 Credits, 3 hours in a week)

Students will work in groups or individually to develop a term project for a solution of any real life problem. Project may include system automation, mobile application, operating systems modules, embeded system. Students will uselatest technologies and programming for the project development. Finally, they will submit a report on the developed project and will present it.

CSE 3101: Mobile Application Development

(3.0 Credits, 3 hours in a week)

Mobile Platforms: Anatomyof mobile devices,mobile OS (e.g., Android, iOS),mobileprogramming(e.g.,Java,Objective-C);**Mobile Environment Issues:** Limited Resource Computing; Memory Management; Low Power Computing; Fault Tolerance and Persistence; Security Issues.**Android Programming Basics:** SDKs, activities, life cycles, views, intent, resource, storage, UIs; **Android Advanced Programming:** SQLite,networking,maps, multimedia;**iOS Programming Basics:** objective C, SDKs, views, view controllers, gestures, storage; **iOS Advanced Programming:** memory management, datamanagement,networking,graphics,locationtechnologies;Web-based mobile applications(e.g., HTML5).

CSE 3102: Mobile Application DevelopmentLaboratory

(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 3101

CSE 32103: Operating Systems

(3.0 Credits, 3 hours in a week)

Introduction: Fundamental concepts, the role of an operating system in computer systems, operating system structure and operation; **Process Management:** Process concept, process scheduling, process state, process management, co-operating processes, inter-process communication (IPC), kernel; **Threads:** Basics concept, multithreading models, threading issues;

CPU Scheduling: Basic concepts, scheduling criteria, scheduling algorithm, algorithm evaluation; **Process Synchronization:** Critical-section problem, synchronization hardware, semaphores, classic problems of synchronization; **Deadlocks:** System model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.**Storage Management:** Basic concepts, swapping, contiguous memory allocation, paging, segmentation, and segmentation with paging;**Virtual Memory:** Basic concepts, demand paging, page replacement, thrashing.

File Concept: File support, access methods, allocation methods, directory systems, file protection, free space management.**Distributed Systems:** Types of distributed operating system, Communication Protocols.**Distributed File Systems:** Naming and transparency, Remote file access.**Protection and Security:** Goals of protection, domain of protection, access matrix, implementation of access matrix, the security problem, user authentication, security system and facilities.**Case Studies:** Study of a representative operating system.

CSE 32104: Operating Systems Laboratory

(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 32103

CSE 3205: Applied Statistics and Queuing Theory

(3.0 Credits, 3 hours in a week)

Introduction: Elementary concepts, Laws of Probability, Conditional Probability and Bay's theorem, random variables.**Distribution of Sampling Statistics:** Sample, population, sample mean & variance, distribution of sample mean, Markov Inequality, Chebyshev's Inequality, Central Limit Theorem. **Correlation and Analysis of Variance:** Correlations, rank correlation, one way analysis of variance, and two factor analysis of variance: parameter estimation and hypothesis testing.**Regression:** Simple linear regression model, Estimation of the regression parameters, method of least squares, error of random variable, regression to the mean, coefficient of determination, sample correlation coefficient Hypothesis testing, Tests of independence and goodness of fit.**Parameter Estimation:**Estimation of population mean, Interval Estimators & lower-upper bounds of population mean using known and unknown variance;**Hypothesis Testing:**Test concerning the mean of a normal population, testing equality of means of two normal populations, test concerning the variance of normal population, statistical significance,t-tests, Chi-square tests, chi-square test of goodness-of-fit.**Markov Cchains:** Discrete time Markov chains, Continuous time Markov chains, birth-death process, embedded markov chain.

Queuing Models: M/M/1, M/M/C, M/G/1, M/D/1, G/M/1, open and closed queuing network, network of exponential servers, phase-dependent arrival and serviceapplication of queuing models.

CSE 3107: Theory of Computation

(3.0 Credits, 3 hours in a week)

Introduction: Formal language theory, Formal proof, Inductive proofs and central concepts of automata theory.**Finite Automata:** Deterministic finite automata, nondeterministic finite automata, finite automata with with ε-transitions, equivalence and conversion of deterministic and nondeterministic finite automata;**Regular Expressions and Languages:** Regular expressions, algebraic laws for regular expressions, regular languages, pumping lemma, closure and decision properties of regular languages. **Context Free Grammar and Languages:** Context free grammars, parsing (or derivation) and parse trees,ambiguity in grammars and languages, Normal forms for context-free grammars, pumping lemma for CFL's, closure and decision properties of CFL's.**Push Down Automata:** Push down automata, Acceptance by empty store and final state, Equivalence between pushdown automata and context-free grammars, deterministic push down automata.**Turing Machines:**Turing Machines, The Church-Turing machine, Techniques for Turing machine construction, configurations, computing with Turing machines, restricted Turing machines, Turing machines and computers, combining Turing Machines.**Undecidability:** Recursively enumerable language, the undecidability of the halting problem. Undecidable problems about Turing machines, post's correspondence problem.**Complexity Theory**: The classes P, NP, examples of problems in these classes. P versus NP question. NP completeness, polynomial time reducibility, the Cook-Levin theorem. Examples of NP complete problems: vertex cover problem, Hamiltonian path problem. Approximation algorithm, probabilistic algorithms.

CSE 3209: Compiler Design

(3.0 Credits, 3 hours in a week)

Introduction to Compiler: Phases of compilation and overview. Compiling techniques including parsing, semantic processing, and optimization; Complier- compliers and translator writing systems.**Lexical Analysis:** The role of the lexical analyzer, specification and recognition of tokens, lexical analyzer generator.**Syntax Analysis (Parser):** Top-down parsing, Bottom-up parsing, Operator-precedence parsing, Ambiguity, LL and LR parsers.**Semantic Analysis:** Attribute grammar, syntax directed definition, evaluation and flow of attribute in a syntax tree.**Type Checking:** Syntax directed translation, Error management; Error detection and recovery.**Symbol tables**: Data structures for symbol tables.

Run-time storage management and run time support: Parameter passing mechanisms, Stack storage organization and templates, Heap storage management, memory allocation and scope.**Intermediate Code Generation:** Translation of different language features, different types of intermediate forms, languages, declarations and assignment statements.**Code Improvement:** Analysis: control-flow, data-flow dependence etc. Code improvement local optimization, global optimization, Garbage Collection, loop optimization, peep-hole optimization etc. Architecture dependent code improvement: instruction scheduling, loop optimization etc.**Code generation:** Register allocation and target code generation.

CSE 3210: Compiler Design Laboratory
(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 42209

CSE 3111: Computer Networks
(3.0 Credits, 3 hours in a week)

Introduction: Definition of Internet, The network edge, Network code, Network access and physical media, ISPs and internet backbones, Delay and loss in packet-switched networks, Protocol layers and their service models.**Application Layer:** Principles of application layer protocols; Web and HTTP; File transfer protocol (FTP); Electronic mail: SMTP, POP3, IMAP; DNS; P2P; Socket programming with TCP and UDP.**Transport Layer:** Transport layer services; Multiplexing and Demultiplexing; Connectionless transport and UDP; Principles of reliable data transfer; Connection oriented transport and TCP; Principles of congestion control; congestion and flow controls with TCP.**Network Layer and Routing:** Network layer services; Routing principles; Hierarchical Routing; Internet Protocol: IP4 addressing, IPv6, ICMP, DHCP and NAT; Routing: Distance vector and link state routing algorithms; Multicast routing; Router architecture.**Link Layer and Local Area Networks:** Link layer services: Error detection and correction techniques; Multiple access protocols: CSMA, CSMA/CD, Slotted ALOHA; LAN address and ARP; Ethernet; Hub, Bridge and Switch; Wireless links: Wi-Fi and WLAN architecture, Bluetooth; PPP; ATM; Frame relay.**Security in Computer Networks:** Security issues in computer networks**;** Principles of cryptography: Symmetric Key Cryptography and Public Key Encryption; Message Integrity and Digital Signatures; End-Point Authentication; Operational Security: Firewalls and Intrusion Detection Systems.

CSE 312: Computer NetworksLabarotory
(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 3111

CSE 3115: Software Engineering
(3.0 Credits, 3 hours in a week)

Concepts of software engineering: Software engineering paradigms, different phases of software system development, different types of information, qualities of information; **Project management concepts:**Software process and project metrics, software project planning, risk analysis and management, project schedulingand tracking, software cost analysis,COCOMOmodel;**Analysisconceptsandprinciples:**Requirement analysis,analysismodeling,datamodeling;Designconceptsandprinciples: architectural design, user interface design, object oriented software developmentanddesign, iterative development andthe unified process, sequential waterfall life cycles, use case model for requirement writing, elaboration using system sequence diagram, domain model,visualizing conceptclasses;**UMLdiagrams:** InteractionandCollaborationDiagramfor designing Software,class diagram; GoF design patterns: adapter, factory, singleton, strategy, composite, facade,and observer; **Contentmanagement systems:**Concepts,planning anddeveloping dynamic webcontent sites; **Softwaretesting:**Whiteboxandblackboxtesting,basispathtesting,testing for specialized environment; **Software testing strategies:**Unit testing, integration testing, validation testing, system testing; Art of debugging; **Analysisofsystemmaintenanceandupgrading:**Softwarerepair,downtime, error and faults, specification and correction, maintenance cost models, documentation; **Software quality assurance:**Quality factors. software quality measures, cost impact of software defects, concepts of software reliability,availabilityandsafety,functionbased metrics and bang metrics, metricsforanalysisanddesignmodel,metricsforsourcecode,testingand maintenance.

CSE 3116: Software EngineeringLaboratory
(1.5 Credits, 3 hours in a week)

Laboratory works based on CSE 3115

CSE 3217: Information System Design
(3.0 Credits, 3 hours in a week)

System analysis fundamentals: systems, roles, and development methodologies; Understanding and modeling organizational system; Project management; **Information requirements analysis:** Interactive methods;

Informationgathering: Unobtrusive methods; agile modeling and prototyping; **The analysis process:** Using data flow diagrams; Analyzing systems using data dictionaries; Process specifications and structured decisions; Object oriented systems analysis and designusing UML; **The essentials of design:** Designing effective output, Designing effectiveinput; Designing databases; Human-computer interaction; **Quality assurance and implementation:** Designing accurate data entry procedures; Quality assurance and implementation.

CSE 3218: Information System Design Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 3217

CSE 4220: Technical Writing and Seminar

(0.75 Credits, 3 hours in alternate weeks)

Reading, writing and summarizing technical papers. Citation methodologies; Plagiarism issues. Presentation guidelines and techniques. Summarization and presentation of technical papers.

ETE 3231: Data Communication

(3.0 Credits, 3 hours in a week)

Data and Signals: Analog signals, digital signals, transmission impairment, data rate limits, performance measures; **Analog Transmission:** Digital-to-Analog Conversion: ASK, FSK, PSK, QAM, Analog-to-Analog conversion: amplitude modulation, frequency modulation, phase modulation; **Digital Transmission:** Digital-to-digital conversion: line coding, analog-to-digital conversion: pulse code modulation, delta modulation, transmission modes: parallel and serial transmission; **Transmission Media:** Guided media: twisted-pair cable, coaxial cable, fiber-optic cable, unguided media: radio waves, micro waves, infrared. **Bandwidth Utilization:** Multiplexing: frequency-division multiplexing, wave division multiplexing, synchronous time-division multiplexing, statistical time-division multiplexing, spread spectrum: frequency hopping spread spectrum, direct sequence spread spectrum; **Switching Networks:** Circuit switched networks, datagram networks, and virtual-circuit networks. **Telephone Networks for Data Transmission:** Telephone networks, dial-up modems, and digital subscriber line: ADSL, HDSL, SDSL, VDSL, cable TV networks; **Error Detection and Correction:** Block coding, linear block codes, cyclic codes, checksum; **Data Link Control:** Fixed-size and variable-size framing, HDLC.

HUM Optional Group Courses

HUM 371: Sociology for Scienceand Technology

(2.0 Credits, 2 hours in a week)

Society, Science and Technology; Social Research: Methods, Social Impact Assessment (SIA); Culture, civilization and professional ethics; Socializationand leadership development; Social stratificationand social mobility; Globalization, mass media and technology; Deviance, crime, and juvenile delinquency; Social groups and organizations; Population and society: concepts and theories; EnvironmentandUrbanization; Social changeand technology.

HUM 373: Government

(2.0 Credits, 2 hours in a week)

Basic concepts of government and politics: form of government, organs of government, democracy; socialism, bureaucracy, good governance, e-government; GovernmentandPolitics of Bangladesh: major amendments to the constitution, local government, NGOs, public policies, managing development project, constitutional bodies: EC, PSC; Foreign policy of Bangladesh;International Organization: UNO.

HUM 375: Business and Industrial Law

(2.0 Credits, 2 hours in a week)

Administration, Management and organization, Authority and responsibility, Scientific management, Organization structure, organization chart, Span of control, Selection and recruitment of employees; Training and its types, Promotion,

Wage system and incentive; Job-evaluation and merit rating, 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-need and methods of control, Factors affecting inventory building-up, Economic lot size and reorder point.

The Nature and Sources of Law: Meaning and necessity for the law, Classifications of the law, Historical development of the law, Sources of written law; Criminal Law: Classification: felonies, misdemeanors, infractions, Penalties, Youthful offenders; **Civil Law:** Types of torts, Remedies, Responsibility of a minor for his torts; The Court System: Federal, state, and local court systems, Steps in litigation.

HUM 3177: Entrepreneurship for IT Business

(2.0 Credits, 2 hours in a week)

The foundations of entrepreneurship; Inside the entrepreneurship mind: from ideas to reality; The rewards and challenges of entrepreneurship: driving forces behind small business, ethics and social responsibility, creativity and innovation; New business planning process: conducting a feasibility analysis, designing a competitive business model, building a solidstrategicplanandcraftingawinningbusinessplan;Formsofbusiness ownership: franchising and the entrepreneur, buying an existing business; Building a marketing plan: building a bootstrap marketing plan, creative use of advertising and promotion, pricing and credit strategies, global marketing strategies, e-commerce; Building a financial plan: creating a successful financial plan, managing cash-flow, sources of financing-equity and debt; Building an operational plan: location, layout and physical facilities, supply chain management, managing inventory, staffing and leading a growing company; Legal aspects of small business: succession, ethics, business law and government regulation; Strategic plan and risk management; Global aspects of entrepreneurship; Building a new venture team and planning for the next generation.

HUM 379: Professional Ethics and Moral Thoughts

(2.0 Credits, 2 hours in a week)

Meaning of Ethics, Professional Ethics Codes, Psychological basis of Ethics, Religion and Ethics, Egoism and Relativism, Utilitarianism and Rational Utilitarianism, Ethics and other branches of knowledge, Intuitionism, Standard as Values.

Concept of Moral Thoughts and Moral Judgment, Bases of human behavior, Moral development and Reasoning, Morality and Social Institution, Moral rights and duties, Interpersonal Moral Sentiment, Occupational Culture and Ideology, Occupational stress, Morality and Religion, Organizational Commitment, Morality in International Context.

4th Year Courses

CSE 4200: Project / Thesis

(2nd Semester:3.0 Credits, 6 hours in a week)
(3rd Semester:3.0 Credits, 6 hours in a week)

Study and solution of a problem in the field of Computer Science and Engineering.

N.B.: The Project / Thesis work of 2ndSemester is to be continued in the 3rdSemester.

CSE 4103: Artificial Intelligence

(3.0 Credits, 3 hours in a week)

Introduction: Definition, AI technique, Application. **Intelligent agent**: Introduction, Structure of intelligent agent, Agent programs, Goal-based agents, Environments;**Problem Solving:** Solving problem by searching**:** Problem solving by agent, Formulating problems, Toy problems, Search strategies, Breadth-First, Uniform cost, Depth-First, Depth-Limited and Iterative deepening search; Informed Search Methods**:** Best-First, Greedy and A* search, Heuristic functions, IDA* search, Iterative improvement algorithms, Hill-Climbing search, Simulated annealing; Game Playing:Introduction, Perfect decisions in two person games, Imperfect decisions, Alpha-Beta pruning, State-of-the-Art games programs: Chess, Checkers, Backgammon.**Knowledge and Reasoning:** Agents that Reason Logically**:** Knowledge-Based agent, Representation, Reasoning and logic, Propositional logic; **First-Order Logic:** Syntax and semantics, Terms, Atomic and complex sentences, Quantifiers, Equality, Extensions and notational variations, Higher-Order logic, Using First-Order logic, Axioms, Definitions and theorems; **Inference in First-Order Logic:** Inference rules involving quantifiers, Generalized modus ponens, Canonical form, Unification, Forward and Backward chaining,

Completeness, Resolution inference rule, Canonical forms for resolution, Resolution proofs, Conversion to normal form; **Uncertain Knowledge and Reasoning:** Uncertainty**:** Acting under uncertainty, Basic probability notation, Conditional probability, Axioms of probability, Bayes rules and its use, Normalization; **Probabilistic Reasoning Systems:** Representing knowledge in an uncertain domain, Knowledge engineering for uncertain reasoning, Default reasoning, Rule-based methods for uncertain reasoning, Dempster-Shafer theory, Fuzzy sets and fuzzy logic; **Communicating, Perceiving, planning and Acting:** Natural language understanding: syntactic processing, ambiguity resolution, text understanding; **Action:** The situation calculus, a simple solution to the framework problem, complex actions; Planning: Planning in the situation calculus,The STRIPS representation, Planning as a reasoning task.

CSE 4104: Artificial Intelligence Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4103

CSE 4207: Machine Learning

(3.0 Credits, 3 hours in a week)

Introduction: Aspects of machine learning; Leaning Frameworks: supervised, unsupervised, semi-supervised, reinforcement; Evaluation of hypothesis; Practical applications of machine learning.**Artificial Neural Networks:** Neurons and biological motivation; Perceptron and solving Boolean functions; Feed forward and recurrent networks; Single layer and multilayer networks; Back-propagation training method; Radial basis function networks; Associative memory; Ensemble methods.**Support Vector Machines**: Linear maximal margin classifier; Linear soft margin classifier; Nonlinear Classifier.

Decision Trees: Recursive induction; Splitting attribute selection: Entropy and Information Gain; Overfitting and Pruning; ID3 and C4.5 algorithms.

Genetic Algorithms: Motivation from Natural evolution; Genetic operators; Fitness function; Genetic algorithms for optimization.**Swarm Intelligence:** Features of natural swarms; Swarm based methods for optimization: Ant colony optimization, Particle swarm optimization, Bee colony optimization.

Clustering and Unsupervised Learning: Learning from unclassified data; Clustering; Hierarchical Agglomerative Clustering; K-means partitional clustering.**Dimensionality Reduction:** Curse of the dimensionality, empty space phenomenon; Linear and nonlinear techniques for dimensionality reduction.

CSE 4208: Machine Learning Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4207.

CSE 4111: Computer and Network Security

(3.0 Credits, 3 hours in a week)

Introduction and mathematical foundations: Introduction, overview of modern cryptography, number theory, probability and information theory; **Cryptography**: Mechanisms and cryptanalysis of classical cryptosystems, Shannon's theory, Symmetric key cryptography including AES and DES, Asymmetric key cryptography including RSA and ElGamal cryptosystems, Digital Signature including ElGamal and DSA, Hash functions including MD and SHA, Message authentication codes. **Security Protocols**: Key Exchange, Authentication, Authentication and Key Exchange, Secret splitting and secret sharing; **Program Security:** Attacks, Malware, Viruses and other Malicious Codes, Controls against program threats;**Networks Security:**Network protocols, Kerberos, Pretty good privacy (PGP), Secure socket layer (SSL), Threats in networks, Network security con
trols, Firewalls, Intrusion detection system, Secure E-Mail, Web security;

Access Control: Security models and access policies, Access Control in operating systems and databases.

CSE 4112: Computer and Network Security Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4111

CSE 4115: Computer Graphics

(3.0 Credits, 3 hours in a week)

Graphics Hardware: Display devices, Input devices; Basic raster graphics algorithms for drawing 2D primitives; Polygon filling; Basic and composite transformations of 2D and 3D objects, viewing, clipping, and transformations; Normalization and Projection.**Three Dimensional Object Representations**: Polygon surface, curves and surfaces, BSP trees, Fractal geometry methods; Illumination models; **Surface Rendering Methods**: Polygon rendering, ray tracing, terrain visualization with height mapping, modeling surface details with texture mapping; Color models; Computer Animation.

CSE 4116: Computer Graphics Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4115.

CSE 4117: Digital Image Processing and Computer Vision

(3.0 Credits, 3 hours in a week)

Digital Image Fundamentals: Different types of digital images, sampling and quantization, imaging geometry, image acquisition systems, image transformation. **Morphological Image Processing:** Basic morphological concepts, thinning, thickening, opening and closing operations.**Images Enhancement:** Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement.**Image Restoration:** Degradation and observation models, Inverse Filtering, Geometric Transformation.**Image Segmentation:** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Oriented Segmentation.**Image Compression:** Lossy and lossless compression schemes, Predictive compression methods, vector quantization, JPEG and MPEG image compression.**Image Perception and Physical Modeling:** Human visual system; Light, brightness, contrast; Color modeling and representation.**Recognition and Analysis:** Object Recognition; Edge detection, linking and representation; 2D motion analysis; Stereo and multi-view analysis.

CSE 4118: Digital Image Processing and Computer Vision Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4117.

IPE 3171: Industrial Management

(3.0 Credits, 3 hours in a week)

Introduction: Basic theories of management, management functions. **Organization**: Theory and structure, co-ordination, span of control, authority, delegation, centralization and decentralization; **Personnel Management**: Need hierarchy, motivation, leadership, performance appraisal, wages and incentives, organizational change and conflicts.**Cost and Financial Management**: Elements of cost, asset depreciation; break event analysis, investment analysis; **Operations Management**: Demand forecasting, Inventory management systems, Master production schedule, MRP, Basic scheduling techniques, CPM and PERT, plant location and layout, Maintenance management; Management Information System (MIS), Computer aided process planning (CAPP).

CSE Optional Group A Courses

CSE 425: Modeling and Simulation

(3.0 Credits, 3 hours in a week)

Basic simulation modeling: systems, models and simulation, classification of simulation models, steps in a simulation study; **Concepts in discrete-event simulation:** event-scheduling vs. process-interaction approaches, time-advance mechanism, organization of a discrete-event simulation models; Continuous simulation models; Combined discrete-continuous models; Monte Carlo simulation; Simulation of Queuing systems.**Building valid and credible simulation models:** validation principles and techniques; Statistical procedures for comparing real-world observations and simulated outputs; Simulation and analytical methods for analysis of computer systems and practical problems in industry; Introduction to the development of simulation packages; Introduction to Petri Nets and their applications to computing systems

CSE 426: Modeling and Simulation Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 425

CSE 427: Pattern Recognition

(3.0 Credits, 3 hours in a week)

Introduction: Basic concepts of pattern recognition, importance of pattern recognition.**Statistical and Neural Pattern Recognition**: Bayesian classifier, Bayes decision theory, discriminator functions and decision surfaces; Parametric and non-parametric classification methods. **Linear Classifiers**: Discriminating functions and decision hyper-planes; Perceptron algorithm and its variants, Kessler's construction.**Nonlinear Classifiers**: Multilayer perceptron, back-propagation algorithm and its variants.**Template Matching:** Optimal path searching techniques, Dynamic programming methods, Correlation based matching and 2D log search algorithm for image matching.**Context Dependent Classification:** Viterbi algorithm, Observable and hidden Markov models (HMMs), HMMs and their application in speech recognition. **Syntactic Pattern Recognition:** Introduction to syntactic pattern recognition, grammar-based approach, parsing, graph-based approach.**Unsupervised Classification:** Basic concepts of clustering, proximity measures, categories of clustering algorithms, sequential clustering algorithms; Vector Quantization; Feature extraction for representation and classification.

CSE 428: Pattern Recognition Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 427

CSE 429: Algorithm Engineering

(3.0 Credits, 3 hours in a week)

Randomized Algorithms: Las Vegas and Monte Carlo Algorithms;Randomized Data Structures: Skip Lists;
Amortized Analysis: Different methods.Approximation Algorithms: Approximation Schemes, Hardness of Approximation;**P-Completeness reOnline Algorithms:** Competitive Analysis, Online Paging Problem, Randomized online algorithms, Adversary models, Marker algorithm view Multithreaded Algorithms Van Emde Boas tree Algorithms for Massive Data Sets, External Memory Algorithms, Cache-Oblivious Algorithms.**Quantum Algorithms:**Quantum Bits (Qbits), Quantum Gates and CircuitsQuantum Algorithms, Quantum Parallelism, Approximationalgorithms, LP based approximation algorithms, Experimental algorithmic.

CSE 430: Algorithm Engineering Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 429

CSE 431: High Performance Computing

(3.0 Credits, 3 hours in a week)

Introduction to high performance computing: motivation, applications, challenges; Multi-processor computer organization: architecture, memory hierarchy, and pipelines; Performance measures and analysis: speedup, efficiency and scalability, algorithmic techniques, instruction-level optimizations; Parallelization strategies: task parallelism, data parallelism, and work sharing techniques; Parallel algorithms: problem decomposition, partitioning and load balancing; High performance parallel programming: shared memory and message passing models, OpenMP and MPI programming; High performance cloud and cluster computing: Map Reduce programming model, Apache Hadoop, Hadoop distributed file system (HDFS), Apache Spark, Apache Cassandra.

CSE 432: High Performance Computing Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 431

CSE 433:Ubiquitous Computing

(3.0 Credits, 3 hours in a week)

The Ubiquitous Computing Vision: Introduction, definition and scope of ubiquitous computing, essential elements of ubiquitous networks; Visions and challenges in ubiquitous computing.**Architecture:** Autonomic Computing, Distributed Computing, Cloud Computing, Peer to Peer, Mobility, Mobile Computation and Agents, Smart Places, Wearable Computing, Service-Orientation, Sensors and Actuators. **The Design and Evaluation of Different Ubicomputing Applications:** Context-aware computing, automated capture and access systems, smart home, healthcare and assistive applications, energy monitoring and sustainability, mobile social network software, games and entertainment, augmented reality.**Context Awareness:** Surveillance, Monitoring, Navigation, GPS, Location and Tracking, Ontologies, Reasoning. **Privacy:** Problems of Authentication, Confidentiality, Total Information Awareness, Credentials, Access Control.

CSE 434:Ubiquitous Computing Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 433

CSE 435:Digital Signal Processing

(3.0 Credits, 3 hours in a week)

Representation of Discrete-Time Signals and Systems; Sampling of Continuous-Time Signals; Discrete Fourier Transform (DFT); Computation of DFT, The z-Transform; Spectral Analysis of Signals Using DFT.Introduction to filter design, Digital Filter Structure, Infinite Impulse Response Filter Design Techniques, Finite Impulse Response Filter Design Techniques; applications of DSP in Audio, Image, and Video Processing.

CSE 436:Digital Signal Processing Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 435

CSE 3237: Peripherals and Interfacing

(3.0 Credits, 3 hours in a week)

Introduction: Basics of Peripherals, and Interfacing; General Purpose Peripherals, and Special Purpose Peripherals, I/O Techniques: Simple I/O, Strobe I/O, Handshake I/O, DMA Controlled I/O; Hardware and Software interfacing in Microcomputer System Design, Multi-processor Configurations; **Memory Interfacing**: Compatibility between memory and MPU system bus, Address Space Partitioning, Standard versus system memories, Restriction imposed by MPU architecture;**Data Transfer Techniques and Their Implementation**: Programmed data transfer, DMA mode of data transfer, I/O port, and Serial modes of data transfer; **Common Peripherals and their Interfacing:** Interfacing I/O devices - floppy disk, hard disk, solid state disk, CDROM and other optical memory, keyboard, mouse, display devices, etc.; Interfacing with USB.**Programmable Peripheral Interface:** Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature, programming; ADC and DAC chips and their interfacing.**Programmable Interval Timer:** Intel 8254, pin configuration, internal block diagram of counter and modes of operation, counter read methods, programming.**I/O Devices for Process Control and Instrumentation:** Transducers;Operational Amplifier,Optocouplers; Relays; AD and DA converters.**Microprocessor in Scientific Instruments and Other Applications:** Display, Protective relays, Measurements of Electrical quantities, Temperature monitoring system, water level indicator, motor speed controller, Traffic light controller, etc.

CSE 3238: Peripherals and Interfacing Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 3237

CSE 439: Real-time Embedded Systems

(3.0 Credits, 3 hours in a week)

Embedded architectures: 16/32/64-bit embeddedprocessors; Interaction with devices: buses, memory architectures, memory management, device drivers; Concurrency: software and hardware interrupts, timers; Real-time principles: synchronization, scheduling, multi-tasking; Real-time task scheduling: scheduleablity analysis, rate and deadline monotonic scheduling, fixed and dynamic priority scheduling; Feedback control theory and application; Profiling and

code optimization; Embedded software systems: exception handling, loading, modeswitching,programming embeddedsystems.

CSE 440:Real-time Embedded Systems Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 439

CSE 441: Digital System Design

(3.0 Credits, 3 hours in a week)

Register Transfer Logic: Inter Register Transfer, Arithmetic, Logic and Shift Micro-Operations, Conditional Control Statements, Fixed-Point Binary data, Overflow, Arithmetic shifts, Decimal data, Floating-Point data, Non-numeric data, Instruction codes, Design of simple computer; **Processor Logic Design:** Processor Organization, Arithmetic Logic Unit, Finite State Machine-design and implementation. Design of Arithmetic Circuit, Design of Logic Circuit, Design of Arithmetic Logic Unit, Status Register, Design of Shifter, Processor Unit, Design of Accumulator, and Introduction to hardware description languages (VHDL and Verilog).**Control Logic Design:** Control Organization, Hardwired control, Micro-program Control, Control of Processor Unit, PLA Control, Micro-program Sequencer; **Computer Design:** System Configuration, Computer Instructions, Timing and Control, Execution of Instructions, Design of Computer Registers, Design of Control. Register Load and Inter Register Transfer; Bus Buffer and Memory Cycle of Microcomputers;**Memories:** ROMs, RAMs, A Small TTL Memory. **Simple as Possible (SAP-1)Computer Design:** Architecture, Instruction Set, Programming, Fetch Cycle, Execution Cycle.

CSE 442:Digital System Design Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 441

CSE 4243: System Automation

(3.0 Credits, 3 hours in a week)

Introduction to System Automation: Control, Drives, Transducers, Sensors, Transmitters, Converters etc.**Automation Hardwires:** Microcontroller, Microprocessor, Programmable Logic Controller (PLC), Field Programmable Gate Array (FPGA).**Control Systems:** Power Electronics & Electric Machines, Connection and Circuit technology for Transducers, Drives and Servos, Sensors and Process Control, Robotics and Servo Control, etc.

Computer / Microprocessor based Automation: Technology and Architecture details, Peripherals and Interfacing, I/O communications, Networking, Software Development Tools (SDK), etc.

Microcontroller based Automation: Technology and Architecture details, Datasheet, Pin configuration, System Design Flow, Microcontroller programming and debugging, Interfacing, ADC, Timer, Pulse Width Modulation (PWM), USART and I2C Communications, troubleshooting, etc.

PLC based industrial Automation: PLC configuration and control, Ladder Logic and Relays, PLC Programming, PLC Operation, Input and outputs, Logical sensors, Logical actuators, Boolean Logic Design, PLC Design, Analog inputs and outputs, etc.;Trouble shooting, and maintenance of PLC;Supervisory Control and Data Acquisition (SCADA): HMI introduction, Design, Implementation, Configuration, Control and Operation.

FPGA based Automation: Technology and Architecture details, Physical Design, FPGA Design Flow, Technology Mapping, Placement &Routing, FPGA Synthesis: Register Transfer (RT)/Logic Synthesis, I/O Pin Configuration, bit file generation, Program Loading in FPGA, Clock Synchronization, Bus Architecture and Memory Design: ALU Design, Processor Architecture, Memory, VHDL/Verilog Programming: RTL design and Coding, Test bench, Simulation.

CSE 4244:System Automation Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 4243

CSE 445: VLSI Design

(3.0 Credits, 3 hours in a week)

Introduction:VLSI Design Methodology, Introduction to Microelectronics and CMOS technology, Brief overview of Fabrication process; Basic electrical properties of CMOS and BiCMOS circuits; **Hardware Modeling:** Logic networks,

state diagrams, Data flow, behavioral optimization. Introduction to GaAs technology: Ultra-fast VLSI circuits and systems.

CMOS and BiCMOS Design Process: Stick diagram and Lambda-based design rules, Subsystem Design processes; **Subsystem Design Layout:** Gate Logic, Combinational Design, Clocked Sequential circuits, Bus designs; **Design of Computational Elements:** ALU sub-system, Adder, Multipliers, Memory, Registers, and aspects of system timing. Architectural Synthesis: Circuit specification, Architectural optimization, Data-path synthesis, Control unit synthesis, Synthesis and testing of VLSI circuits. Various CAD tools for design, simulation, and verification;Introduction to hardware description languages (VHDL and Verilog); Design style: FPGA and CPLDs.

CSE 446:VLSI Design Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 445

CSE 447: Robotics

(3.0 Credits, 3 hours in a week)

Introduction: History, definitions, robotic systems design, applications;**Coordinate Systems:** Cartesian coordinates, degrees of freedom, reference frames, orientation, bi-dimensional andtridimensional transformation matrices, relative and general transformations, homogeneoustransformations, inverse transformations, graphs;**Robots Systems and Structures:**Robot architectures, technical concepts of robotics, actuation;**Robot Kinematics (position):**Joints, members, reference frames, *A* matrices, direct and inverse kinematics, trigonometricsolution, precision, efficiency/complexity of kinematic solutions;**Robot Kinematics (velocity and acceleration):** Derivatives, velocity and acceleration of rigid bodies, differential movement, Jacobian, singularities;**Sensors and Perception:** Internal and external sensors, sensors hierarchy, interfaces, data fusion, classification,localization, machine vision, applications;**Control:** Classical approaches for robot control, feedback loops, position and force control, compliance, fuzzy logic control;**Task and Path Planning:** Action-level planning, modeling, motion planning in R-space and C-space, path tracking.**Different Types of Robots:** Legged Robots and Zero Momentum Point (ZMP), Humanoid Robots, Robots, Middle Sized and Small Sized Soccer Robots.

CSE 448:Robotics Laboratory

(0.75 Credits, 3 hours in alternate weeks)

Laboratory works based on CSE 447

CSE Optional Group B Courses

CSE 451: Basic Graph Theory

(3.0 Credits, 3 hours in a week)

Graphs: Simple graphs, digraphs, subgraphs& complements, vertex-degrees, walks, paths,cycles and distance, connectedness & components of a graph,Random Graphs**,** bridges and blocks, isomorphism and *2*-isomorphism, Trees: Trees, spanning trees, *k*-trees, spanning *k*-trees, forests; Matrices of a graph: incidence matrix, cut matrix, circuit matrix, orthogonality relation.**Traversability:** Eulerian graphs, Hamiltonian graphs, Chinese postman problem, Traveling salesman problem; Graph coloring: Vertex coloring and chromatic Number, Chromatic polynomials, Edge coloring and chromatic index, four-color problem; Vizing's theorem; Planar graphs. Graph applications: Matching, Covering and Packing; Flow Networks.

CSE 453: Computational Geometry

(3.0 Credits, 3 hours in a week)

Historical perspective, Algorithmic background, Geometric preliminaries, Models of Computation, Geometric searching, Point location problem and range searching problems, Divide and conquer, Amortization, Multi-dimensional search, Space sweep, Polygon Triangulation, Intersection and union of rectangles.Proximity, Closest pair problem, Duality and randomization, Voronoi and Delaunay diagrams, Arrangements of lines and points, Geometry of rectangles, Hidden surface removal, Art gallery theorems, Shortest paths, and lower-bounds. Convex hulls: 2D& 3D proximity;Facility location and linear programming, Mobility of objects in space.

CSE 455: Data Mining
(3.0 Credits, 3 hours in a week)

Introduction: Kinds of data and patterns to be mined, basic statistical description of data.**Data preprocessing**: Data objects and attributes, data similarity and dissimilarity, data cleaning, data integration, data reduction, data transformation and discretization.**Data warehousing:** Data warehouse modeling, design issue, implementation and usage, data mining, associations, correlations, mining methods, pattern evaluation.**Data classification**: Decision tree induction, classification methods, evaluation and selection of classification, classification accuracy.**Cluster analysis**: Partitioning, hierarchy, density and grid based clustering methods, evaluation of clustering methods, cluster quality.**Outlier detection**: Outlier detection methods, statistical approaches,proximity based approaches, clustering and classification basedapproaches.

CSE 3257: Big Data Analytics
(3.0 Credits, 3 hours in a week)

Introduction: Defining big data, big data as a service, big data processing, technology and tools; **Big Data Architecture:** Space of big data, characteristics of data, data-driven decision making, deriving value from data, data R&D, building the data architecture; **Big Data Processing Algorithms:** Mapreduce, hadoop tools for mapreduce, computing platform, advanced mapreduce techniques, machine learning with mapreduce; **Big Data Search and Mining:** Big data search and retrieval, social network clustering, text sentiment mining, big data mining and analysis tools. **Security of Big Data:** Big data security in IT, security in critical infrastructure, confidentiality, integrity, availability. **Privacy of Big Data:** Security versus privacy, online privacy, offline privacy, privacy post archival. **Applications of Big Data:** Applications in finance, retail industry, manufacturing, telecommunications, social media, health care and others.

CSE 459: E-Commerce
(3.0 Credits, 3 hours in a week)

E-commerce: What is e-Commerce? Defining B2B, B2C and C2C Commerce. Advantages &
Disadvantages of e-commerce, Tools for enabling e-commerce. Internet, Extranet, Intranet, WWW, Web Pages & their Design, HTML, XML, WML, WAP.**B2B Commerce:** Electronic Data Interchange Standards EDIFACT, ANSI X12, Value Added Network Services, Security Issues in e-Commerce, Symmetric Key Encryption, Digital Encryption Standards (DES), Public Key Encryption, RSA System Digital Signature, Digital Signature Certification Authority, MIME and MIME Standards, PGP for e-mail. **B2C Commerce:** Varieties of Business, New Business Models, Electronic Payment Systems, Credit Cards, Electronic Funds Transfer, Electronic Cheque Payments, Electronic Cash, Issues in Cash Payment, Micro Payments over the Internet, Digital Watermark, C2C Commerce.
E-Governance: Introduction to E-Governance, Understanding the Relationship - Governance and E-governance;**E-Government at work:** E-administration and E-services; E-Democracy; Local E-government. Joined-up Government, National Land & Property Gazetteer (NLPG) - meta-frameworks and interoperability in action - GIS systems, Pathfinder-Beacon councils, **Example:** One Stop Shop, International Perspectives on E-Government - Focus on Malaysia, US Perspectives on E-Government, Information security and privacy protection; Future directions of e-governance.

CSE 461: Multimedia Technology
(3.0 Credits, 3 hours in a week)

Fundamentals: Media and data streams, sound/audio, image, graphics, video and animation. Color Science and Color Models. **Data Compression:** Coding requirements, source, entropy, and hybrid coding, Lossless and Lossy Compression, JPEG, H.261, MPEG, MP3 and etc.**Computer Technology Issues:** Communication architecture, multimedia workstations, cache systems, storage systems and optical storage. **Multimedia OS:** Real-time operation, resource management, process management, file systems, and Multimedia networking.**Multimedia Synchronization:** Presentation requirements, reference model, and synchronization techniques. **Multimedia Database:** Data organization, indexing and retrieval. **Web TechnologiesIssues:** Elements of Web Styling, Usability, Accessibility and Information Architecture and Content Management Systems (CMS).**Multimedia Applications:** Digital libraries, system software, toolkits, conferencing paradigms, structured interaction support, and examples from video/audio/graphics conferencing.

CSE 463: Biomedical Engineering
(3.0 Credits, 3 hours in a week)

Bioelectric Phenomena and Biosignals: Cell membrane, Resting potential, Action potential; ECG, EEG, EMG, EOG and ERG: origin, characteristics and applications in medical diagnosis. **Physiological Measurement:** Electrode: working

principle, equivalent circuit and classifications; Transducers: characteristics, classifications and applications; Measurements: body temperature, blood pressure and heart rates.**Biosignal Processing:** Instrumentation amplifiers, Signal conditioner, A/D and D/A converter, Computerized automatic analysis, Bio-telemetry.**Diagnostic Methods:** Ultrasound, X-ray, CT, and MRI techniques: principles, merits, demerits and applications; Applications of Laser and Optics in Diagnosis.**Biomedical Equipment:** Surgical diathermy machines, Defibrillators, Pacemakers, Ventilators; Prosthesis and Prosthetic devices; ICU and CCU.**Electrical Safety:** Physiological effects of electricity, Susceptibility parameters, Electrical shock hazards in safety aspects of biomedical instrumentation and Good grounding concepts.

CSE 465: Bioinformatics

(3.0 Credits, 3 hours in a week)

Molecular biology basics: DNA, RNA, genes, and proteins; Genome rearrangements; DNA sequence alignments; Gene prediction; Dynamic Programming, Local and Global Alignment; DNA sequencing, genome sequencing, protein sequencing, spectrum graphs; Combinatorial pattern matching: Database Search, Rapid String Matching, BLAST, FASTA; GenomeAssembly: Consensus-alignment-overlap,Graph-basedassembly; Expression Analysis, Clustering and classification; Evolutionary trees and Phylogenetics;StatisticalandmachineLearningMethodsinBioinformatics.

CSE 471: Principles of Programming Languages

(3.0 Credits, 3 hours in a week)

Specification of Programming Languages: Syntax, semantics: operational semantics, denotational semantics, axiomatic semantics and attribute grammars.**Issues in Language Design:** Names, scope, and binding, types, control flow, subroutines and control abstraction, modules, mutation, laziness, polymorphism, objects, classes and inheritance in object-oriented languages.**Programming Language Paradigms:** Data abstraction and object oriented, programming, Non-imperative paradigms: Functional languages, Logic programming, Dynamic and scripting languages, Concurrent programming.**Runtime Management:** Runtime structure and operating environment; practical and implementation issues in run-time systems and environment.**Concurrency:** Subprogram-level concurrency, semaphores, monitors, message passing, statement-level concurrency.**Exception Handling:** Design issues, evaluation of exception handling in C++ and Java.

CSE 473: Parallel and Distributed Processing

(3.0 Credits, 3 hours in a week)

Motivation for Parallelism: Parallel Computing, Speed Up, Moore's Law, Grand Challenge Problems, Trends; The status and future of massively parallel processing.**Parallel and Distributed Computers:** Flynn's Taxonomy, Distributed Memory Multicomputers, Shared Memory Multiprocesors, Networks of Workstations, Cluster and Grid Computing; PRAMs, Interconnection Networks.**Performance Measures:** Granularity, Speed Up, Efficiency, Cost, Amdahl's Law, Gustafson's Law, Isoefficiency; Optical Computing, Quantum Computing.**Interconnection Networks:** Interconnection networks for inter-processor communication, Permutation Routing, Non Uniform Routing, Deadlock free routing and multicasting, mapping and embedding.**Distributed Processing:** Distributed models and systems, real time distributed systems; **Applications:** Sorting, Searching, Matrix Algorithms, Fourier Transform, Finding the Maximum, Image Processing.

CSE 475: Software Architecture

(3.0 Credits, 3 hours in a week)

Definition and overview; Architecture design: patterns, Attribute-Driven Design (ADD) method; Architecture influence cycle: what influences softwarearchitectsandsoftware architecture; Understanding and achieving quality attributes: Quality Attribute Workshop (QAW) methodfor identifying criticalqualityattributes; Documentingsoftware architecture;Evaluatingsoftwarearchitecture: ArchitectureTradeoffAnalysis Method (ATAM) for evaluating software architecture; Architecture reuse; Architecture review; Improving an existing architecture design; Software Architecture in Agileprojects; Software Architecture in service orientedsystems;SoftwareArchitectureinembeddedandmobilesystems.

CSE 477: High Performance Database System

(3.0 Credits, 3 hours in a week)

High performance database systems: client-server databases, parallel and distributed databases, cloud databases; **Transaction oriented computing:** transaction models, flat transactions, nested transactions, distributed transactions, long-lived transactions, transaction processing monitors; **Concurrency control:** isolation theorems, locking, nested transaction locking, schedulingand deadlock,deadlock detection and management; Failure and recovery; Replica

management, Transactional and tuple oriented file system; Transaction and database performance benchmarks; NoSQL systems: data models, system architecture, transactions, elasticity and optimizations.

CSE 479: Natural Language Processing

(3.0 Credits, 3 hours in a week)

Introduction to natural language processing; Regular Expressions and Automata; Morphology and FSTs; Phonetics, Phonology and Text-to-Speech; N-grams and Machine Learning; Word Pronunciation and Spelling; Automatic Speech Recognition. Word Classes and POS Tagging; CFGs for English; Basic Parsing with CFGs; Parsing Problems and Some Solutions; Probabilistic and Lexicalized Parsing.Meaning Representations and Semantic Analysis; Lexical Semantics; Word Sense Disambiguation; Robust Semantics and Information Retrieval;Hidden Markov and Maximum Entropy Models;Text Coherence and Discourse Structure; Reference Resolution; Information Status; Spoken Dialogue Systems; Intonation in TTS Systems; New Approaches to Story Modeling for Understanding, Generation and Summarization;Machine Translation; Summing Up: NLP Applications.

CSE 4281: Human Computer Interaction

(3.0 Credits, 3 hours in a week)

Introduction and overview: Definition and Importance of HCI, Usability Requirements, Understanding Users, Requirements Analysis; **User Centered Design and Prototyping:** System Centered Design, User Centered Design, Case Studies, Participatory Design, Design Rationale, User interface prototyping, Paper-based prototypes, Software-based prototypes; **Sensation, Perception, Cognition:** Psychophysics, Visual perception - low level, Visual perception - high level, Auditory Perception, Haptic / kinesthetic perception, Attention, Motor behavior, ergonomics; **Experimental Design and Analysis:** A Model of Usability Factors, Ethics, experimental planning, basic terminology, Experimental design, Statistical analysis (t-test, F-Test, correlation/regression), Anova, Non-parametric analysis; **Interaction Systems:** Visual: eye movements, Visual: gesture recognition, Tabletop interfaces, Tangible interfaces, 3D interfaces, Virtual and augmented reality, Brain Computer Interface.

CSE 483: Fault Tolerant System

(3.0 Credits, 3 hours in a week)

Introduction: Definition of fault tolerance; Redundancy; Applications of fault-tolerance. **Fundamentals of Dependability:** Attributes: reliability, availability, safety; Impairments: faults, errors and failures; Means: fault prevention, removal and forecasting.**Dependability Evaluation Techniques:** Common Measures: failures rate, mean time to failure, mean time to repair, etc.; Dependability Model Types, Dependability Computation Methods.**Hardware Redundancy:** Redundancy Allocation; Passive Redundancy: Triple Modular Redundancy; Reliability Evaluation; Voting Techniques; N-modular Redundancy; Active Redundancy: Duplication, Standby Sparing, Pair-and-a-spare; Hybrid Redundancy: Self-purging Redundancy, N-modular Redundancy; Evaluation and comparison, Applications.**Information Redundancy:** Coding Theory: Parity codes, Hamming codes, Cyclic codes, Checksum, M-of-N codes, Berger codes, Arithmetic codes, etc.; Encoding and decoding techniques; Applications; Algorithm based fault tolerance.

Time Redundancy: Check-pointing and roll-back; Analysis and optimality; Alternating Logic.**Software Redundancy:** Single-version Techniques**;** Multi-version TechniquesSoftware Testing;Self-checking Software.**Fault Detection in Cryptographic Systems:** Overview of Ciphers,Security attacks through fault injection: Fault attacks on symmetric key ciphers, Fault attacks on public (asymmetric) key ciphers, Countermeasures.**Fault-models:** Layers of Reality;Stuck-at fault model and the Single fault assumption**;** Functional fault models.**Case Studies:** Stratus Systems**;** IBM Sysplex**.Soft Error:** Overview of soft errors; Sources of soft errors;Soft error mitigation techniques.

CSE 485: Wireless Networks

(3.0 Credits, 3 hours in a week)

Cellular concepts: frequency reuse, handoff strategies, interference and systemcapacity, grade of service,improving capacity and coverage, call blocking probability; Propagation effects: outdoor propagation models, indoorpropagationmodels,powercontrol,Doppler'seffect,smallandlarge scale fades; Wireless LAN Technology; IEEE 802.11: standard, protocol architecture, physicallayer and mediaaccess control; Mobile IP; Wireless ApplicationProtocol;IEEE802.16BroadbandWirelessAccess;Briefreview of2ndand3rdgenerationwireless: GSM,GPRS,CDMA;Cordlesssystem; Wireless local loop; Bluetooth: overview and baseband specifications.

CSE 487: CommunicationSystems

(3.0 Credits, 3 hours in a week)

Communication link engineering: Fundamental noise processes, Brightness and antenna noise, Polarization-wave and antenna, Wave propagation, Channel impairmenteffects, Receiver system noise, Receiver types and sub-assembly survey, Low noise antenna design;Signal power budgets and system design techniques; Interference and frequencyreuse; System& circuitlevel design and implementation of communication hardware: mixers, RF amplifiers, filters, oscillators and frequency synthesizers,modulatorsanddetectors,carrierandsymboltimingrecovery subsystems; Issues in software-defined radio transmitter and receiver implementation.