VARENDRA UNIVERSITY

Faculty of Science and Engineering

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

**Syllabus for B.Sc. in Computer Science and Engineering
for students admitted in Spring 2023 or later**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Name of the Program: Bachelor of Science (B.Sc.) in Computer Science and Engineering (CSE)

Program Summary

The B.Sc. in CSE degree program requires 150 credits and is extended over a period of 4 years. This program is to be completed in 8 semesters, each year having 2 semesters namely:

Name of the Semester	Duration
Spring	January to June
Summer	July to December

Each semester will be of 14 weeks duration (to conduct theory and lab classes). Midterm examination will be held without hampering normal classes.

1 Credit (Theory) means 60 minutes/week
1 Credit (Lab) means 120 minutes/week

Minimum 150 credits and CGPA 2.50 are required to obtain B.Sc. Degree.

Grading Scale and Grades

Numerical Grade	Letter Grade	Grade Point
80% and above	A+ (A Plus)	4.00
75% to less than 80%	A (A Regular)	3.75
70% to less than 75%	A- (A Minus)	3.50
65% to less than 70%	B+ (B Plus)	3.25
60% to less than 65%	B (B Regular)	3.00
55% to less than 60%	B- (B Minus)	2.75
50% to less than 55%	C+ (C Plus)	2.50
45% to less than 50%	C (C Regular)	2.25
40% to less than 45%	D (D Regular)	2.00
Less than 40%	F (Failure)	0.00

Cumulative Grade Point Average

Student's performance will be evaluated on the basis of Grade Point Average (GPA) semester wise and Cumulative Grade Point Average (CGPA) of total completed courses.

The CGPA will be computed in the following manner:

$$CGPA = \frac{Sum\ of\ (Earned\ Credit\ \times\ Corresponding\ Grade\ Points)}{Total\ Credits}$$

Grading/Evaluation

Evaluation of students' performance will be based on Continuous Assessment (CA) and Summative Assessment (SA). The distribution of marks for theory and laboratory courses are as follows:

Theory Course

Assessment Tools		Marks (%)	
Continuous Assessment (CA)	Class Participation	10%	40%
	Class Test, Assignment, Project, Discussion, Presentation	30%	
Summative Assessment (SA)	Mid-term Examination	24%	60%
	Final Examination	36%	
Total		**100%**	

Lab Course

Assessment Tools		Marks (%)
Continuous Assessment (CA)	Lab Participation	10%
	Continuous Assessment (Experiment, Report, Viva)	40%
Summative Assessment (SA)	Final Examination (Lab Test, Quiz, Viva, Project)	50%
Total		**100%**

Course Distribution

The syllabus includes courses on Mathematics and Basic Science, Humanities, Basic and Major Engineering. The distribution of different categories of courses is as follows:

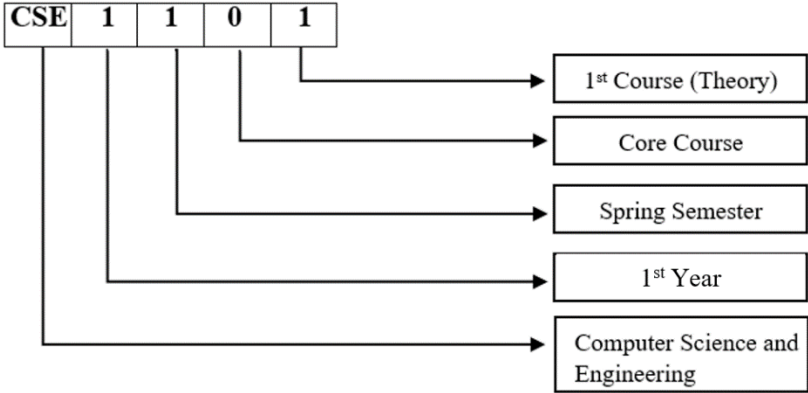| Course Type	Credits	% of Credits
Mathematics and Basic Science	**22**	**14.67%**
a) Mathematics	12	
b) Statistics	3	
c) Physics	4	
d) Chemistry	3	
Humanities	**12**	**8%**
a) Economics	2	
b) Accounting	2	
c) English	3	
d) Law	2	
e) History of the Emergence of Bangladesh	3	
Basic and Major Engineering	**116**	**77.33%**
a) Theoretical	84	**56%**
b) Laboratory	32	**21.33%**
Total	**150**	

Course Designation and Numbering System:

Each course is designated by a three-letter word identifying the department, which offers it following, by a four-digit number with the following criteria:

a) The 1st digit corresponds to the year in which the course is normally taken by the students.

b) The 2nd digit represents the semester (Spring/Summer) in which the course is normally taken by the students.

c) The 3rd digit corresponds to the course category (Core courses, Mathematics, Humanities, etc.)

d) The 4th digit represents the course sequence. Odd sequence number corresponds to theory courses and even sequence number corresponds to lab courses.

The course designation system is illustrated by one example as shown below:

Course Code: CSE 1101

| CSE | 1 | 1 | 0 | 1 |

- 1st Course (Theory)
- Core Course
- Spring Semester
- 1st Year
- Computer Science and Engineering

YEAR AND SEMESTER WISE DISTRIBUTION OF COURSES

1st Year First Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 1101	Structured Programming Language	40	60	100	3
CSE 1102	Structured Programming Language Lab	50	50	100	1.5
EEE 1131	Basic Electrical Circuits	40	60	100	3
EEE 1132	Basic Electrical Circuits Lab	50	50	100	1
MAT 1141	Differential and Integral Calculus	40	60	100	3
PHY 1151	Basic Physics	40	60	100	3
PHY 1152	Basic Physics Lab	50	50	100	1
ENG 0002	English Fundamentals	40	60	100	3
				Total	18.5

1st Year Second Semester

Couse Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 1201	Object Oriented Programming	40	60	100	3
CSE 1202	Object Oriented Programming Lab	50	50	100	1.5
CSE 1203	Discrete Mathematics	40	60	100	3
EEE 1231	Electronic Devices and Circuits	40	60	100	3
EEE 1232	Electronic Devices and Circuits Lab	50	50	100	1
MAT 1241	Coordinate Geometry and Vector Analysis	40	60	100	3
CHE 1261	Chemistry	40	60	100	2
CHE 1262	Chemistry Lab	50	50	100	1
				Total	17.5

2nd Year First Semester

Course Code	Course Title	Marks CA	Marks SA	Total	Credit
CSE 2101	Object Oriented Design and Design Patterns	40	60	100	3
CSE 2102	Object Oriented Design and Design Patterns Lab	50	50	100	1.5
CSE 2103	Data Structures	40	60	100	3
CSE 2104	Data Structures Lab	50	50	100	1.5
CSE 2105	Digital System Design	40	60	100	3
CSE 2106	Digital System Design Lab	50	50	100	1
MAT 2141	Differential Equations	40	60	100	3
BAN 0001	History of the Emergence of Bangladesh	40	60	100	3
				Total	19

2nd Year Second Semester

Course Code	Course Title	Marks CA	Marks SA	Total	Credit
CSE 2201	Software Engineering and System Analysis	40	60	100	3
CSE 2203	Computer Algorithms	40	60	100	3
CSE 2204	Computer Algorithms Lab	50	50	100	1.5
CSE 2205	Numerical Methods	40	60	100	3
CSE 2206	Numerical Methods Lab	50	50	100	1
CSE 2207	Computer Networks	40	60	100	3
CSE 2208	Computer Networks Lab	50	50	100	1
MAT 2241	Linear Algebra and Complex Variables	40	60	100	3
				Total	18.5

3rd Year First Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 3101	Computer Graphics	40	60	100	3
CSE 3102	Computer Graphics Lab	50	50	100	1
CSE 3103	Database Management System	40	60	100	3
CSE 3104	Database Management System Lab	50	50	100	1.5
CSE 3105	Computer Architecture	40	60	100	3
CSE 3106	Computer Architecture Lab	50	50	100	1
CSE 3107	Communication Engineering	40	60	100	3
MAT 3141	Applied Statistics and Probability	40	60	100	3
				Total	18.5

3rd Year Second Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 3201	Theory of Computation and Compiler Design	40	60	100	3
CSE 3203	Operating System and System Programming	40	60	100	3
CSE 3204	Operating System and System Programming Lab	50	50	100	1
CSE 3205	Microprocessor and Assembly Language	40	60	100	3
CSE 3206	Microprocessor and Assembly Language Lab	50	50	100	1
CSE 3207	Digital Signal Processing	40	60	100	3
CSE 3208	Digital Signal Processing Lab	50	50	100	1
CSE 3209	E-commerce and Web Programming	40	60	100	2
CSE 3210	E-commerce and Web Programming Project Lab	50	50	100	1.5
ECO 3271	Engineering Economics	40	60	100	2
				Total	20.5

4th Year First Semester

Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 4101	Artificial Intelligence	40	60	100	3
CSE 4102	Artificial Intelligence Lab	50	50	100	1
CSE 4103	Digital Image Processing	40	60	100	3
CSE 4104	Digital Image Processing Lab	50	50	100	1
CSE 4105	Engineering Ethics and Environmental Protection	40	60	100	2
Option I (T)	Theory: Should be selected from Table-I	40	60	100	3
Option I (L)	Lab: course based on Option-I (T)	50	50	100	1
ACC 4171	Industrial Management and Accountancy	40	60	100	2
CSE 4100	Project or Thesis with Seminar Part I	50	50	100	2
CSE 4120	Industrial Attachment	50	50	100	1
CSE 4122	Technical Report Writing	50	50	100	0.5
				Total	19.5

Table-I: Option I

Course Code	Course Title	Marks	Credit
CSE 4107	Microcontroller, Computer Peripherals and Interfacing	100	3
CSE 4108	Microcontroller, Computer Peripherals and Interfacing Lab	100	1
CSE 4109	Computer Vision and Pattern Recognition	100	3
CSE 4110	Computer Vision and Pattern Recognition Lab	100	1
CSE 4111	Mobile Apps and Game Development	100	3
CSE 4112	Mobile Apps and Game Development Lab	100	1

4th Year Second Semester

Course Code	Course Title	Marks		Total	Credit
		CA	SA		
CSE 4201	Parallel Processing and Distributed System	40	60	100	3
CSE 4202	Parallel Processing and Distributed System Lab	50	50	100	1
CSE 4203	Cryptography and Network Security	40	60	100	3
CSE 4204	Cryptography and Network Security Lab	50	50	100	1
Option II (T)	Theory: Should be selected from Table-II	40	60	100	3
Option II (L)	Lab course based on Option-II (T)	50	50	100	1
Option II (T)	Theory: Should be selected from Table-II	40	60	100	3
Option II (L)	Lab course based on Option-II (T)	50	50	100	1
CSE 4200	Project or Thesis with Seminar Part II	50	50	100	2
				Total	18

Table-II: Option II

Course Code	Course Title	Marks	Credit
CSE 4205	Robotics and Automation	100	3
CSE 4206	Robotics and Automation Lab	100	1
CSE 4207	Big Data Analysis	100	3
CSE 4208	Big Data Analysis Lab	100	1
CSE 4209	Cloud Computing and IOT	100	3
CSE 4210	Cloud Computing and IOT Lab	100	1
CSE 4211	Machine Learning	100	3
CSE 4212	Machine Learning Lab	100	1

DETAIL DESCRIPTION OF THE COURSES

1st YEAR FIRST SEMESTER

CSE 1101: Structured Programming Language

Credit: 3.0
Pre-requisite: None

Course Content: Basic Overview of Computer Programming Languages, Structure of a C Program, Basic Concepts of Compiler, Interpreter, Algorithm and Flowchart. C Tokens, Variables, Operators, Expressions and Data Types. Decision Making: Simple If, If-Else, Nested If-Else, Else-If Ladder, Switch Case, For Loop, While, Do-While Loop, Infinite Loop Array, String, Enum and Pointers User-Defined Function, Return Type, Parameter, Call by Value and Call by Reference Structure, Union, File and Dynamic Memory Allocation.

Books Recommended:

1.	H. Schildt	:	**Teach yourself C**, *McGraw-Hill Publishers* **[Text Book]**
2.	E. Balagurusamy	:	**Programming with ANSI C**, *Tata McGraw Hill*
3.	Gotfreid Hill	:	**Programming with C**, *Schaum's Outline Series, Tata McGraw*
4.	D.E. Knuth	:	**The Art of Computer Programming**, *Addison-Wesley Professional*
5.	Kernighan and Ritchie	:	**The C Programming Language**, *Prentice Hall*

CSE 1102: Structured Programming Language Lab

Credit: 1.5
Pre-requisite: None

Course Content: Program structure, Program creating, compiling, debugging and running, basic I/O functions. Simple Programs in C. Variable, operators, data types Simple if, if-else, nested if-else, else-if ladder, Switch-case, nested switch-case. For loop, while loop, do-while loop, nested for loop Functions: call

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by value, call by reference. Recursive function. One dimensional array, two-dimensional array String, Structure, union, pointer. File Handling.

Books Recommended:

1.	H. Schildt	:	**Teach yourself C**, *McGraw-Hill Publishers* **[Text Book]**
2.	E. Balagurusamy	:	**Programming with ANSI C**, *Tata McGraw Hill*
3.	Gotfreid Hill	:	**Programming with C**, *Schaum's Outline Series, Tata McGraw*
4.	D.E. Knuth	:	**The Art of Computer Programming**, *Addison-Wesley Professional*
5.	Kernighan and Ritchie	:	**The C Programming Language**, *Prentice Hall*

EEE 1131: Basic Electrical Circuits

Credit: 3.0
Pre-requisite: None

Course Content: Fundamental electrical concepts and measuring units. Direct current: voltage, current, resistance and power. Laws of electrical circuits and methods of network analysis; Network theorem, KCL, KVL superposition theorem, Theremin's theorem, Norton theorem, Max Power transfer theorem Introduction to magnetic circuits. 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.

Books Recommended:

1.	Robert L. Boylestad:	:	**Introductory Circuit Analysis [Text Book]**
2.	Charles K.Alexander, Matthew N.O. Sadiku	:	**Fundamentals of Electric Circuits**
3.	Richard C. Dorf, James A. Svoboda	:	**Introduction to Electric Circuits**
4.	L. Theraja, A.K. Theraja	:	**A Text Book of Electrical Technology (Volume-1)**

EEE 1132: Basic Electrical Circuits Lab

Credit: 1
Pre-requisite: None

Course Content: Verification of Superposition theorem, Verification of Thevenin's theorem, Verification of Norton Theorem, Verification of Maximum power transfer theorem, Observation of phase differences of current and voltage of a series RLC circuit.

Books Recommended:

1.	Robert L. Boylestad:	:	**Introductory Circuit Analysis [Text Book]**
2.	Charles K.Alexander, Matthew N.O. Sadiku	:	**Fundamentals of Electric Circuits**
3.	Richard C. Dorf, James A. Svoboda	:	**Introduction to Electric Circuits**
4.	L. Theraja, A.K. Theraja	:	**A Text Book of Electrical Technology (Volume-1)**

MAT 1141: Differential and Integral Calculus

Credit: 3.0
Pre-requisite: None

Course Content:
Functions: Domain, Range, Inverse function and graphs of functions, Composition of function, Limits, Continuity, Indeterminate form, asymptotes.
Ordinary Differentiation: Differentiability, Differentiation, Successive differentiation, and Leibnitz theorem.
Expansions of functions: Rolle's Theorem, Mean value theorem, Taylor's and Maclaurin's formulae, Power series. Maximum and minimum of functions of one variable.
Partial Differentiation: Partial differentiation, successive partial differentiations, differentiation of implicit functions, total differential coefficient, exact differential, Euler's theorem
Tangents and normal: Equation of tangents, equation of normal, angle of intersection of two curves, subtangent and subnormal. Indefinite Integrals: Method of substitution, Integration by parts, Special trigonometric functions and rational fractions.
Definite Integrals: Fundamental theorem, General properties, Evaluations of definite integrals and reduction formulas.
Multiple Integrals: Determination of lengths, Areas and Volumes.

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Books Recommended:

1. Frank Ayres, Jr. and: **Calculus**, *Schum's outline, 6th Edition,* Elliott Mendelson *McGraw-Hill* **[Text Book]**

2. B. C. Das and : **Differential Calculus,** *U.N. Dhur and Sons* B.N. Mukherjee *and Pvt. Ltd., 51th Edition, India, 2009*

3. B. C. Das and : **Integral calculus including differential** B.N. Mukherjee **equations**. *U.N. Dhur and Sons and Pvt. Ltd., 54th Edition, India, 2008*

4. Joseph Edwards : **Differential Calculus,** *Kessinger Publishing*

5. Md. Abdul Latif and: **Differential Calculus,** *Chandaapure,* S. Bhattacharjee *Chittagong.*

6. E. W. Swokowshi,: **Calculus of Several Variables,** *PWS* M. Olinick and D, *Publishing Company, India, 1995* Pence

PHY 1151: Basic Physics

Credit: 3.0
Pre-requisite: None

Course Content: Columb's law, Gauss's Law and its application; Electric field in dielectric media, Energy in an electrostatic field, Electrostatic force, Electromotive force. Magnetic induction, Magnetic force on a charge, Lorenz force, Magnetic field of a current, Torque on a current Loop, Moving coil galvanometer, Biot-Savart law and its applications, Ampere's law, Hall effect. Faraday's induction law, Lenz's law, induced current and voltage, Self- inductance and mutual inductance, Inductor, Ideal transformer, Energy stored in a magnetic field. Types of waves, Equation of Waves, Velocity and Energy, Complex waves, Standing waves, Resonance, Beats, Sound waves, the Doppler Effect. Huygens's principle, Interference phenomena, Young's experiment, Michaelson interferometer, Interference involving multiple reflections, Newton's ring, Holography. Fraunhofer and Fresnel diffraction, Diffraction by single slit; Diffraction gratings and its resolving power. Polarization of light.

Books Recommended:

1 Halliday, Resnick and Walker :**Fundamentals of Physics. [Text Book]**

2. Dr. Giasuddin Ahmad, Hafiz :**Physics for Engineers,** *Part-1 & Part-2 (4th ed)*

3. N. Subrahmanyam Brij Lal, :**A Text Book of Optics,** *Oscillations* M.N. Avadhanulu

4. Feyman, Leighton, Sands :The Feymman Lecture on Physics

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PHY 1152: Basic Physics Lab

Credit: 1.0
Pre-requisite: None

Course Content:

Measurement of Coulombs force between charges. Verification of Biot-savart law for straight and circular wire. Verification of Faraday's law of electromagnetic induction. Measurement of the frequency, wavelength, and speed of standing waves on a string Use of Michelson interferometer to measure the wavelength of a HeNe laser and to measure the refractive index of air and investigate its dependence on pressure. Fraunhofer single slit diffraction.

Books Recommended:

1. Halliday, Resnick and Walker : **Fundamentals of Physics. [Text Book]**
2. Dr. Giasuddin Ahmad, Hafiz : **Physics for Engineers,** *Part-1 & Part-2 (4th ed)*
3. N. Subrahmanyam Brij Lal, M.N. Avadhanulu : **A Text Book of Optics**, *Oscillations*
4. Feyman, Leighton, Sands : **The Feymman Lecture on Physics**

ENG 0002: English Fundamentals

Credit: 3.0
Pre-requisite: None

Course Content: Parts of Speech, Types of Phrases, Types of Clauses and Sentences, Verb and Phrasal verb, Preposition and Conjunction. Transitional Words and Phrases, Subject-Verb Agreement, Tense, Voice, Making Question (WH-Question, Yes/No Question, Tag Question, Embedded Question), Reading Comprehension (Reading for Gist and Detail, Reference and Inference, Finding Factual Information, Finding Author's Purpose) and High Frequency Academic Vocabulary, Paragraph Writing Techniques, Essay Writing Techniques, Resume Writing, Cover Letter Preparation, Email Writing, Précis Writing, Report Writing, Common Spoken Discourse in Formal and Informal Context.

Books Recommended:

1. Baker, S. : **The Practical Stylist** (7th ed.), *HarperCollins College Div* **[Text Book]**
2. Barnet, S., Stubbs, M., Bellanca, P., & Stimpson, P. G. : **Practical Guide to Writing with Readings and Handbook** (8 ed.), *Prentice Hall Canada* **[Text Book]**
3. Eastwood, J. : **Oxford Practice Grammar Intermediate** (Pap/Cdr ed.), *Oxford University Press* **[Text Book]**
4. Imhoof, M., & Hudson, H. : **From Paragraph to Essay: Developing Composition Writing** (7th ed.). *Longman* **[Text Book]**
5. Leech, G., & Svartvik, J. : **A Communicative Grammar of English** (3rd ed.), *Routledge* **[Text Book]**
6. Murphy, R. : **English Grammar in Use Book** (5th ed.), *Cambridge University Press*

1st YEAR SECOND SEMESTER

CSE 1201: Object Oriented Programming

Credit: 3.0
Pre-requisite: CSE 1101 (Structured Programming Language)

Course Content:
Introduction: Object oriented programming and procedural oriented programming, encapsulation, inheritance, polymorphism, data abstraction, data binding, static and dynamic binding, message passing. Variable declaration and constants, expression and statements, data types, operators, Functions.
Classes: Structure of classless, public, private and protected members, array of object, argumented and non-argumented member functions, nested member class and their object, static class member, Friend function, friend class.
Inheritance: Mode of inheritance, classifications of inheritance, virtual inheritance. Array of objects of derived class.
Constructor and Destructor: Default constructor, argumented constructor, copy constructor, dynamic constructor, constructor function for derived class and their order of execution, destructor.
C++ data file: C++ file stream classes, input and output file, mode of files, file pointer, random file accessing.

Operator and Function Overloading: Unary and binary operator overloading, run-time and compile time polymorphism, object pointer and pointer to an object, virtual function, dynamic binding.

Template and Exception handling: Function template and class template, Exception Handling.

Books Recommended:

1. H. Schidt   :**C++: The Complete Reference,** *McGraw Hill* **[Text Book]**

2. H. Schidt   :**C++: A Beginner's Guide,** *McGraw Hill*

3. N. Barkakati :**Object Oriented Programming with C++,** Prentice *Hall India*

4. B. Stroustrap :**The C++ Programming Language,** *Addison Wesley*

CSE 1202: Object Oriented Programming Lab

Credit: 1.5

Pre-requisite: CSE 1101 (Structured Programming Language), CSE 1102 (Structured Programming Language Lab)

Course Content:

The basic on how to create C++ program and implement simple logics in C++, problem for: basic class and object creation, member functions with different access specifiers, enumeration, inline function, function overloading, operator overloading, friend function and class, file processing. Problem for: Constructor, Destructor, copy constructor, constructor in derived class. Problem for: different types of inheritance, virtual base class, function overriding, Dynamic binding, abstract class, templates and exceptions.

Books Recommended:

1. H. Schidt   :**C++: The Complete Reference,** *McGraw Hill* **[Text Book]**

2. H. Schidt   :**C++: A Beginner's Guide,** *McGraw Hill*

3. N. Barkakati :**Object Oriented Programming with C++,** Prentice *Hall India*

4. B. Stroustrap :**The C++ Programming Language,** *Addison Wesley*

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CSE 1203: Discrete Mathematics

Credit: 3.0
Pre-requisite: None

Course Content:
Introduction: Logic and Proofs, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Sets and Set Operations, Mathematical Inductions and Recursive Definitions.
Counting: Basic Counting Principles, Inclusion- Exclusion Principle, Permutations and Combinations, Sequences, Binomial Theorem, Fibonacci, and Pascal's triangle. Probability: Probability of an event, Complement of an event, Conditional Probabilities, Bayes' Theorem, and its application.
Graph: Introduction to graph, graph terminology, representing graph and graph isomorphism, paths, reachability, connectivity, Euler and Hamilton path, shortest path problems, graph coloring, memory representation of graph.
Trees: Introduction of trees, application of trees, tree traversal, labeling trees, trees and sorting, spanning trees, minimal spanning tree.

Books Recommended:

1. Kenneth H. Rosen : **Discrete Mathematics and Its Applications**, *McGraw-Hill*. **[Text Book]**
2. J. P. Tremblay and R. Manohar : **Discrete Mathematics structures with applications to Computer Science**, *Mc-Graw Hill*
3. C.L. Liu : **Elements of Discrete Mathematics**, *McGraw-Hill*.
4. Seymour Lipschutz : **Theory and Problems of Discrete Mathematics, Schaum's Outline Series**, *McGraw-Hill*
5 Bernard Kolman, Robert Busby, Sharon C. Ross : **Discrete Mathematical Structures**, *Prentice Hall*

EEE 1231: Electronic Devices and Circuits

Credit: 3.0
Pre-requisite: PHY-1151 (Basic Physics), EEE-1131 (Electrical Circuits)

Course Content:
Introduction to semiconductors: p-type and n-type semiconductors; p-n junction diode characteristics; Diode applications: half and full wave

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rectifiers, clipping and clamping circuits, regulated power supply using Zener diode.

Bipolar Junction Transistor: Principle of operation, I-V characteristics; Transistor circuit configurations (CE, CB, CC), BJT biasing, load lines; BJTs at low frequencies; Hybrid model, h parameters, simplified hybrid model; Small-signal analysis of single and multi-stage amplifiers, frequency response of BJT amplifier.

Field Effect Transistor: principle of operation of JFET and MOSFET; Depletion and enhancement type NMOS and PMOS; biasing of FETs; Low and high frequency models of FETs, switching circuits using FETs; Introduction to CMOS.

Operational Amplifiers: linear applications of OPAMPs, gain, input and output impedances, active filters, frequency response and noise. Introduction to feedback, Oscillators, Silicon Controlled Rectifiers (SCR), TRIAC, DIAC and UJT: characteristics and applications; Introduction to IC fabrication processes.

Books Recommended:

1. Robert L. Boylestad: :**Electronic Devices and Circuit Theory,** *Pearson* **[Text Book]**

2. Mehta, Rohit, V K Mehta :**Principles of Electronics,** *S. Chad Publications*

3. Sedra / Smith :**Microelectronics Circuits,** *Oxford University Press*

4. A. Mottershead :**Electronic Devices and Circuits,** *Prentice-Hall of India Pvt. Limited, 1973.*

EEE 1232: Electronic Devices and Circuits Lab

Credit: 1.0
Pre-requisite: PHY-1152 (Basic Physics Lab), EEE-1131 (Electrical Circuits Lab)

Course Content: VI- Characteristics of PN junction and Transistors Design of rectifier circuits and voltage regulation, half wave (AC to DC conversion) with efficiency, Full wave (AC to DC Conversion) With efficiency, Implementation of Zener Diode for voltage/load current regulation Design Clipper and clamper circuits and Amplifier Circuits, Wave shape change using diodes, Signal amplification using single stage BJT.

Books Recommended:

1.	Robert L. Boylestad:	:**Electronic Devices and Circuit Theory,** *Pearson* **[Text Book]**
2.	Mehta, Rohit, V K Mehta	:**Principles of Electronics,** *S. Chad Publications*
3.	Sedra / Smith	:**Microelectronics Circuits,** *Oxford University Press*
4.	A. Mottershead	:**Electronic Devices and Circuits,** *Prentice-Hall of India Pvt. Limited, 1973.*

MAT 1241: Coordinate Geometry and Vector Analysis

Credit: 3.0
Pre-requisite: MAT 1141 (Differential and Integral Calculus)

Course Content:
Co-ordinate Geometry: Co-ordinates, Polar co-ordinates, the straight line, Change of axes, Pair of straight lines Circles, system of circles, Parabola, Ellipse, Hyperbola.
Co-ordinate geometry of three dimensions: System of co-ordinates, transformation of co-ordinates, distance between two points, section formula, projection, direction cosines, equations of planes and lines.
Vector Analysis: Vector algebra; scalar and vector product; Scalar and vector fields, Application of vectors in geometry, Calculus of vector valued function, Differentiation of vectors, Gradient, Divergence and curl of a vectors and their physical significance, Directional derivatives, vector Integration, Green's theorem, Stocke's theorem, Divergence theorem with example.

Books Recommended:

1.	Henry Burchard Fine and Henry Dallas Thompson	:**Coordinate Geometry**, *Macmillan Company, New York*. **[Text Book]**
2.	M. R. Spiegel, S. Lipschutz: and D. Spellman	:**Vector Analysis and An Introduction to Tensor Analysis**, *McGraw-Hill* **[Text Book]**
3.	R. J. T. Bell:	:**An Elementary Treatise on Coordinate Geometry of Three Dimension**. *Macmillan*

4.	L. S. Loney	**:The Elements of Coordinate Geometry**, *Macmillan Company, New York.*
5.	A.F.M. Abdur Rahman and P.K. Bhattacharjee	**:A Text Book on Coordinate Geometry with Vector Analysis**, *New Book Palace, Dhaka-1100, Bangladesh.* 1st *New Flat Edition-2003*

CHE 1261: Chemistry

Credit: 2.0
Pre-requisite: None.

Course Content:
Chemical Bond: Different types of chemical bonds, Properties of Ionic and Covalent Compound, and Modern Approaches of Covalent Bond.
Solution: Types of Solution, Factors Influencing the Solubility of Substance. Mechanism of Dissolution; Solution of Gases in Liquids, Different Units of Concentration, Distribution Law and its Application; Properties of Dilute Solution, Raoult's Law - its Application, Elevation of Boiling Point, Depression of Freezing Point and Osmotic Pressure.
Phase rule and phase diagram of mono-component system: Pure substances (one component), one component phase diagram, Gibb's phase rules and application of Gibbs phase rule for one-component system.
Electro-chemistry: Electrolytes, Mechanism of Electrolytic Conduction, Transport Number and Electrolytic Conductance, Cell EMF.
Chemical kinetics and chemical equilibrium: Rate of a Reaction, Factors Determining the Rate, Law of Mass Action, Evaluation and Characteristics of Equilibrium Constant of Reaction; The Lechatclier's Principle.

Books Recommended:

1.	Bahl, B. S., & Tuli, G. D.	:**Essentials of Physical Chemistry**, S *Chand and Co* **[Text Book]**
2.	Huque, M. &Auni, A.	:**Advanced Physical Chemistry**, *Venus Prokashoni.*
3.	Madan, R. D.	:**Modern Inorganic Chemistry**, *S Chand & Co.*
4.	Cotton, A. F., Wilkinson, G., Bochmann, M., & Murillo, C. A.	:**Advanced Inorganic Chemistry**, *Wiley.*

CHE 1262: Chemistry Lab

Credit: 1.0
Pre-requisite: None.

Course Content: Measurement of pH of different solutions Quantitative estimation of acids, bases and salts by volumetric methods; Determination of rate of chemical reactions; Electro-deposition.

Books Recommended:

1.	Bahl, B. S., & Tuli, G. D.	:**Essentials of Physical Chemistry**, *S Chand and Co.* **[Text Book]**
2.	Huque, M. &Auni, A.	:**Advanced Physical Chemistry**, *Venus Prokashoni.*
3.	Madan, R. D.	:**Modern Inorganic Chemistry**, *S Chand & Co.*
4.	Cotton, A. F., Wilkinson	:**Advanced Inorganic Chemistry**, *Wiley.*

2ND YEAR FIRST SEMESTER

CSE 2101: Object Oriented Design and Design Patterns

Credit: 3.0
Pre-requisite: CSE 1201 (Object Oriented Programming)

Course Content:

OOP Concepts: Modularity, reusability, functional decomposition, object-based decomposition, abstract data types. Classes and uniform type system, objects and references, memory management, inheritance techniques, generic classes and templates, exception handling.

Software Design with UML: Introduction to UML. Overview of the design process using UML Rational Unified Process. Structured description of system usage and function, requirements capture techniques, identification of scenarios and UML use case diagrams. Description of scenario elements in terms of CRC models - classes, responsibilities and collaborators. Systematic definition of classes, data and system structure. Abstraction, modularization and UML class diagrams. Combining top-down refinement with bottom-up construction. Object interaction, behavior and state. Different varieties of UML interaction diagram. Recognizing coupling between modules and responsibility-driven design. Structuring source code as a design model. Recognition of variable roles. Defensive programming methods including recognition of pre- and post-conditions, invariants, composition and

assertions. Rapid and agile prototyping strategies, optimization and debugging techniques.

Design Patterns: Introduction, creational patterns - abstract factory, builder, factory method, prototype, singleton; structural patterns - adapter, bridge, composite, decoder, proxy, facade, flyweight; behavioral patterns-chain, command, interpreter, iterator, mediator, memento, observer, state, strategy, visitor, template method.

Books Recommended:

1. Herbert Schildt : **Java the Complete Reference [Text Book]**
2. H. M. Deitel, P. J. Deitel : **Java how to Program**
3. Cay S. Horstmann : **Java SE8 for the Really Impatient**
4. Barry Burd : **Beginning Programming with Java for Dummies**

CSE 2102: Object Oriented Design and Design Patterns Lab

Credit: 1.5
Pre-requisite: CSE 1202 (Object Oriented Programming)

Course Content: Overview of software, review the basic how to create Java Projects and files, Basic input and output related problems. Arithmetic operations and conversion of number to character number format Perform different operations: factorial of a given number, multiplication of numbers and print number in sorting order Check Armstrong number, find the Roots of a Quadratic Equation, print the Fibonacci series Print the Prime Numbers, check Palindrome string, sort the given list of names Create multiple threads, create pie charts design in own interface, draw the line, rectangle Design a simple calculator using Grid layout to arrange buttons for the digits and +, -, * % operations. Implements the client/server application

Books Recommended

1. Herbert Schildt : **Java the Complete Reference [Text Book]**
2. H. M. Deitel, P. J. Deitel : **Java how to Program**
3. Cay S. Horstmann : **Java SE8 for the Really Impatient**
4. Barry Burd : **Beginning Programming with Java for Dummies**

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CSE 2103: Data Structures

Credit: 3.0
Pre-requisite: CSE 1101 (Structured Programming Language)

Course Content: Data representation: Internal data representation, Abstract data types, Ideas on linear and non-linear data structures, Elementary data structures. Arrays: Maximization, ordered lists, sparse matrices, representation of arrays. Stacks, Queues and Recursion: Different types of stacks and queues: Circular, dequeues, etc; evaluation of expressions, multiple stacks and queues. Recursion: Direct and indirect recursion, depth of recursion, Simulation of Recursion, Removal of recursion; Towers of Hanoi. Linked Lists: singly linked lists, linked stacks and queues, the storage pool, polynomial addition, equivalence relations, sparse matrices, doubly linked lists and dynamic storage management, generalized lists, garbage collection and compaction. Trees: Basic terminology, binary trees, binary tree representations, binary tree traversal; Extended binary trees: 2-trees, internal and external path lengths, Huffman codes/algorithms; threaded binary trees, binary tree representation of trees; Application of Trees: Heap tree, Max Heap, Min Heap, Heap sort, decision trees, games trees: Counting binary trees. Graphs: Introduction & it's storing techniques in memory, traversing algorithm: BFS & DFS, spanning tree & algorithm for Minimal Spanning tree using Kruskal & Prims methods. Symbol Tables: static tree tables, dynamic tree tables; Hash Tables: Hashing functions overflow handling, theoretical evaluation of overflow techniques. Files: file, queries and sequential organizations: Indexing Techniques: Cylinder-surface indexing hashed indexes, tree indexing-B-trees; Tree indexing.

Books Recommended:

1. Seymour Lipschutz : **Data Structures,** *McGraw-Hill.* **[Text Book]**
2. Robert Lafore :**Data Structures and Algorithms in Java**
3. Donald E. Knuth :**The Art of Computer Programming**
4. J A Storer and John C Cherniavsky :**An Introduction to Data Structures and Algorithms**

CSE 2104: Data Structures Lab

Credit: 1.5
Pre-requisite: CSE 1102 (Structured Programming Language Lab)

Course Content: Overview of data structure and algorithm, Solve different algorithm for data structure Problem for Basic array operation Insertion and deletion in an array Problem for Linear search Binary search Problem for Singly link list Doubly link list Basic operations on linked list Problem for

manipulating stacks and queues Complete binary tree and binary search trees Problem for Tree traversals, insertions, deletions Complete binary tree and binary search trees Problem for Graphs as adjacency matrix, adjacency list. Searching technique - Breadth First Search and Depth First Search

Books Recommended:

1.Seymour Lipschutz	:**Data Structures,** *McGraw-Hill.* **[Text Book]**
2.Robert Lafore	:**Data Structures and Algorithms in Java**
3.Donald E. Knuth	:**The Art of Computer Programming**
4.J A Storer and John C Cherniavsky	:**An Introduction to Data Structures and Algorithms**

CSE 2105: Digital System Design

Credit: 3.0

Pre-requisite: CSE 1203 (Discrete Mathematics)

Course Content: Number Systems, Error detection code, Binary addition and subtraction, 2's compliment methods, Boolean Algebra & Logic Gates, Boolean Functions, Switching circuit design, Input-output (binary) signals for gates. Postulates of Boolean algebraic structures, Basic theorem & properties of Boolean Algebra, Boolean functions (Complement, Duality), Canonical & Standard Forms, Boolean Expression Simplification using Boolean Algebraic rules, Karnaugh Map and Reed Muller Methods. Combinational Circuit: Design procedure, analysis procedure, multilevel NAND& NOR circuits, exclusive-OR & equivalence functions, Binary parallel adder, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Full adder using half adder, Encoder, Decoder, Adder using Decoder, Multiplexer. Sequential Circuit: Transistor, Latch, Clock signals and Clocked FFs: Clocked SR, JK and D Flip-Flops, timing diagram of different FFs, Edge-triggered and Level triggered timing diagram, design procedure & design of different shift registers, Memory devices and their applications.

Books Recommended:

1.M. Morris Mano	:**Digital Logic and Computer Design,** *Prentice Hall* **[Text Book]**
2.Ronald J. Tocci	:**Digital Systems: Principles and Applications**, *Prentice Hall*
3.V. K. Jain	:**An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
4.William H. Gothmann	:**Digital Electronics**, *Prentice Hall*

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| 5.A. Mottershead | :**Electronic Devices and Circuits an Introduction**, *Goodyear Pub* |
| 6.Mehta, Rohit, V K Mehta | :**Principles of Electronics**, *S. Chand Group* |

CSE 2106: Digital System Design Lab

Credit: 1.0

Pre-requisite: CSE 1203 (Discrete Mathematics)

Course Content: Implementation of basic gates: AND, OR, NOT using ICs Implementation of Boolean expression after simplification (using Boolean theorem & K-map). Proof of Universality using NAND & NOR ICs. Design combinational circuits, Adder, subtractor, Encoder, Decoder. Circuits using NAND, NOR gates only. Design sequential circuits, Truth table. verification of Flip-Flops: SR, JK, D- Type, T- Type, Shift-registers.

Books Recommended:

1.M. Morris Mano	:**Digital Logic and Computer Design,** *Prentice Hall* **[Text Book]**
2.Ronald J. Tocci	:**Digital Systems: Principles and Applications**, *Prentice Hall*
3.V. K. Jain	:**An Introduction to Switching Theory and Digital Electronics**, *Khanna Publishers, New Delhi*
4.William H. Gothmann	:**Digital Electronics**, *Prentice Hall*
5.A. Mottershead	:**Electronic Devices and Circuits An Introduction**, *Goodyear Pub*
6.Mehta, Rohit, V K Mehta	:**Principles of Electronics**, *S. Chand Group*

MAT 2141: Differential Equations

Credit: 3.0
Pre-requisite: MAT 1141 (Differential and Integral Calculus)

Course Content:
Introduction: Degree and order of ordinary differential equations, formation of ODE from any equation of two variables.
Differential Equation: Solution of the ordinary differential equation of 1st order differential equation with variable separable, exact differential

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equation, linear differential equation, homogeneous differential equation, solution of 2nd order linear differential equation with constant coefficient.

Partial Differential Equations: Introduction. Solutions of linear and nonlinear partial differential equations of first order. Linear equations of higher order. Equations of the second order with variable coefficients.

The special functions: Introduction, the factorial function, Beta Gamma function, reduction formula for Gamma of n and factorial of transformation of Gamma function, relation between Beta and Gamma functions, example.

Fourier series and Fourier Integral: periodic function, even function, odd function, Fourier series, determining the co-efficient, Fourier sine and co-sign series and Fourier Integral.

Legendre's differential equation: Define Legendre's differential equation, solution of Legendre's differential equations, Legendre's polynomials, Rodrigue's formula, orthogonality of Legendre's polynomials, Laplace's first definite integral for Legendre's polynomials, Laplace's second definite integral for Legendre's polynomials.

Bessel's differential Equation: Define Bessel's differential equation, solution of Bessel's differential equations, Legendre's functions, orthogonality of Bessel's functions, recurrence formulae for Bessel's functions.

Recommended Books:

1.	Erwin Kreyszig	:**Advanced Engineering Mathematics**, *10th Edition* **[Text Book]**
2.	Dr. B. D. Sharma	:**Differential Equations,** *Kedar Nath Ram Nath Publisher, New Delhi.*
3.	Prof. Md. Abdur Rahaman	:**Mathematical Methods: Special Functions & Vector Analysis,** *Nahar Book Depot & Publications, Volume One, 3rd Edition-2009.*
4.	H. T. H. Piaggio	:**Differential Equations**. *Hayne Press, Us, 2008.*
5.	M.D. Raisinghania	:**Ordinary and Partial Differential Equations**, *S. Chand and Company, 15th Revised Edition, India, 2013.*

BAN 0001: History of the Emergence of Bangladesh

Credit: 3.0
Pre-requisite: None

Course Content: Partition of India in 1947 Lahore conference; United Bangla plan; Two nation theory; Creation of Pakistan and India; Displacement crisis. Language Movement of 1952 Primary discussion on

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Bangla and Urdu language; early stage of movement; Agitation of 1948, 21 February of 1952; Constitutional status of Bangla language. Disparity Between Two Wings of Pakistan Economic disparity; Administrative disparity; Political disparity. Military Rule of Ayyub Khan and Six Point Movement. Commander-in-Chief of the Pakistan Army; President of the Pakistan; Constitutional and legal reforms; Background of Six-point movement; Six-point movement; Result of six-point movement. Mass Upsurge of 1969 and Yahiya Khan, General Election of 1970 Shorbodolio Chatro Shongram Porishad (All Party Student Action Committee); Democratic Action Committee. Withdrawal of Agartala conspiracy case; Election campaign in East Pakistan, Political condition of west Pakistan. Result of the election and aftermath condition of election. Historic Speech of 7 March, Non-cooperation Movement. Genocide of 25 March, Declaration of Independence and Proclamation of Independence. Mujibnagar Government. Contribution of different countries to independence, 14th December Tragedy, 16th December Victory. Government of Bangabandhu Sheikh Mujibur Rahman. 4th November and 15th August tragedy. Liberation War: Expectation and Achievement: A Study.

Books Recommended:

1. K. B. Sayeed	:	**Political System of Pakistan**
2. ডা. মো: মাহবুবর রহমান	:	বাংলাদেশের ইতিহাস, ১৯৪৭-১৯৭১।
3. বশির আল হেলাল	:	ভাষা আন্দোলনের ইতিহাস।
4. আতিউর রহমান	:	মুক্তিযুদ্ধের প্রস্তুতি পর্ব : অসহযোগের দিনগুলি।
5. আবুল মাল আব্দুল মুহিত	:	বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব
6. William Schendel	:	**A History of Bangladesh**

2ND YEAR SECOND SEMESTER

CSE 2201: Software Engineering and System Analysis

Credit: 3.0
Pre-requisite: None

Course Content:

Software Development Life-Cycle: Requirement analysis, Software design, Coding, Testing and Maintenance, SDLC models like Water fall model,

Incremental model, Spiral model, Agile model and their role of management in software development.

Design: Problem partitioning, Top-down and bottom-up design, Functional versus object-oriented approach, Component-level design, User-system interaction, Data visualization etc.

Software Project Management: Cost estimation and techniques, Project scheduling, Risk management, Role of matrices and measurement.

Software Reliability: Reliability growth modelling, ISO 9000 certification for software industry, SEI capability maturity model, Comparison between ISO & SEI CMM.

Testing: Verification and validation, testing strategies, Unit testing, Integration testing, Top-down and bottom-up testing, Alpha and Beta testing, System testing and debugging.

Overview: System concepts and the information system environment, The system development life cycle, The role of systems analyst and the concepts of MIS.

System Analysis: Information Gathering, The tools of structured analysis, Cost/benefit analysis.

System Design and Implementation: The process and stages of system design, Input/output and forms design, System testing and quality assurance.

Books Recommended:

1. E.M. Awad   :**System Analysis and Design**, *Galgotia Publication Ltd* **[Text Book]**
2. P. Edwards   :**System Analysis & Design**, *McGraw-Hill*
3. Roger S. Pressman   :**Software Engineering**, *A practitioner's Approach, McGraw-Hill*
4. Ian Sommerville   :**Software Engineering,** Pearson Education.

CSE 2203: Computer Algorithms

Credit: 3.0

Pre-requisite: CSE 1201 (Object Oriented Programming), CSE 1203 (Discrete Mathematics), CSE 2103 (Data Structures)

Course Content:

Basics of Algorithms: analyzing algorithms, different design techniques, asymptotic notations, best case, worst case and average case time complexity analysis.

Divide and Conquer Design: Definition, general technique, recurrence relations, and polynomial multiplication, maximum sub array sum problem, analysis of divide and conquer algorithms.

Dynamic Programming: general principles, difference between divide and conquer and dynamic programming, rod cutting problem, memorization vs.

caching, discrete knapsack, longest common subsequence, weighted activity scheduling problem.

Greedy Design: General principles, difference between dynamic programming and greedy, un weighted activity scheduling, fractional knapsack, Huffman coding and their analysis.

Graph Theory: Single source shortest path for general weight case, and all pair shortest path problem: Floyd Warshall algorithm, network flow problem: Edmond-Karp's algorithm. Matching problem.

String Processing: Naïve string matching and its pitfalls, KMP algorithm, Trie, Aho-Korasick algorithm, Boye-Moore algorithm.

Sorting Algorithms: Algorithm and complexity for bubble sort, insertion sort, radix sort, quick sort, merge sort, Topological sort.

Computational Complexity: Definition, polynomial, pseudo polynomial and exponential class, P vs. NP, encoding, reductions, approach to proving NP-completeness, approximation techniques.

Books Recommended:

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein	:**Introduction to Algorithms**, *PHI Learning* **[Text Book]**
2.	Jon Kleinberg, Eva Tardos	:**Algorithm Design**, *Pearson*
3.	Sartaj Sahni, Ellis Horrowitz, Rajasekaran	:**Fundamentals of Computer Algorithms**, *University Press*

CSE 2204: Computer Algorithms Lab

Credit: 1.5
Pre-requisite: CSE 1202 (Object Oriented Programming Lab), CSE 2104 (Data Structures Lab)

Course Content: Introduction to existing data structures library in the programming language of choice. Data structures practice problems to be solved using library routines. Implement graph algorithms using existing data structure routine. Debug the implementation of algorithms using any debugger. Implementation of different recursive and or divide conquer algorithm to track recursive calls using a debugger. Implement greedy and dynamic programming practice problems to understand the internal working flow of those design principles. Solve different flow network problems, modeled around max flow problem in graph theory. Solve real life graph related optimization problems e.g., Minimum Spanning Tree, Shortest Path Problem. Implementation of different string pattern matching algorithms and solve real life problems with them. Analyze the hardness and approximation schemes for real life problems and understand the reduction of those problems to well- known problems in the NP class.

Books Recommended:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein : **Introduction to Algorithms**, *PHI Learning* **[Text Book]**

2. Steven S. Skiena : **Algorithm Design Manual**, *Springer*

3. Michael T. Goodrich, Robert Tamassia : **Data Structures and Algorithms in C++**, *Wiley and Sons*.

CSE 2205: Numerical Methods

Credit: 3.0

Pre-requisite: MAT 1141 (Differential and Integral Calculus), MAT 2141 (Differential Equations)

Course Content: Floating-point representations, General properties, Floating- point exception handling, Rounding methods, Floating-point operations (+, -, ×, /), Accuracy and Precision, Error Definitions, Round-Off Errors, Truncation Errors. Graphical Methods, The Bisection Method, The False- Position Method, Simple One-Point Iteration, The Newton- Raphson Method, The Ramanujan's Method, The Secant Method. Gauss Elimination, Solving Small Numbers of Equations, Naive Gauss Elimination, Pitfalls of Elimination Methods, Matrix Inversion and Gauss –Seidel, The Matrix Inverse, Polynomial Interpolation, Newton's Interpolation, Gauss's central interpolation, Lagrange interpolation. Linear Regression, Polynomial Regression, Multiple Linear Regression. Least Square curve fitting procedure, Weighted least square approximation. The Trapezoidal Rule, Simpson's Rules, Integration with Unequal Segments, High-Accuracy Differentiation Formulas, Derivatives of Unequally Spaced Data.

Books Recommended:

1. Steven C. Chapra, Raymond P. Canale : **Numerical Methods for Engineers**, *McGraw-Hill* **[Text Book]**

2. S. S. Kuo : **Computer Applications of Numerical Methods**, *Addison-Wesley* **[Text Book]**

3. S. S. Sastry : **Introductory Methods of Numerical Analysis**, *Prentice-Hall of India Pvt. Ltd.*

4. Cantrell : **Modern Mathematical Methods for Physicists and Engineers**, *Cambridge University Press.*

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5. Press, Teukolsky,   : **Numerical Recipes in C: The Art of Scientific**
   Vetterling and   **Computing**, *Cambridge University Press.*
   Flannery

6. V. Rajaraman   : **Computer Oriented Numerical Method**,
                               Prentice-Hall of India Pvt. Ltd.

CSE 2206: Numerical Methods Lab

Credit: 1.0
Pre-requisite: CSE 1102 (Structured Programming Language Lab)

Course Content: Find different types of error. Implementation of Bisection method. Implementation of False Position method. Implementation of Newton Raphson method. Implementation of Iteration method. Calculate difference table for interpolation. Implementation of Forward and Backward interpolation and Lagrange interpolation. Implementation of curve fitting methods. Implementation of differentiation and integration rules.

Books Recommended:

1. Steven C. Chapra,   : **Numerical Methods for Engineers**, *McGraw-*
   Raymond   *Hill* **[Text Book]**
   P. Canale

2. S. S. Kuo   : **Computer   Applications   of   Numerical**
                               Methods, *Addison-Wesley*
                               [Text Book]

3. S. S. Sastry   : **Introductory Methods of Numerical Analysis**,
                               Prentice-Hall of India Pvt. Ltd.

4. Cantrell   : **Modern   Mathematical   Methods   for**
                               Physicists   and Engineers,
                               Cambridge University Press.

5. Press, Teukolsky,   : **Numerical Recipes in C: The Art of Scientific**
   Vetterling and   **Computing**, *Cambridge University Press*.
   Flannery

6. V. Rajaraman   : **Computer   Oriented   Numerical   Method**,
                               Prentice-Hall of India Pvt. Ltd.

CSE 2207: Computer Networks

Credit: 3.0
Pre-requisite: CSE 1102 (Structured Programming Language Lab)

Course Content: Introduction: Computer Networks and Applications, OSI reference model, TCP/IP model and terminology, Connectionless and Connection Oriented services, Service primitives, The ARPANET Physical Layer: Circuit switching and Packet switching, X-25 protocol, Frame relay and Cell relay, ATM reference model; Medium Access Sub layer: Pure and slotted ALOHA, Persistent and Non persistent CSMA, CSMA with collision detection and collision free protocols, IEEE standard 802.3 and Ethernet; Data Link Layer: Types of errors, framing, error detection & correction methods; Flow control, Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC Network Layer: Internet address, classful address, subnetting, static vs. dynamic routing, shortest path algorithm, flooding, distance vector routing, link state routing, ARP, RARP, IP, ICMP; Transport Layer: UDP, TCP, Connection management, Addressing, Establishing and Releasing Connection, Congestion control algorithm, Flow control and Buffering, Multiplexing; Presentation Layer: Data Compression techniques, Frequency Dependent Coding, Context Dependent Encoding; Application Layer: Internet and intranets, Internet services and goals, DNS, SMTP, FTP, Telnet, HTTP, World Wide Web (WWW), DHCP and BOOTP; Networking in Practice: Designing LAN, Cabling, Establishing Client- Server network, Configuring: Directory Server, Proxy server, FTP server, E-mail server, web server, DB server, Firewall, Network troubleshooting, network maintenance, network monitoring, Network programming

Books Recommended:

1. Andrew S. Tanenbaum	:**Computer Networks,** *Prentice Hall* **[Text Book]**	
2. Behrouz A. Forouzan	:**Data Communications and Networking,** *McGraw-Hill*	
3. Behrouz A. Forouzan	:**TCP/IP Protocol Suite,** *McGraw-Hill*	
4. William Stallings	:**Data and Computer Communications,** *Prentice Hall*	

CSE 2208: Computer Networks Lab

Credit: 1.0
Pre-requisite: CSE 1102 (Structured Programming Language Lab)

Course Content: Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool. Install and configure Network Devices: HUB, Switch and Routers. Study of network IP, LAN connection, network topology Study of basic network command and network configuration commands. Configure a Network topology using packet tracer software Configuration of multiple networks using router Static routing configuration of multiple networks using multiple routers RIP routing configuration of multiple networks using multiple routers DHCP and DNS configuration HTTP, FTP and SMTP configuration.

Books Recommended:

1. Andrew S. Tanenbaum	:	**Computer Networks,** *Prentice Hall* **[Text Book]**
2. Behrouz A. Forouzan	:	**Data Communications and Networking,** *McGraw-Hill*
3. Behrouz A. Forouzan	:	**TCP/IP Protocol Suite,** *McGraw-Hill*
4. William Stallings	:	**Data and Computer Communications,** *Prentice Hall*

MAT 2241: Linear Algebra and Complex Variables

Credit: 3.0
Pre-requisite: MAT 1141 (Differential and Integral Calculus)

Course Content:
Linear Algebra: Determinants, Matrices, Inverse of a Matrices, Rank of a Matrix, Solution of system of linear equations by Cramer's rule and by Matrix inversion, System of linear equation, Linear Transformation, Eigen values and Eigen vectors, Matrix Decomposition Techniques, Matrix Valued Function Differentiation. Indeterminate form.
Complex Variables: Complex number, Complex function, Hyperbolic functions, Euler's formula, Exponential and polar forms, De Mover's theorem, Limit and continuity of a complex function, Complex differentiation and Cauchy-Riemann equations.
Analytic functions, Complex integration and Cauchy's theorem; Cauchy's integral formula and related theorems, Infinite series, Taylor's and Laurent's series, Residues and residue theorem.

Recommended Books:

1. Seymour Lipschutz, Marc Lipson : **Linear Algebra,** *Schaum's Outline Series, McGraw-Hill Education.* **[Text Book]**
2. MR Spiegel : **Complex Variables**, *McGraw-Hill Education* **[Text Book]**

3. Howard Anton, Chris Rorres : **Linear Algebra with Application**
4. M. Abdur Rahman : **College Linear Algebra**, *Nahar Book Depot & Publications, Dhaka, 7th Edition.*

3RD YEAR FIRST SEMESTER

CSE 3101: Computer Graphics

Credit: 3.0
Pre-requisite: MAT 1241 (Coordinate Geometry & Vector Analysis), MAT 2241 (Linear Algebra and Complex Variable)

Course Content:
Scan Conversion: Points plotting techniques, Line drawing algorithms: Horizontal and vertical line drawing algorithm, Direct Line drawing algorithm, DDA algorithm, Bresenham's algorithm. Circle Drawing algorithms: Direct method, Mid-point circle drawing algorithm. Ellipse generating algorithm. Polygon Filling: Scan line polygon fill algorithm, Boundary fill algorithm, and Flood fill algorithm.
2D and 3D transformation: Basic transformations (2D and 3D): Translation, Scaling, Rotation, Other transformations (2D and 3D): Reflection, Reflection through an arbitrary plane, Rotation about an arbitrary axis in space, shearing. Matrix representations and Homogeneous coordinates, General parallel projection Transformation.
Viewing and Clipping: Viewing pipeline, Window to viewport coordinate transformation, 3D viewing, View port clipping, clipping operations: point clipping, line clipping, polygon clipping etc.
Curves: Curve representation, Surfaces design, Hermit curves, Bezier curves, B-spline curves, End conditions for periodic B-spline curves, Rational B-spline curves.

Recommended Books:

1. Donald Hearn and M. Pauline Barker : **Computer Graphics,** *Prentice Hall* **[Text Book]**

2. Steven Harrington   :**Computer Graphics: A Programming Approach,** *McGraw-Hill College*

3. F.S. Hill   :**Fundamentals of Computer Graphics,** *Prentice Hall*

CSE 3102: Computer Graphics Lab

Credit: 1.0
Pre-requisite: MAT 1241 (Coordinate Geometry & Vector Analysis), MAT 2241 (Linear Algebra and Complex Variable)

Course Content: Using different primitives and drawing scenery using shapes Implementation of line, circle, ellipse drawing algorithms in drawing primitive shapes. Apply Different kind of geometric transformations, Coordinate transformations, Composite transformations in both 2D and 3D objects. Practice Clipping algorithms: Line, Polygon clipping Implementation of animation on 2D screen

Recommended Books:

1. Donald Hearn and Pauline Barker   :**Computer Graphics,** *Prentice Hall* **[Text Book]**

2. Steven Harrington   :**Computer Graphics: A Programming Approach,** *McGraw-Hill College*

3. F.S. Hill   :**Fundamentals of Computer Graphics,** *Prentice Hall*

CSE 3103: Database Management System

Credit: 3.0
Pre-requisite: None

Course Content:
Introduction: Data and information, Purpose of Database Systems, View of Data, Database Languages DDL, DML, DCL.
Database Design and the E-R Diagram: Entity and attributes, Entity-Relationship Model, Entity-Relationship Diagrams, convert E-R model into tables.
Relational Data Model: Structure of Relational Databases, Database Schema, Keys, Schema, Diagrams, Relational Query Languages, Relational Database Design, Normalizing database up to 3rd normal form, BCNF.

SQL: Overview of the SQL Query, Language, SQL Data Definition, Basic Structure of SQL, Queries, Aggregate Functions, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, Functions and Procedures, Triggers, Recursive Queries, Advanced Aggregation Features.

Storage and File Structure: Overview of Physical Storage Media, Magnetic Disk and Flash Storage, RAID, Tertiary Storage, File Organization, Organization of Records in Files, Data-Dictionary Storage, Database Buffer.

Transactions: Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Transaction Isolation and Atomicity, Transaction Isolation Levels, Implementation of Isolation Levels, Transactions as SQL Statements, Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols.

Database-System Architectures: Centralized and Client–Server Architectures, Server System Architectures, Parallel Systems, Design and types of Parallel Systems, Distributed Systems architecture and its application.

Books Recommended:

1. A. Silberschatz : **Database System Concepts,** *Mcgraw-Hill.*

2. R. Ramakrishnan, : **Database Management System,** *McGraw-Hill* Johannes Gehrke *Higher Education*

3. James Martin : **Principles of Database Management**, *Prentice-hall*

4. Ullman : **Database Management systems**, *Prentice-Hall Publication.*

CSE 3104: Database Management System Lab

Credit: 1.5
Pre-requisite: None

Course Content: Create a relational database for a domain like an organization and discuss how the schema is effective for that organization. Design an E-R diagram and mapping a relational model from that E-R diagram for a given scenario. Practice intermediate and advanced SQL operation for a given relation. o   Intermediate SQL: Join Expressions, Views etc. o   Advanced SQL: Trigger, Stored procedure, sub query etc. Practice cascading operation using keys for the given relations. Removing insertion, deletion and update anomalies using normalization technique and redesign the database schema.

Books Recommended:

1. A. Silberschatz   : **Database System Concepts,** *Mcgraw-Hill.*

2. James Martin   : **Principles of Database Management**, *Prentice-hall*

3. Ullman   : **Database Management systems**, *Prentice-Hall Publication.*

4. Abey   : **Oracle 8i a Beginners Guide**, *McGraw-Hill*

CSE 3105: Computer Architecture

Credit: 3.0
Pre-requisite: CSE 2105 (Digital System Design)

Course Content:
Basic Concept: Introduction to Computer Architecture, Computer Design and Computer Organization. Interaction of hardware with the system and application software, basic hardware components of computer system and bus structure, concept and analysis of performance.
Machine Instruction: Concept of machine instruction, different parts of machine instruction, memory model maps for instruction, micro-operation, registers, addressing modes, I/O registers and instruction, program control status bits.
Processing Unit: Components of processing units and their functions, general register organization for micro-operation, control word, pipelining, instruction pipelining and performance of pipelining.
I/O Organization: Peripheral devices, I/O Interface, I/O bus module, synchronous data transfer and its different types, asynchronous data transfer, different modes of transfer, interrupt processing, direct memory access (DMA), I/O processor (IOP).
Memory Organization: Concept of memory, memory hierarchy, main memory, functions of RAM and ROM, memory address map, memory connection with CPU, Cache memory and its performance, secondary storage, virtual memory.
Composite Architecture: Multiprocessor and its different types, multicomputer, CISC and RISC processors, parallel processing, parallelism in multiprocessor, Flyinn's classification.

Books Recommended:

  1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky   :**Computer Organization**, *McGraw-*

	Hill. **[Text Book]**
2. Patterson, David A. and John L. Hennessy	:**Computer Organization and Design: The Hardware/Software Interface**, *Third edition.*
3. William Stallings	:**Computer Organization and Architecture: Designing for Performance**, *Prentice Hall*

CSE 3106: Computer Architecture Lab

Credit: 1.0
Pre-requisite: None

Course Content: Design asynchronous counters using J-K flip-flop, Design synchronous counters to count the sequence using J-K flipflop Design 8-bit Serial In/ Parallel Out shift register using 74LS164, Design 8 bit Parallel In/ Serial Out shift register using 74LS165 Design memory read/write operation using IDT 6116 Static RAM.

Books Recommended:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky	:**Computer Organization**, *McGraw-Hill.* **[Text Book]**
2. Patterson, David A. and John L. Hennessy	:**Computer Organization and Design: The Hardware/Software Interface**, *Third edition.*
3. William Stallings	:**Computer Organization and Architecture: Designing for Performance**, *Prentice Hall*

CSE 3107: Communication Engineering

Credit: 3.0
Pre-requisite: CSE 2207 (Computer Networks)

Course Content:
Communication Engineering Fundamentals: Waveforms Spectra, Elements of basic communication systems, Periodic and nonperiodic waveforms and their properties, Fourier series, Noise and its different types.
Analogue Communication: Amplitude modulation, Amplitude modulation index, Frequency spectrum for sinusoidal AM, Frequency Modulation: Frequency Modulation, Sinusoidal FM, Frequency spectrum for Sinusoidal FM, Phase Modulation. Pulse Modulation, Pulse Codes Modulation (PCM), Quantization, Compression, PCM Receiver, Differential PCM, Delta Modulation, Sigma-Delta A/D conversion, Pulse Modulation. Analog Multiplexing
Digital Communication: Basic Digital Communication System, Synchronization, Asynchronous Transmission, Probability of Bit Error in Base band Transmission, Matched Filter, Eye Diagrams, Digital Carrier Systems, Amplitude Shift keying, Frequency Shift Keying, Phase Shift Keying, Carrier Recovery Circuits, Quadrature Phase Shift Keying, Error Control Coding, Block Control, Repetition Encoding, Parity Encoding, Convolution Encoding. Digital Multiplexing.
Satellite Communication: Satellite Communication, Kepler's First and Second Law, Orbits, Geostationary Orbits, Power System. 5G technologies.
Fiber Optic Communication: Fiber Optic Communication, Propagation within a Fiber, Modes of Propagation, Losses in Fibers, Light sources for Fiber optics, Photo detectors.

Books Recommended:

1. Behrouz A. Forouzan : **Data Communication and Networking,** *Tata McGraw-Hill Edition* **[Text Book]**
2. George Kennedy, Bernard Davis : **Electronic communication System**, *Tata McGraw-Hill Edition* **[Text Book]**
3. John M. Senior : **Optical Fiber Communication**, *Prentice-Hall of India Pvt Ltd*
4. William Stallings : **Data and computer Communication**, *Addison Wesly*
5. Theodore S. Rappaport : **Wireless Communication,** *Prentice-Hall of India Pvt Ltd*

MAT 3141: Applied Statistics and Probability

Credit: 3.0
Pre-requisite: MAT 1141 (Differential and Integral Calculus), MAT 2241

(Linear Algebra and Complex Variables)

Course Content:

An introduction: Definition of Statistics, Uses and importance, Variables, Measurement level of variables, Sample and Population.

Measures of central tendency: Introduction, the arithmetic mean, Geometric mean, Harmonic mean, Median, mode, computing of means for grouped data and ungrouped data, Advantages, and disadvantages, and Uses of all measures.

Measures of dispersion: Introduction of dispersion, Absolute and Relative measures, Range, mean deviation, Standard deviation, Variance, Quartile deviation, Coefficient of Variation, Advantages, disadvantages and uses of all measures.

Data representation: Classification, Types of classification, Tabular representation, Graphical representation, Pie chart, Histogram, Bar chart, Frequency curve, Frequency Polygon and Ogive curve.

Correlation and Regression: Correlation, Types of correlation, Importance and uses of correlation, Properties of correlation, Rank correlation, Regression, Differences between regression line and regression model, Simple linear Regression, Importance of regression analysis, Comparison of regression and correlation.

Probability: Concept of probability, Sample Space, Events, Union and Intersection of Events, Probability of events, Laws of probability, Conditional probabilities, Bayes' theorem, Chebyshev's Inequality and Practical examples.

Random variables and probability Distribution: Basic concepts, Discrete and continuous random variables, Probability Mass Function (PMF), Probability Density Function (PDF), Cumulative Distribution Function (CDF), Mathematical expectation and variance, Joint, marginal and conditional density functions, Conditional Expectation and conditional variance, Probability generating function, Characteristic function, Binomial distribution, Poisson distribution, and Normal distribution with Practical examples.

Sampling design and Statistical test: Sampling Design, Simple random sampling, Systematic sampling, Stratified sampling; Cluster sampling, Judgment sampling, Chi-squared test, Z test, t-test and F-test.

Books Recommended:

1. Murray R. Spiegel and Larry J. Stephens — **:Schaum's Outlines of Statistic**s, *Companies, USA, Fourth Editions.* **[Text Book]**

2. Mr. Nurul Islam — **:Statistics & Probability**

3. J. B. Anderson — **:Interpreting Data**, *Chapman and Hall, London*

4. H. Cramer — **:The Elements of Probability Theory**, *Wiley, N. Y*

5. P. Hoel — **:Introductory Statistics, Wiley and Sons**, *N. Y*

6. Lind, Marchal, Mason — **:Statistical Techniques in Business & Economics**, *Irwin/McGraw-Hill, USA, Fourteen Editions.*

3rd YEAR SECOND SEMESTER

CSE 3201: Theory of Computation and Compiler Design

Credit: 3.0
Pre-requisite: CSE 1203 (Discrete Mathematics)

Course Content:
Languages and Grammars: Finite Automata - accepting languages, strings, string search algorithm, distinguishing strings, integers, lexical analysis, decision problems and languages, minimizing finite automata.
Regular languages and Expression: Non-deterministic finite automata, Kleene's theorem. Context-free languages, regular languages and grammars. Simplified forms and normal forms. Push-Down Automata- deterministic PDA and non-deterministic PDA, top-down and bottom-up PDA, Parsing - top down and bottom-up parsers. Decision problems and CFL.
Computational Models: Computational tasks - search and decision problems, General model of computation, Turing Machines.
Decision Problems: Undecidable problems, reduction and halting problem, context-free languages. Decision trees. Satisfiability problem.
Introduction: Introduction to compiler, compiler and translator, the structure of a compiler.
Parsing: Basic parsing technique, parsers, shift reduce parsing, operator procedure parsing, top-down parsing, bottom-up parsing, predictive parsing.
Syntax: Syntax directed translation, intermediate code generation, polish notation, parse tree and syntax trees, quadruples, triples, Boolean expression.

Symbol Table: Perspective and motivation of symbol table. Symbol table content, operation on symbol table, organization of symbol table.

Code Optimization: Code optimization, sources of optimization, basic blocks, folding, loop optimization, flowgraph, induction variable elimination, reduction in strength, code motion. Code generation, object programs, problems in code generation, a machine model, a simple code generator, register allocation.

Books Recommended:

1. John C. Martin
   :Introduction to Languages and The Theory of Computation. *McGraw Hill.* **[Text Book]**

2. Sanjeev Arora and Boaz Barak
   :Computational Complexity: A Modern Approach, *Cambridge University Press* **[Text Book]**

3. Oded Goldreich
   :Complexity of Algorithms – A Conceptual Perspective

4. Peter Gacs and Laszlo Lovasz
   :Complexity Algorithms

5. Alfred V. Aho and Jeffrey D. Ullman:
   :Principles of Compiler Design, *Addison Wesley Publication.*

6. A.J. Holub
   :Compiler design in C, *Prentice-Hall of India*

CSE 3203: Operating System and System Programming

Credit: 3.0
Pre-requisite: CSE 1I01 (Structured Programming Language)

Course Content: Introduction to Operating system functions, Different types of OS, Computer System Structure, operating system structure (simple, layered, modular), virtual machine, O/S services, system calls and API, Process Management CPU scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling (Processor affinity, Load Balancing) Critical section problem, race condition, synchronization hardware, classical problems of synchronization, semaphores, monitors. Deadlocks: system model, necessary conditions for deadlock, resource allocation graph, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock. Base and limit register, logical vs. physical address space, swapping, contiguous memory allocation (first-fit, best-fit, worst-fit algorithm), paging technique, segmentation, segmentation with paging.

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Books Recommended:

1. A. Silberschatz and Peter Baer Galvin	:**Operating System Concepts**, *Wiley Publishe*r **[Text Book]**
2.Tanenbaum	:**Operating Systems**, *Prentice Hall*
3.Madnick and J. Donovan	:**Operating Systems**, *McGraw-Hill*
4.B. Hausen	:**Operating System Principles,** *Prentice Hall of India*
5.Donovan	:**Systems Programming,** *Prentice Hall*
6.M. MilenKovie	:**Operating System Concept and Design**, *Tata McGraw Hill*

CSE 3204: Operating System and System Programming Lab

Credit: 1.0
Pre-requisite: CSE 1I02 (Structured Programming Language Lab)

Course Content: Discussion and installation process of VMware/virtual box and ubuntu operating system on pc. Practice Linux commands Process Creation: Parent, child, Process Identifier Code implementation using fork () and execlp() Implementation of FCFS algorithm Implementation of SJF algorithm Implementation of Priority Scheduling algorithm Implementation of Round Robin algorithm.

Books Recommended:

1. A. Silberschatz and Peter Baer Galvin	:**Operating System Concepts**, *Wiley Publishe*r **[Text Book]**
2.Tanenbaum	:**Operating Systems**, *Prentice Hall*
3.Madnick and J. Donovan	:**Operating Systems**, *McGraw-Hill*
4.B. Hausen	:**Operating System Principles,** *Prentice Hall of India*
5.Donovan	:**Systems Programming,** *Prentice Hall*
6.M. MilenKovie	:**Operating System Concept and Design**, *Tata McGraw Hill*

CSE 3205: Microprocessor and Assembly Language

Credit: 3.0
Pre-requisite: CSE 3105 (Computer Architecture)

Course Content: Introduction to IMB PC Assembly Language, Assembly Language syntax. A few basic Instructions, program structure, memory models Input/output instruction, running program, Program Segment Prefix The processor status and the Flag register Multiplication and Division Instructions, signed versus unsigned multiplications Overflow condition, debugging a program. Flow control instructions, High-level language structures: branching and looping structures Divide overflow, Arrays and related addressing modes, DUP operator. Register indirect modes, Based, and Indexed addressing modes. The string instructions, director flag, moving a string, storing a string Loading a string, scanning a string, comparing strings, substring operation

Books Recommended:

1. Ytha Yu and Charles Marut	:**Assembly Language Programming and Organization of the IBM PC**, *McGraw-Hill* **[Text Book]**
2. Rafiquzzaman	:**Microprocessor and Microcomputer based System Design,** *Crc Press Publication*
3. D. V. Hall	:**Microprocessors and Interfacing,** *McGraw-Hill*

CSE 3206: Microprocessor and Assembly Language Lab

Credit: 1.0
Pre-requisite: CSE 3106 (Computer Architecture Lab)

Course Content: Practice writing simple programs to take input characters and print them afterward Implement basic string printing operations Implement the concept of compare operation by solving various basic condition related problems Execute various types of Jumps in a wide range of practical scenarios. Include programs that have both of: Signed and Unsigned jumps Implement the logic operations (AND, OR, XOR) and solve relating problems. Using Shift and rotate operation build the concept of manipulating bit-wise operation Using the DUP operator and various addressing modes work with basic array operations

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Books Recommended:

1.Ytha Yu and Charles Marut	:**Assembly Language Programming and Organization of the IBM PC**, *McGraw-Hill* **[Text Book]**	
2.Rafiquzzaman	:**Microprocessor and Microcomputer based System Design,** *Crc Press Publication*	
3.D. V. Hall	:**Microprocessors and Interfacing,** *McGraw-Hill*	

CSE 3207: Digital Signal Processing

Credit: 3.0

Pre-requisite: CSE 2205 (Numerical Methods), MAT 2141 (Differential Equations)

Course Content: Introduction to Digital signal processing – Motivation: the importance and different applications of DSP in real time system. Overview: Basic concepts, Classifications of signals, Analog and discrete signal. Different types of discrete time signals, applications of discrete time signals, different operations of Signals. Analog to Digital Conversion, Sampling, Quantization. Digital to Analog Conversion. Discrete time signals and systems: Discrete time signals, discrete time systems, analysis of discrete-time linear time- invariant systems. Discrete time systems described by difference equations, implementation of discrete time systems, correlation and convolution of discrete time signals. The Discrete Fourier Transform: The DFT, Properties of the DFT, Filtering method based on the DFT, Frequency analysis of signals using the DFT Fast Fourier Transform Algorithms: FFT algorithms, applications of FFT algorithm. Digital Filters: Design of FIR and IIR filters. Adaptive filters: Adaptive system, Kalman filters, RLS adaptive filters, the steepest-descent method, the LMS filters.

Books Recommended:

1. Monson H. Haye:	:**Digital Signal Processing (Schaum's Outlines) [Text Book]**	
2. John G. Proakis, Dimitris G. Manolakis	:**Digital Signal Processing**	
3. David J. Defatta	:**Digital Signal Processing**	

CSE 3208: Digital Signal Processing Lab

Credit: 1.0
Pre-requisite: CSE 2205 (Numerical Methods), MAT2141 (Differential Equations)

Course Content: Overview of software, how to generate a waveform, amplitude, frequency generate some basic signals continuous and discrete signals. Signal Addition, Multiplication, Shifting operation. Folding or Time reversed Problem for different types of operations on signals. Change of shape with noise for real world signals. Finding features of a signal. How to generate: Fourier Transform Convolution

Books Recommended:

1.	Monson H. Haye	:**Digital Signal Processing (Schaum's Outlines) [Text Book]**
2.	John G. Proakis, Dimitris G. Manolakis	:**Digital Signal Processing**
3.	David J. Defatta	:**Digital Signal Processing**

CSE 3209: E-Commerce and Web Programming

Credit: 2.0
Pre-requisite: CSE 1101 (Structured Programming Language)

Course Content: E-Commerce Definition, E-Commerce business models, E-Commerce Challenges, E-Commerce Opportunities. Internet Access Requirements, Web Hosting Requirements, Storefront and Template Services, E- Commerce Software Packages, E-Commerce Developers, E-Business Solutions Web Site Goals, Planning Stages, Resource Allocation, Content Development, Web Site Design Principles, Web Site Design Tools, Web Page, Programming Tools, Data-Processing Tools. Navigation Aids, Web Site Search Tools, Search Engines, Web Site Monitoring, Forms, Shopping Carts, Checkout Procedures, Shipping Options. Electronic Payment Issues, E-Cash, Credit Card Issues, Merchant Accounts, Online Payment Services, Transaction Processing. Security Issues and Threats, Security Procedures, Encryption, Digital Certificates, SSL and SET Technologies, Authentication and Identification, Security Providers, Privacy Policies. HTML tags, formatting text, creating links, adding images, lists, tables, frames, forms, Cascading Style Sheets (CSS), graphics; Adding Multimedia – Audio, Video, Graphics. introduction to JavaScript, JavaScript syntax, variables, functions, events, jQuery, Ajax

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Books Recommended:

1. Elias M. Awad : **Electronic Commerce: From Vision to Fulfilment**, *Prentice-Hall Inc.* **[Text Book]**

2. Jeffrey F., Rayport, Bernard J. Jaworsk : **E-Commerce,** *McGraw-Hill*

3. David Kosiur : **Understanding Electronic Commerce**, *Microsoft Press*.

4. Jeffrey F. Rayport, et al. : **Introduction to E-Commerce**, *McGraw-Hill.*

5. Debra Cameron : **E-Commerce Security Strategies: Protection the Enterprise**, *Computer Technology Research Corp*

6. Charles Trepper : **E-Commerce Strategies**, Phi Learning Pvt. Ltd

CSE 3210: E-Commerce and Web Programming Project Lab

Credit: 1.5

Pre-requisite: CSE 1101(Structured Programming Language), CSE 3103(Database Management System)

Course Content: HTML tags, formatting text, creating links, adding images, lists, tables, frames, forms, Cascading Style Sheets (CSS), graphics; Adding Multimedia – Audio, Video, Graphics. Introduction to JavaScript, JavaScript syntax, variables, functions, events, jQuery, Ajax PHP basics, processing forms, sessions, cookies, back-end database support, database interface in PHP, searching in web applications. PHP and MySQL CRUD

Books Recommended:

1. Elias M. Awad : **Electronic Commerce: From Vision to Fulfilment**, *Prentice-Hall Inc.* **[Text Book]**

2. Jeffrey F., Rayport, Bernard J. Jaworsk : **E-Commerce,** *McGraw-Hill*

3. David Kosiur : **Understanding Electronic Commerce**, *Microsoft Press*.

4. Jeffrey F. Rayport, et al.	:**Introduction to E-Commerce**, *McGraw-Hill.*
5. Debra Cameron	:**E-Commerce Security Strategies: Protection the Enterprise**, *Computer Technology Research Corp*
6. Charles Trepper	:**E-Commerce Strategies**, Phi Learning Pvt. Ltd

ECO 3271: Engineering Economics

Credit: 2.0
Pre-requisite: None

Course Content:

Basic Concepts of Economics: Definition and subject matter of Economics; Microeconomics vs macroeconomics; Law of Economics; Central economic problems of every society; Different economic systems; Economics and Engineering.

Theory of Demand, Supply and Consumer Behavior: Law of Demand; Demand schedule and demand curve; Supply law, Supply schedule and supply curve; Shift in demand and supply; Equilibrium in the market; Elasticity of demand and supply.

Production and Costs and Theory of the Firm: Meaning of production; Factors of production; Concepts of total, average and marginal costs, fixed and variable costs.

Theory of the Firm: Perfect competition and monopoly; Total, average and marginal revenue of a firm; Average and marginal revenue under perfect competition and monopoly; Firm's Equilibrium; Equilibrium of firm under perfect competition and monopoly.

The Input-Output Analysis: Meaning of input-output analysis; Input-output analysis model; balance equation; coefficient matrix; Determination of final demand vector.

Concepts of Macroeconomics: Growth; Unemployment; Inflation; Philips Curve, Business cycle; Circular flow of economics; Two, three and four sector economics.

National Income accounting and determination: Concepts of GNP, GDP and national income; Methods of national income accounting; Problems of national income accounting; Keynesian model of national income determination; The multiplier; Effect of fiscal policy in the Keynesian model.

Budgets of Bangladesh: The revenue at the capital budget; Income, expenditure of the government; direct and indirect taxes.

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Development Planning in Bangladesh: Need for planning in Bangladesh; Various five-year plans in Bangladesh; Development strategies in the five-year plans of Bangladesh.

Books Recommended:

1. K. K. Dewett : **Modern Economics Theory,** *S. Chand Publishers* **[Text Book]**

2. H.L Ahujaaa : **Advanced Economic Theory**, *S. Chand Publishers*

3. A. Koutsoyiannis : **Modern Microeconomics**, *Palgrave Macmillan*

4th YEAR FIRST SEMESTER

CSE 4101: Artificial Intelligence

Credit: 3.0
Pre-requisite: MAT 3141 (Applied Statistics and Probability)

Course Content:
Fundamental of Artificial Intelligence: Definition of Al, Historical Development of Al, Application of Al, Intelligent agents – Structure of agents and its functions, Problem spaces and Search Algorithms- Breadth First Search, Depth First Search, Iterative Deepening Search, Hill Climbing, Heuristic Search, A* Algorithm, Greedy Best First Search, the Minimax Algorithm, Constraint Satisfaction Problems.
Knowledge Representation: Approaches and issues in knowledge representation- Knowledge - Based Agent- Propositional Logic – Predicate logic – Unification – Resolution - Weak slot - filler structure – Strong slot - filler structure.
Reasoning under Uncertainty: Bayesian Reasoning, Naive Bayes Probability Theory, Dempster-Shafer Theory, Algorithm, Fuzzy Logic, Fuzzy Set Theory.
Introduction to selected topics in AI: Expert Systems. Robotics, Natural Language Processing., Neural Networks, Forms of learning - inductive learning - Reinforcement Learning - learning decision trees - Neural Net learning and Genetic learning. Features of Al Programming Languages, Major Al Programming Languages: Python and Prolog, Implementation of AI Algorithms Through Python and Prolog.

Books Recommended:

1. Elaine Rich, Kevin Knight and S.B. Nair   : **Artificial Intelligence [Text Book]**

2. Staurt J. Russel,and P. Norvig   : **Artificial Intelligence: A modern Approach**

3. D.W. Patterson   : **Introduction to Artificial Intelligence and Expert System**

4. Pattrick Henry Winston   : **Artificial Intelligence**

5. N. P. Padhy   : **Artificial Intelligence and Intelligent System**

6. Bratko, I   : **Prolog programming for artificial intelligence**

CSE 4102: Artificial Intelligence Lab

Credit: 1.0
Pre-requisite: MAT 3141 (Applied Statistics and Probability)

Course Content: Basics of Turbo Prolog, Intro to Prolog programming, Running a simple program. An Introduction to Python Programming. Performance of a Machine Learning Algorithm. (Accuracy, Precision, Sensitivity, Specificity). The Family relations Prolog Problem. The Jungle Problem. Different Arithmetic Programs using Prolog and Python. Medical Diagnosis system, Implementation of KNN Algorithm, Implementation of Support Vector Machine (SVM)

Books Recommended:

1. Bratko, I   :**Prolog Programming for Artificial Intelligence, [Text Book]**
2. Carl townsend   :**Introduction to Turbo Prolog**
3. Prateek Joshi   :**Artificial Intelligence with Python**

CSE 4103: Digital Image Processing

Credit: 3.0
Pre-requisite: CSE 3207 (Digital Signal Processing)

Course Content:
Introduction and Image Representation: Introduction to digital image and digital image processing, history of digital image processing, state of the art examples of digital image processing, key stages in digital image processing, digital image representation, image sampling and quantization, image resolution.
Image Enhancement: Concept of image enhancement, Different kinds of image enhancement, histogram processing, point processing, neighborhood operations. Some point processing includes Point Processing: concept on point processing.
Enhancement by Spatial Filtering: Defining point processing, Negative images, Thresholding, Logarithmic transformation, Power law transforms, Grey level slicing, Bit plane slicing, Neighborhood operations, spatial filtering, Smoothing operations, Correlation and convolution, sharpening filter, combining filtering techniques.
Frequency Domain Filtering: Concept of Fourier transform (FT), 2D implementation of FT and image processing in frequency domain, different frequency domain filters for image smoothing and sharpening, comparison of spatial and frequency domain filtering
Image Restoration: Introduction to image restoration, noise and images, different noise models, noise removal using spatial domain filtering, dealing with periodic noise, different types of mean filters, noise removal using frequency domain filtering.
Image Segmentation: The segmentation problem, finding points, lines and edges, derivative based edge detection, effects of noise in derivative-based edge detection, common spatial filters for edge detection, thresholding-based image segmentation, simple thresholding, global thresholding, adaptive thresholding.
Morphological image processing: Morphology and its application in image processing, structuring element and basic morphological operations, compound operations, opening, closing, boundary extraction, other morphological algorithm used in image processing.
Image Compression: Image compression, lossy and lossless compression, compression ratio and data redundancy, different types of data redundancy, information and entropy, image compression model, concept of different methods.

Books Recommended:

1. Rafael C. Gonzalez and Richard E. Woods	:**Digital Image Processing**, 4th Edition. [**Text Book**]	
2. David Vernon	:**Machine Vision: Automated Visual Inspection and Robot Vision,** *Prentice Hall*, *1991*	
3. Pratt William K	:**Digital Image Processing**, PIKS Scientific Inside, 4th Edition, *John Wiley*	
4. Pitas Ioannis	:**Digital Image Processing Algorithms and Applications**, *John Wiley*	

CSE 4104: Digital Image Processing Lab

Credit: 1.0
Pre-requisite: CSE 3208(Digital Signal Processing Lab)

Course Content: Apply basic image conversion: RGB to Gray, BW, Color channel separation. Gray level transformation: Thresholding, negative, log, inverse log gray level transformation: power law: nth power, nth root, gray level slicing, bit plane slicing, scaling, rotation, histogram, histogram equalization. Different arithmetic operations on images. Analyze different filtering techniques of Smoothing and Sharpening in Spatial domain. Analyze different point processing techniques: point detection, line detection, edge detection Implement different filtering techniques of image restoration and compare. Implement basic operations, compound operations of morphological operation. Implement algorithms of morphological operation.

Books Recommended:

1. Rafael C. Gonzalez and Richard E. Woods	:**Digital Image Processing**, 4th Edition. [**Text Book**]	
2. David Vernon	:**Machine Vision: Automated Visual Inspection and Robot Vision,** *Prentice Hall*, *1991*	
3. Pratt William K	:**Digital Image Processing**, PIKS Scientific Inside, 4th Edition, *John Wiley*	
4. Pitas Ioannis	:**Digital Image Processing Algorithms and Applications**, *John Wiley*	

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CSE 4105: Engineering Ethics and Environmental Protection

Credit: 2.0
Pre-requisite: None

Course Content:
Introduction to Engineering ethics and professionalism: What is engineering ethics? Why study engineering ethics? Responsible Professionals, Professions, and Corporations, The Origins of Ethical Thought, Ethics and the Law, Moral Reasoning and Codes of Ethics: Ethical decision-making strategies, Ethical dilemmas, Codes of ethics, Case studies Moral Frameworks for Engineering Ethics: Ethical theories, Personal commitments, and professional life
Ethical Problem-Solving Techniques: Analysis of Issues in Ethical Problems, An Application of Problem-Solving Methods, Engineering as Social Experimentation: Engineering as Experimentation, Engineers as Responsible Experimenters, Risk, Safety, and Accidents: Assessment of safety and risk, Design considerations, uncertainty, Risk-benefit analysis, safe-exit and fail- safe systems.
Engineer's Responsibilities and Rights: Employee/employer rights and responsibilities, Confidentiality and conflict of interest, Whistleblowing, Case studies on whistleblowing
Honesty and Research Integrity: Truthfulness, Trustworthiness, Research Integrity, Protecting Research Subjects
Computer Ethics: The Internet and Free Speech, Power Relationships, Property, Privacy, Additional Issues
Environmental Ethics: Engineering, ecology, economics, Sustainable development, Ethical frameworks
Global Issues: Multinational corporations, globalization of engineering, Technology transfer, appropriate technology
Cautious Optimism and Moral Leadership: Cautious optimism as a technology development attitude, Moral leadership in engineering
Cyber Law: Definition Nature, Scope, Utility of Cyber Law, Origin and Development of Cyber Law and Internet
ICT Policy in Bangladesh: Internet Service Providers (ISP)- Domain Name, Present Legal Basis of ISP in Bangladesh; e- Readiness in Bangladesh- e-Commerce in Bangladesh, e-Governance in Bangladesh, e-Learning/Education in Bangladesh, e-Journal in Bangladesh, e-Voting in Bangladesh; Electronic Evidence- Digital Signature, The Evidence Act of 1872 Vs. ICT Act-2006, Electronic Evidence in Bangladesh, Legal Effects of Electronic Evidence, UNCITRAL Model Law on Electronic Evidence;
Cyber Crime: Jurisdiction and Cyber Crime, Criminal Justice in Bangladesh and Implications on Cyber Crime; Cyber vandalism, Hacking, Malicious Spreading in Viruses, Password fraud, Cheating, Cyber Pornography, Child Pornography, Protection of Copyrights and Intellectual

Property right, Invasion of Privacy, Constitutional basis of Privacy, Unsolicited E-Mail, Defamation, Harassment and e-Mail Abuse, Present Legal Protection;

Human Rights Violation and Internet; The Information and Communication Technology Act, 2006- Objectives, Strengths & Weaknesses of the ICT Law, Regulation of Cryptography;

Environmental Laws of Bangladesh: The Environment Conservation Act 1995, The Environment Court Act 2010, The Forest Act 1927, The Wildlife (Conservation and Security) Act 2012, The Brick Manufacturing and Brick Kilns Establishment (Control) Act 2013, The Bangladesh Biodiversity Act 2017

International Environment Law: International Environment Law and its effects and regulations on the computer technology industry.

Books Recommended:

1. Charles B. Fleddermann : **Engineering Ethics.** *Pearson, 4th Edition, 2011* [**Text Book**]
2. Mike W. Martin, Roland Schinzinger : **Introduction to Engineering Ethics,** *McGraw-Hill, 2nd Edition, 2010*
3. Vivck Sood : **Cyber Law Simplified,** *Tata McGraw Hill Publications*
4. V. D. Dudej ; **Information Technology & Cyber Laws,** *Commonwealth Publishers*
5. I.Brownlie : **Principles of Public International Law,** *(4th Ed.) 1990*
6. John Strawson : **Public International Law,** *London, 1996*

ACC 4171: Industrial Management and Accountancy

Credit: 2.0
Pre-requisite: None

Course Content:
Industry: Commerce-Industry: Meaning & Characteristics of Industry, Types of Industry. Business: Meaning & Objectives of Business, Types of Business- Sole Proprietorship, Partnership, Joint Stock Company, State Enterprise and Cooperative Society.

Fundamentals of Management: Meaning of Management, Principles of Management, Functions of Management, Levels of Management, Roles of Management, Management skills, Scientific Management, Consultative Management, and Participative Management. Factory Location, Plant Location and Utility, Factors Determining Location of Factory, Steps in Location.

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Plant Layout and Utility: Definition, Types of Layouts, Problems of Layout, Plant Utility, Problem Solving, Linear Programming EOQ, Lead Time, Safety Stock, Re-Order Point, Lighting, Ventilation, Air-conditioning, Sanitation and Noise Control.

Accountings: Basic Accounting Principles, Objectives of Accounting, Information and Uses.

Transactions: Meaning and Classification of Account, Accounting Equation, Double Entry System, Rules for Determining Debit and Credit, Accounting Cycles.

Journal, Ledger and Trial Balance: Meaning, Features, Necessity, Rules, Double and Triple Column Cash Book and Practical Problems. Work Sheet: Meaning, Purpose, Adjustment Entries and 10 Columns Work Sheet.

Cost Terms, Concepts and Classification: Meaning of Cost, Manufacturing and Non-Manufacturing Costs, Periodic and Product Costs, Fixed and Variable Costs, Direct and Indirect Costs, Preparation of Cost Sheet, Cost Volume Profit (CVP) Analysis, Standard Costing, Process Costing.

Books Recommended:

1. M. C. Shukla : **Business Organization and Management**, *S. Chand Publisher* **[Text Book]**

2. Harold Koontz and Heinz Weihrich : **Management,** *Tata McGraw-Hill*

3. Krajewski and Ritzman : **Operation Management**, *Addison-Wesley Publishing Company*

4. David A. Decenzo and Stephen P. Robbins : **Human Resource Management**, *John Wiley & Sons Publisher*.

5. Hermanson Etar : **Accounting Principles**, *Business Publications*

6. Ray H. Garrison : **Managerial Accounting**, *Irwin Professional Publishing*

CSE 4100: Project or Thesis with Seminar Part I

Credit: 2.0

Pre-requisite: Completion of at least 100 credit hours of course works including all major core courses and mathematics and science courses.

Course Content:

Group formation & project selection.

Lecture 1 – Introduction to Final Year Project. Meet the supervisor and discuss about the possible topics for the project. Document the outcome of the meeting in the log book.

Lecture 2 – Effective Literature Review for the Final Year Projects. Meet the supervisor and finalize the topic for the project. Document the outcome of the meeting in the log book.

Lecture 3 – Research Methodologies for the Final Year Projects. Start the literature review process and meet the supervisor to show the findings from literature review. Document the outcome of the meeting in the log book.

Lecture 4 – Avoiding Plagiarism Continue with the literature review and meet the supervisor to show the findings from literature review. Write the preliminary research objectives and get the feedback from the supervisor. Document the outcome of the meeting in the log book.

Lecture 5 – Sustainability and SDGs Continue with the literature review and meet the supervisor to show the findings from literature review. Finalize the research objectives. Document the outcome of the meeting in the log book.

Lecture 6 – Engineer & Society Continue with the literature review and develop a research methodology based on sound practices to achieve the research objectives. Meet the supervisor to discuss about the research methodology. Document the outcome of the meeting in the log book.

Lecture 7 – Effective Technical Report Writing Continue with the literature reviewand finalize the research methodology.Meet the supervisor to approve the research methodology. Document the outcome of the meeting in the log book.

Lecture 8 – Effective Presentation Skill Compile information/data from the literature review for preliminary analysis. Meet the supervisor to discuss about the preliminary engineering analysis. Document the outcome of the meeting in the log book.

Conduct the preliminary analysis. Meet the supervisor and discuss findings from the analysis. Document the outcome of the meeting in the log book. Improve the preliminary analysis. Meet the supervisor and discuss findings from the analysis. Finalize the analysis and document the results. Meet the supervisor and discuss results from the final analysis.

Document the outcome of the meeting in the log book. Discuss the progress. Document the outcome of the meeting in the log book. Prepare the draft version of the final report for the semester. Discuss the final report with supervisor. Submit the log book along with signatures to the department.

CSE 4120: Industrial Attachment *(Internship)*

Credit: 1.0
Pre-requisite: None

Course Details: This course is designed to provide experience to students through internship/Co-op works in IT/Software industry. Students will work there, prepare detailed reports and their supervisors will evaluate their work. This course aims to provide students with a professional environment and workload similar to what they would find when they join different firms after graduation.

CSE 4122: Technical Report Writing

Credit: 0.5
Pre-requisite: ENG 1171 (Functional English)

Course Content:
Introduction: Issues of Technical Writing and Effective Oral Presentation in Computer Science and Engineering,
Writing Issues: Writing Styles of Definitions, Propositions, Theorems and Proofs; Preparation of Reports, Research Papers, plagiarism & plagiarism detection.
Writing and Presentation Tools: LATEX; Diagram Drawing Software; Presentation Tools

Books Recommended:

1.	Eunson B, John Wiley	:**Writing and presenting reports,** *Wiley* **[Text Book]**
2.	Roy Peter Clark	:**Writing Tools: 50 Essential Strategies for Every,** *Writer, Little, Brown and Company*
3.	Lutz Hering, Heike Hering	:**How to Write Technical Reports: Understandable Structure, Good Design, Convincing Presentation,** *Springer*
4.	Leslie Lamport	:**LaTeX: A Document Preparation System**

Table-I: Option I
CSE 4107: Microcontroller, Computer Peripherals and
Interfacing

Credit: 3.0
Pre-requisite: CSE 1101(Structured Programming Language), CSE 3205 (Microprocessor and Assembly Language)

Course Content:
Introduction to Microcontroller and Embedded System: Classification and applications, Overview of AVR Family, History and Features, Embedded System Specifications and Modelling, Embedded Hardware Platforms and Peripherals, Embedded Processors, Embedded Computing Platform, Real Time Embedded Systems, Embedded Systems Programming, Embedded Communication Systems, Embedded Computer Security.
Microcontroller I/O Port Programming: General Purpose Registers, Port Programming, Bit Manipulation, AVR Hardware Connection, Hex Files
Microcontroller Peripheral Features: Timer, PWM, Serial Communication Subsystems (USART, UART, SPI, TWI Protocols).
Microcontroller Special Features: External and Internal Interrupt, ADC
Basic Concepts of Microprocessor Interfacing: Reviews of Address Decoding Concepts, Input and Output Port Design, Decoder, Encoder, Multiplexer, De-multiplexer, Microcomputer System Overview
I/O Controller and Computer Peripheral Components: Interfacing ICs of I/O Devices, I/O Ports, Programmable Peripheral Interface, DMA Controller, Interrupt Controller, Communication Interface, Interval Timer, Mapping Between Languages and Hardware
Memory Device: Memory Terminology, CPU-Memory Connections, Memory Interfacing ROM Architectures and Time Diagram, Different Type of ROM, Flash Memory, RAM Architectures and Time Diagram, Different Type of RAM and Read/Write Cycle, Programmable Logic Device Architectures
Interfacing Components: Programmable Timer, Bus Architecture, Bus Timing, Transceiver Device, Latches, Bus Controller, Hard Disk Controllers, Barcode Reader, Sound Card, Printer Interface, Characteristics of Memory And I/O Interface, Synchronous- Asynchronous communication, Serial I/O Interface, Programmable Peripheral Interface, Real Time Operating Systems

Books Recommended:

1.	Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi	:	**The AVR Microcontroller and Embedded Systems using Assembly and C,** *Pearson* [**Textbook**]
2.	Douglas Hall	:	**Microprocessors & Interfacing,** *McGraw*

			- Hill
3.	A. K. Ray, K M Bhurchandi	:	**Advanced Microprocessors and Peripherals,** *McGraw-Hill*
4.	John Nussey	:	**Arduino For Dummies**, *Wiley*

CSE 4108: Microcontroller, Computer Peripherals and Interfacing Lab

Credit: 1.0
Pre-requisite: CSE 1102(Structured Programming Language Lab), CSE 3206 (Microprocessor and Assembly Language Lab)

Course Content: Writing I/O Programs-Creating Hex File for the Microcontroller, Interfacing Microcontroller with Led Bar Graph. Interfacing Seven Segment Display with Microcontroller and Solving Different Problems. Microcontroller Interrupt Implementation, Button debouncing and Microcontroller Timer Implementation, ADC Implementation and Interfacing sensors with Microcontroller. Introduction to Microcontroller Based Development Board, Interfacing LCD display with Microcontroller Based Development Board. Interfacing different sensors with Microcontroller Based Development Board.

Books Recommended:

1.	Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi	:	**The AVR Microcontroller and Embedded Systems using Assembly and C,** *Pearson* [**Textbook**]
2.	Douglas Hall	:	**Microprocessors & Interfacing,** *McGraw - Hill*
3.	A. K. Ray, K M Bhurchandi	:	**Advanced Microprocessors and Peripherals,** *McGraw-Hill*
4.	John Nussey	:	**Arduino For Dummies**, *Wiley*

CSE 4109: Computer Vision and Pattern Recognition

Credit: 3.0
Pre-requisite: CSE 3101 (Computer Graphics), CSE 4103 (Digital Image Processing)

Course Content:
Image formation: Geometric primitives and transformation, photometric image formation, sampling and aliasing
Basic image processing technique review: point operations, correlation and convolution in spatial domain, filter masks, 2D Fourier transform, filtering in frequency domain
Feature detection: edge detection, image segmentation, Hough transformation, active contours, split and merge, mean shift and mode finding, graph cuts and energy-based methods.
Dense motion estimation: translational alignment, parametric motion, spline-based motion, optical flow
Image based rendering: view interpolation, light fields and lumigraphs, environment matters.
Pattern recognition: Linear classifiers, loss function optimization, nonlinear classifiers, kernel methods,
Loss function optimization: Image feature optimization, gradient descent and other advanced 2nd order optimization techniques.
Neural networks: multilayer perceptron, loss function of the MLP network. Convolutional neural networks: the structure of the network, convolution and pooling.
Training and hyper parameter tuning: automatic differentiation using backpropagation, activation functions, batch processing, image normalization, transfer learning, update rules, tuning learning parameters, data augmentation

Books Recommended:

1.	Richard Sizelski	:**Computer Vision: Algorithms and Application,** *Springer* **[Text Book]**
2.	David Forsyth, Jean Ponce	:**Computer Vision: A Modern Approach,** *Pearson*
3.	Ian Goodfellow, Yoshua Bengio, Aaron Courville	:**Deep Learning,** *MIT Press*

CSE 4110: Computer Vision and Pattern Recognition Lab

Credit: 1.0
Pre-requisite: CSE 3102 (Computer Graphics Lab), CSE 4104 (Digital Image Processing Lab)

Course Content: Introduction to Open CV and other machine learning frameworks e.g., keras, scikit-learn. Implement different image filtering techniques in both spatial and frequency domains. Implement image feature extraction techniques and understand the appropriate approach for any specific applications. Solve some real-life computer vision example problems. Implement basic pattern recognition techniques e.g. support vector machines, neural networks, and apply them to computer vision applications Implement different cost function optimization algorithms for application in pattern recognition problems algorithms. Design and implement complete convolutional neural network and understand the strengths and weaknesses of different architectures. Understand the appropriate hyper parameter technique for the problem at hand and implement them for application in the convolutional neural network. Map the practical relationship between the performance of convolutional neural networks and different image feature extraction techniques by implementing and analyzing the performance.

Books Recommended:

1.   Adrian Kehler, Gary Rost : **Learning OpenCV**, *O'Reilly* **[Text Book]**
      Bradski.

2.   Richard Szeliski   : **Computer Vision: Algorithms and Applications**, *Springer.*

3.   Aurelien Geron   : **Hands on Machine Learning with Scikit-Learn, Keras and Tensorflow***, O'Reilly.*

CSE 4111: Mobile Apps and Game Development

Credit: 3.0
Pre-requisite: CSE 1201(Object Oriented Programming), CSE 2101(Object Oriented Design and Design Patterns), CSE 2203(Computer Algorithms), CSE 3101 (Computer Graphics), CSE 3103(Database Management System).

Course Content:

Introduction to App Development: Introduction to Mobile Computing, Introduction to Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User.

Intents on UIs VUIs and Mobile Apps: Text-to-Speech Techniques Designing the Right UI Multichannel and Multi Modal UIs and Services: Android Intents and Services, Characteristics of Mobile Applications, Storing and Retrieving Data, Synchronization, and Replication of Mobile Data, Android Storing and Retrieving Data, Working with a Content Provider

Communications Via Network and the Web: State Machine, Communications Model, Android Networking, Deciding Scope of an App, Wireless Connectivity and Mobile Apps, Android Telephony, Performance and Memory Management, Android Notifications and Alarms

Graphics: Performance and Multithreading, Graphics and UI Performance, Android Graphics and Multimedia, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia Location, Mobility and Location Based Services

Miscellaneous: Packaging and Deploying, Performance Analysis, Active Transactions, Security measures, Testing.

Introduction to Unity and C#: prototyping using C# and Unity. General syntax and code structures in C#, how to use the Unity editor, and how to work with Unity objects through code.

Books Recommended:

1. J. Paul Cardle	:**Android App Development in Android Studio: Java + Android** *Createspace Independent Publishing Platform* **[Textbook]**
2. Jeff Mcherter and Scott Gowell	**Professional Mobile Application** :**Development**
3. Raul Portales	:**Mastering Android Game Development,** *Packt Publishing Limited*

CSE 4112: Mobile Apps and Game Development

Credit: 1.0

Pre-requisite: CSE 1202 (Object Oriented Programming Lab), CSE 2102 (Object Oriented Design and Design Patterns Lab), CSE 2204 (Computer Algorithms Lab), CSE 3102 (Computer Graphics Lab), CSE 3104 (Database Management System Lab)

Course Content: UI development with XML and JavaScript, Game UI design with Unity, Backend development with Java and Kotlin, Android Networking, Android Data Handling, App/Game Deployment.

Students will work in pairs to create an original prototype. Assignments: Pair assignment due during the final exam period. Students will create a new, unique prototype. This will be based on their work throughout the semester and should both showcase all of the skills that they've learned throughout the semester and express a unique design vision.

Books Recommended:

1. J. Paul Cardle	:**Android App Development in Android Studio: Java + Android** *Createspace Independent Publishing Platform* **[Textbook]**
2. Jeff Mcherter and Scott Gowell	**Professional Mobile Application** :**Development**
3. Raul Portales	:**Mastering Android Game Development,** *Packt Publishing Limited*

4th YEAR SECOND SEMESTER

CSE 4201: Parallel Processing and Distributed Systems

Credit: 3.0

Pre-requisite: CSE 2207 (Computer Networks), CSE 3105 (Computer Architecture)

Course Content:

Introduction: Trends towards parallel processing, Parallel processing mechanism, Multiprogramming and Time sharing, Parallel Computer Structures, Parallelism and Pipelining

Parallel Programming: Parallel Programming models, Parallel Languages and Compilers, Code Optimization and Scheduling, Loop Parallelization and Pipelining, Parallel Programming Environments, Shared-variable program structures, mapping programs onto Multicomputer.

Distributed System: Introduction, Distributed System Architectures, Communication in Distributed Systems, Distributed Middleware, Client/Server Design Issues, Inter-process communication, RPC, Distributed Objects and Remote Invocation, Virtualization & Code Migration, Naming, Distributed Synchronization & Coordination, Consistency & Replication in Distributed Systems, Fault Tolerance, Distributed Transactions, Security, P2P Systems, Cloud Computing, Grid Computing.

Distributed System Programming: Java RMI, CORBA, P2P, COM, DCOM, Multi Agent System, SOAP, Web Service.

Hardware Technology: Advanced processor Technology, Superscalar and Vector processor, Shared memory organization, Design of Linear and Nonlinear Pipeline processor, Multiprocessor System Interconnects.

Pipelining and Vector Processing: Principles of Pipelining, Classification of pipelined processors, Instruction and Arithmetic pipeline design, Vector Processing principles, Vector processing requirements, Designing Pipelined processors, Compound Vector processing, Recent Vector processors, Vectorization, and Optimization methods.

Parallel processing applications, Speedup Performance Laws, Parallel Random-Access Machines (PRAM) and VLSI model.

Books Recommended:

1.	Andrew S. Tanenbaum, Maarten van Steen	:	**Distributed Systems Principles and Paradigms,** *Prentice-Hall* **[Text Book]**
2.	Kai Hwang	:	**Advanced Computer Architecture,** *Tata McGraw-Hill* **[Text Book]**
3.	George Coulouris	:	**Distributed Systems Concepts and Design,** *Pearson Education*
4.	Pradeep K. Sinha	:	**Distributed Operating Systems,** *Prentice-Hall*

CSE 4202: Parallel Processing and Distributed Systems Lab

Credit: 1.0

Pre-requisite: CSE 2208 (Computer Networks Lab), CSE 3106 (Computer Architecture Lab)

Course Content: RPC Programming Using DCOM., Java RMI "Hello World" service implementation, Java RMI "Calculator" service implementation, Java RMI Database CRUD implementation, Implement Java CORBA, Multithreaded Service using Java sockets, Mobile Agent Programming, FTP and HTTP server implementation.

Books Recommended:

1.	Andrew S. Tanenbaum,	:	**Distributed Systems Principles and Paradigms,** *Prentice-Hall* **[Text**

	Maarten van Steen		**Book]**
2.	Kai Hwang	:	**Advanced Computer Architecture,** *Tata McGraw-Hill* **[Text Book]**
3.	George Coulouris	:	**Distributed Systems Concepts and Design,** *Pearson Education*
4.	Pradeep K. Sinha	:	**Distributed Operating Systems,** *Prentice-Hall*

CSE 4203: Cryptography and Network Security

Credit: 3.0

Pre-requisite: CSE 2207 (Computer Networks)

Course Content: Overview of cryptography and network security, terminologies, Substitution, and transposition ciphers, Symmetric ciphers, classical encryption technique

Block ciphers (Block Cipher Models), Fiestel Cipher, Simplified data encryption standards, DES, Double DES, Triple DES.

Public-Key Encryption: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie Hellman Key exchange algorithm. Key Distribution, Key Management

Message Authentication: Authentication Requirements, Authentication Functions, Message Authentication Codes, Web Security Considerations, Secure Socket Layer and Transport Layer Security.

Hash Functions, MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital Signatures,

Authentication Protocols. Pretty Good Privacy, S/MIME, IP Security Architecture, Authentication Header

Books Recommended:

1.	W. Stallings	:	**Cryptography and Network Security Principles and Practice**, *Prentice Hall.*
2	Behrouz Forouzan	:	**Cryptography and Network Security**, *McGraw-Hill*
3.	Bruce Schneier	:	**Applied Cryptography**, *John Wiley & Sons.*

4.	Dieter Gollmann	:	**Computer Security**, *John Wiley and Son.*
5.	Edward Amoroso	:	**Fundamentals of Computer Security Technology**, *Prentice Hall*.
6.	E. Biham and A. Shamir	:	**Differential Cryptanalysis of the Data Encryption Standard,** *Springer Verlag.*

CSE 4204: Cryptography and Network Security Lab

Credit: 1.0

Pre-requisite: CSE 1102 (Structure Programming Lab), CSE 2207 (Network Security Lab).

Course Content: Implement encryption and decryption of Caesar cipher, Cryptanalysis, Playfair cipher, Hill cipher, Monoalphabetic Cipher, Polyalphabetic Cipher, Different Transposition Cipher, Multiple transpositions, Implementation of SDES and DES, RSA algorithm, Implement Diffie Hellman Key exchange algorithm, Hash Function, and Digital Signature algorithms

Books Recommended:

1.W. Stallings	:**Cryptography and Network Security Principles and Practice,** *Prentice Hall*
	[Text Book]
2.Bruce Schneier	:**Applied Cryptography**, *John Wiley & Sons.*
3.Dieter Gollmann	:**Computer Security**, *John Wiley & Sons.*
4.Edward Amoroso	:**Fundamentals of Computer Security Technology**, *Prentice Hall*.
5.E. Biham and A. Shamir	:**Differential Cryptanalysis of the Data Encryption Standard,** *Springer Verlag.*
6.D. Denning	:**Cryptography and Data Security,** *Addison Wesley*.

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CSE 4200: Project or Thesis with Seminar Part II

Credit: 2.0

Pre-requisite: CSE 4100 (Project or Thesis with Seminar Part I)

Course Content: Meet the supervisor and obtain feedback for the final report for the previous term. Document the outcome of the meeting in the log book. Modify the draft version of the report. Prepare slides for the presentation. Prepare the slides for the presentation. Document the outcome of the meeting in the log book. Continue with the project work.

Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book. Continue with the project work. Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in Continue with the project work. Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book. Continue with the project work.

Meet and discuss with the supervisor about the progress from the last meeting and document the outcome of the meeting in the log book. Continue with the project work. Meet the supervisor and discuss the progress from the last meeting. Continue with the project work and demonstrate with the team. Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book. Prepare the draft version of the final report for the semester.

Meet and discuss with the supervisor about the draft report and document the outcome of the meeting in the log book Prepare the final report considering the life-long education in the context of modern technology.

Meet the supervisor and discuss the progress from the last meeting. Document the outcome of the meeting in the log book. Submit the final report. Discuss about the final presentation. Document the outcome of the meeting in the log book. Submit the final report book along with signatures to the department.

CSE 4205: Robotics and Automation

Credit: 3.0
Pre-requisite: CSE 4101 (Artificial Intelligence)

Course Content:
Introduction to Robotics: Definition, Origin & Types of Robotics, Historical development of robot, Major components of Robotic system, Robot Anatomy & Degree of Freedom, Robotics and AI
Spatial Transformations: Cartesian Co-ordinate, Reference Frame, Transformation Matrix, Homogeneous Transformation, Inverse Transformation, Graphs, Co-ordinate system overview
Power Sources and Sensors: Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics, machine vision, ranging, laser, acoustic, magnetic, fiber optic and tactile sensors.
Manipulators, Actuators, and Grippers: Manipulators, Classification, Construction of manipulators, manipulator dynamics and force control, electronic and pneumatic manipulator control, End effectors, Loads and Forces, Grippers, design considerations, Robot motion Control, Position Sensing
Robot Kinematics Basics: Forward Kinematics, Inverse Kinematics. Velocities, Static Forces, acceleration of rigid bodies and Jacobians
Robotic mapping: localization, Monte Carlo localization, multi-object localization
Robotic navigation and locomotion: motion planning, dynamics, linear control, non-linear control, Force control, Compliance
Trajectory/Path Planning: Path planning for mobile robots, path planning for industrial robots. Robot Programming Languages and Systems, Simulation and Off-Line Programming
Case Studies: Multiple robots, Machine Interface, Uncertainty, Robots in Manufacturing and not-Manufacturing Application, Robot Cell Design, Mechanical Design of robots, Selection of a Robot

Books Recommended:

1.   John Craig   :**Introduction to Robotics: Mechanics and Control (4th Edition),** *Pearson* [**Text Book**]

2.	William Bolton	:**Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering (6th Edition),** *Pearson*

3.	Professor S. G. Tzafestas	:**Intelligent Systems, Control and Automation: Science and Engineering**, *Springer*
4.	Peter Mckinnon	:**Robotics: Everything You Need to Know About Robotics from Beginner to Expert**

CSE 4206: Robotics and Automation Lab

Credit: 1.0
Pre-requisite: CSE 4102 (Artificial Intelligence Lab)

Course Content: Introduction to principles of robotics, necessary software and toolkits, Programming the robot and platforms. , Demonstration of Cartesian/ cylindrical/ spherical robot. , Developing mobile robots using Arduino, DC motor, motor shields, chassis, jumpers, hex spacers, batteries, motor brackets, sonar sensor, servo motor, motor brackets etc. ,Virtual modeling for kinematic and dynamic verification any one robotic structure using suitable software. , Design, modeling and analysis of different types of grippers. , Study of robotic system design. , Study and testing of power supplies and movement systems, sensing systems, end-of-arm tooling, control systems. , Study and implementation of sensor integration. Demonstration of Articulated/ SCARA robot, Linear and non-linear path programming.

Books Recommended:

1.	John Craig	:**Introduction to Robotics: Mechanics and Control (4th Edition),** *Pearson* [**Text Book**]
2.	William Bolton	:**Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering (6th Edition),** *Pearson*
3.	Professor S. G. Tzafestas	:**Intelligent Systems, Control and Automation: Science and Engineering**,
4.	Peter Mckinnon	:**Robotics: Everything You Need to Know About Robotics from Beginner to Expert**

CSE 4207: Big Data Analysis

Credit: 3.0
Pre-requisite CSE 2103 (Data Structure), CSE 3103 (Database Management System), CSE 3131 (Applied Statistics and Probability)

Course Content:
Introduction to Big Data: Characteristics and size of Big Data, Analytics, Drivers of Big Data, Big Data Attributes, Data Structures, Big Data Ecosystem, Big Data Platforms and Data Storage,
Big Data Tools, Techniques, and Systems: Exascale computing, HDFS, HBase, and NoSQL (Document Store, Graph DB, etc.), MapReduce, Spark, Oozie, Tez, Hive, Pig, etc.;
Introduction to Hadoop: History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, Hadoop 1 and Hadoop 2 (YARN), IBM Big Data Strategy
Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.
Advanced Analytical Theory and Methods: Hadoop/Mahout, Recommendation, Clustering, Classification, Regression
Advanced Topics: Big Data Visualization, High-performance Networking for Big Data Movement, Big Data Scientific Workflow Management and Optimization

Books Recommended:

1. Seema Acharya, Subhasini   :**Big Data Analytics**, *Wiley 2015* **[Text Book]**

2. Tom White   :**Hadoop: The Definitive Guide**, *McGraw-Hill*

3. Jay Liebowitz   :**Big Data and Business Analytics**, *Auerbach Publications, CRC press (2013)*

4. Donald Miner,   :**Map Reduce Design Pattern**, *O'Reilly, 2012*

CSE 4208: Big Data Analysis Lab

Credit: 1.0
Pre-requisite CSE 2104 (Data Structure Lab), CSE 3104 (Database Management System Lab)

Course Content:

Implement the following Data structures a) Linked Lists b) Stacks c) Queues d) Set e) Map

Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, fully distributed Use web-based tools to monitor your Hadoop setup.

Implement the following file management tasks in Hadoop: Adding files and directories, retrieving files, Deleting files

Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.

Write a Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record- oriented.

Implement Matrix Multiplication with Hadoop Map Reduce.

Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Books Recommended:

1. Seema Acharya, Subhasini   :**Big Data Analytics**, *Wiley 2015* **[Text Book]**

2. Tom White   :**Hadoop: The Definitive Guide**, *McGraw-Hill*

3. Jay Liebowitz   :**Big Data and Business Analytics**, *Auerbach Publications, CRC press (2013)*

4. Donald Miner,   :**Map Reduce Design Pattern**, *O'Reilly, 2012*

CSE 4209: Cloud Computing and IOT

Credit: 3.0

Pre-requisite CSE 2101(Object Oriented Design and Design Patterns), CSE 2207(Computer Networks), CSE 4107(Microcontroller, Computer Peripherals and Interfacing)

Course Content:

Introduction to Cloud Computing: Origins of Cloud computing – Cloud components, Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

Cloud Insights: Architectural influences – High-performance computing, Utility, and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information, Application development- security level of third party, security benefits, Regularity issues: Government policies.

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Cloud Architecture- Layers and Models: Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds, Hybrid clouds, Advantages of Cloud computing.

Cloud Simulators- CloudSim and GreenCloud: Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

Introduction to VMWare Simulator: Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Introduction to IoT: Internet of Things, Physical Design, Logical Design- IoT Enabling Technologies, IoT Levels & Deployment Templates, Domain Specific IoTs, IoT and M2M, IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

IoT Architecture: M2M high-level ETSI architecture, IETF architecture for IoT, OGC architecture, IoT reference model, Domain model, information model, functional model, communication model, IoT reference architecture

IoT Protocols: Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols, Unified Data Standards Protocols, IEEE 802.15.4, BACNet Protocol, Modbus–Zigbee Architecture - Network layer – 6LowPAN, CoAP, Security

Building IoT with Raspberry Pi and Arduino: Building IOT with Raspberry PI, IoT Systems, Logical Design using Python, IoT Physical Devices & Endpoints, IoT Device, Building Blocks, Raspberry Pi, Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry Pi with Python, Other IoT Platforms, Arduino.

Case Studies and Real-World Applications: Real world design constraints, Applications, Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities, participatory sensing, Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs, Cloud for IoT, Amazon Web Services for IoT.

Books Recommended:

1.	Anthony T.Velte , Toby J. Velte Robert Elsenpeter	: **Cloud Computing a Practical Approach,** *TATA McGraw-Hill* **[Textbook]**

2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds) : **Architecting the Internet of Things**, *Springer* **[Textbook]**

3. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper : **Cloud Computing for Dummies,** *Wiley Publishing Inc.*

4. Rajkumar Buyya, James Broberg, Andrzej Gościński : **Cloud Computing (Principles and Paradigms),** *John Wiley & Sons, Inc.*

5.   Honbo Zhou : **The Internet of Things in the Cloud: A Middleware Perspective,** *CRC Press*

6. Olivier Hersent, David Boswarthick, Omar Elloumi : **The Internet of Things – Key Applications and Protocols,** *Wiley Publishing Inc.*

CSE 4210: Cloud Computing and IOT Lab

Credit: 1.0
Pre-requisite CSE 2102(Object Oriented Design and Design Patterns Lab), CSE 2208(Computer Networks Lab), CSE 4108(Microcontroller, Computer Peripherals and Interfacing Lab)

Course Content: Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows7 or 8. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs Install Google App Engine. Create hello world app and other simple web applications using python/java. Use GAE launcher to launch the web applications. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. Find a procedure to transfer the files from one   virtual machine to another virtual machine. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version) Install Hadoop single node cluster and run simple applications like wordcount Introduction to Arduino platform and programming Interfacing Arduino to Zigbee module Interfacing Arduino to GSM module, Interfacing Arduino to Bluetooth Module, Introduction   to Raspberry PI   platform and   python programming Interfacing sensors to Raspberry PI Communicate between Arduino and Raspberry PI using any

wireless medium, Setup a cloud platform to log the data Log Data using Raspberry PI and upload to the cloud platform Design an IOT based system

Books Recommended:

1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter	: **Cloud Computing a Practical Approach,** *TATA McGraw-Hill* **[Textbook]**
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds)	: **Architecting the Internet of Things**, *Springer* **[Textbook]**
3. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper	: **Cloud Computing for Dummies,** *Wiley Publishing Inc.*
4. Rajkumar Buyya, James Broberg, Andrzej Gościński	: **Cloud Computing (Principles and Paradigms),** *John Wiley & Sons, Inc.*
5. Honbo Zhou	: **The Internet of Things in the Cloud: A Middleware Perspective,** *CRC Press*
6. Olivier Hersent, David Boswarthick, Omar Elloumi	: **The Internet of Things – Key Applications and Protocols,** *Wiley Publishing Inc.*

CSE 4211: Machine Learning

Credit: 3.0
Pre-requisite CSE 4101 (Artificial Intelligence)

Course Content:
Fundamentals of Machine Learning: Definition and types of learning systems, Goals and applications of machine learning, Aspects of developing a learning system, Main steps in a typical machine learning project, Challenges of Machine Learning like Overfitting, Underfitting, Irrelevant Features etc.
Knowing Your Data: Different Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity; Machine Learning Terms: Feature, Train Data, Test Data, Validation Data, Response Variable, Labelled/ Unlabeled Data, partitioning a Dataset Depending on a Target Variable, Cross Validation Method, Optimizing a cost function

Handling and preparing Data: Data Cleaning, Data Reduction, Data Integration, How to Prepare Data for Machine Learning Algorithm, Reducing the dimensionality of the training data to fight the curse of dimensionality, dimensionality reduction algorithms, Selecting and engineering features, Selecting a model and tuning hyper parameters using cross-validation, facing the main challenges in machine learning-particularly underfitting and overfitting (the bias/variance tradeoff) , Learning by fitting a model to data, Ensemble learning.

Supervised ML: Basic Concepts of classification, Multiclass/Multilabel/Multioutput Classification, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Solving Real Life Problems using Supervised ML Algorithms like SVM, Decision Tree, Naïve Bayes, Linear Regression, Non-Linear Regression, Time-series Analysis.

Unsupervised ML: What is Cluster Analysis and What are the Requirements, Basic Overview of Clustering Methods like Partitioning/ Hierarchical/ Density-based/ Grid based Method; Solving Real Life Problems Using K-Means Clustering Algorithm and its challenges;

Performance Metrics of Supervised and Unsupervised ML Algorithms: R-Squared Value, Confusion Matrix, Accuracy, Precision, Recall, F1 measure, Specificity, ROC curve, Elbow Method

Introduction to Deep Learning: Neural nets and for what they are good for, The most important neural net architectures: feedforward neural nets, convolutional nets, recurrent nets, long short-term memory (LSTM) nets, and autoencoders, Techniques for training deep neural nets, Reinforcement learning

Books Recommended:

1.	Aurélien Géron	:	**Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools and Techniques to Build Intelligent Systems,** *O'REILLY* **[Textbook]**
2.	Noah Gift	:	**Pragmatic AI: An Introduction to Cloud-Based Machine Learning,** *Adison Wesley*
3.	Oliver Theobald	:	**Machine Learning for Absolute Beginners (2nd Edition)**
4.	Jiawei Han, Micheline Kamber, Jian Pei	:	**Data Mining Concepts and Techniques,** *Elsevier Publisher*

CSE 4212: Machine Learning Lab

Credit: 1.0
Pre-requisite CSE 4102 (Artificial Intelligence Lab)

Course Content: Implementing the methods of missing values ratio, low variance filter, high correlation filter, backward feature elimination, forward feature construction. Implementation of principle component analysis, linear discriminant analysis and generalized discriminant analysis. Implementation of different classification, regression and clustering types of machine learning algorithms. Determining the performance metrics for machine learning algorithms: R-Squared value for regression type algorithms; confusion matrix, accuracy, precision, recall, specificity, F1 measure, ROC curve for classification type algorithms; applying elbow method for clustering algorithms.

Books Recommended:

1. Aurélien Géron   : **Hands-On Machine Learning with Scikit-Learn and TensorFlow Concepts, Tools and Techniques to Build Intelligent Systems,** *O'REILLY* **[Textbook]**

2. Noah Gift   : **Pragmatic AI: An Introduction to Cloud-Based Machine Learning,** *Adison Wesley*

3. Oliver Theobald   : **Machine Learning for Absolute Beginners (2nd Edition)**

4. Jiawei Han, Micheline Kamber, Jian Pei   : **Data Mining Concepts and Techniques,** *Elsevier Publisher*