Hajee Mohammad Danesh Science and Technology University (HSTU)
Dinajpur-5200
Faculty of Computer Science and Engineering
Layout of Syllabus for 4 years B. Sc. (Engineering) in Computer Science and Engineering (B.Sc. (Engineering) in CSE)
(Effective from the semester Jan-Jun, 2017)

Summary of Credits per Semester

Level	Semester	Theory Credits	Sessional Credits	Total Credits
Level 1	Semester I	16.00	3.00	19.00
Level 1	Semester II	14.00	5.25	19.25
Level 2	Semester I	17.00	4.50	21.50
Level 2	Semester II	14.00	6.00	20.00
Level 3	Semester I	14.00	4.50	18.50
Level 3	Semester II	14.00	4.50	18.50
Level 4	Semester I	12.00	6.75	18.75
Level 4	Semester II	14.00	5.25	19.25
Total		**115**	**39.75**	**154.75**

Summary of Credits per Course Area

Level	Core Course (Credits)	Others Engineering	Basic Science	Humanities	Total Credits per Level
Level 1	CSE - 14.75	AIE - 4.50, EEE - 3.75	MAT – 6.00, PHY - 4.50,	SOC - 2.00 ENG – 2.75	38.25
Level 2	CSE - 26.00	EEE - 3.75, ECE - 3.75	MAT – 3.00, STT – 3.00	ACT – 2.00	41.50
Level 3	CSE - 32.00	ECE – 3.00	-	ECN – 2.00	37.00
Level 4	CSE - 35.00	-	-	MGT – 3.00	38.00
Total Credits	107.75	18.75	16.50	11.75	154.75

SUMMARY OF COURSES

Level 1 Semester I

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 101	Fundamentals of Computer and Computing	2.00	2.00
2	CSE 102	Fundamentals of Computer and Computing Sessional	0.75	1.50
3	CSE 103	Discrete Mathematics	3.00	3.00
4	MAT 101	Mathematics 1 (Calculus and Co-ordinate Geometry)	3.00	3.00
5	PHY 103	Physics (Electricity, Magnetism, Optics, Waves and Oscillations)	3.00	3.00
6	PHY 104	Physics (Electricity, Magnetism, Optics, Waves, and Oscillations) Sessional	1.50	3.00
7	AIE 105	Basic Mechanical Engineering	3.00	3.00
8	ENG 101	Communicative English	2.00	2.00
9	ENG 102	Communicative English Sessional	0.75	1.50
		Total	**19.00**	**22.00**

No. of Theory Courses: **6**
No. of Sessional Courses: **3**
Total Contact Hour: **22** (16+6)
Total Credit: **19.00**

Level 1 Semester II

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 151	Structured Programming Language	3.00	3.00
2	CSE 152	Structured Programming Language Sessional	1.50	3.00
3	CSE 153	Digital Logic Design	3.00	3.00
4	CSE 154	Digital Logic Design Sessional	1.50	3.00
5	EEE 155	Introduction to Electrical Engineering	3.00	3.00
6	EEE 156	Introduction to Electrical Engineering Sessional	0.75	1.50
7	AIE 106	Engineering Drawing and Auto CAD Sessional	1.50	3.00
8	MAT 105	Mathematics II (Matrix, Ordinary and Partial Differential Equations, and Series Solutions)	3.00	3.00
9	SOC 103	Society and Technology	2.00	2.00
		Total	**19.25**	**24.50**

No. of Theory Courses: **5**
No. of Sessional Courses: **4**
Total Contact Hour: **24.50** (14+10.50)
Total Credit: **19.25**

Level 2 Semester I

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 201	Object Oriented Programming	3.00	3.00
2	CSE 202	Object Oriented Programming (C++) Sessional	1.50	3.00
3	CSE 203	Data Structures	3.00	3.00
4	CSE 204	Data Structures Sessional	1.50	3.00
5	CSE 205	Numerical Methods	2.00	2.00
6	CSE 206	Numerical Methods Sessional	0.75	1.50
7	EEE 209	Electronic Devices and Circuits	3.00	3.00
8	EEE 210	Electronic Devices and Circuits Sessional	0.75	1.50
9	MAT 201	Mathematics III (Vector, Complex Variable, Fourier Analysis and Laplace Transformation)	3.00	3.00
10	STT 227	Statistics (Introduction to Statistics and Probability)	3.00	3.00
		Total	**21.50**	**26.00**

No. of Theory Courses: **6**
No. of Sessional Courses: **4**
Total Contact Hour: **26** (17+9)
Total Credit: **21.50**

Level 2 Semester II

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 254	Object Oriented Programming (Java) Sessional	1.50	3.00
2	CSE 255	Algorithms Analysis and Design	3.00	3.00
3	CSE 256	Algorithms Analysis and Design Sessional	1.50	3.00
4	CSE 257	Theory of Computation and Concrete Mathematics	3.00	3.00
5	CSE 258	Theory of Computation and Concrete Mathematics Sessional	0.75	1.50
6	CSE 259	Computer Architecture and Organization	3.00	3.00
7	ECE 259	Digital Electronics and Pulse Techniques	3.00	3.00
8	ECE 260	Digital Electronics and Pulse Techniques Sessional	0.75	1.50
9	ACT 205	Financial and Managerial Accounting	2.00	2.00
10	CSE 252	Application Development Sessional	1.50	3.00
		Total	**20.00**	**26.00**

No. of Theory Courses: **5**
No. of Sessional Courses: **5**
Total Contact Hour: **26** (14+12)
Total Credit: **20.00**

Level 3 Semester I

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 303	Database	3.00	3.00
2	CSE 304	Database Sessional	1.50	3.00
3	CSE 305	Software Engineering	3.00	3.00
4	CSE 307	Microprocessor and Interfacing	3.00	3.00
5	CSE 308	Microprocessor and Interfacing Sessional	1.50	3.00
6	ECE 311	Data Communication	3.00	3.00
7	ECN 305	Economics	2.00	2.00
8	CSE 302	Software Development Sessional	1.50	3.00
		Total	**18.50**	**23.00**

No. of Theory Courses: **5**
No. of Sessional Courses: **3**
Total Contact Hour: **23** (14+9)
Total Credit: **18.50**

Level 3 Semester II

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 353	Operating System	3.00	3.00
2	CSE 354	Operating System Sessional	0.75	1.50
3	CSE 355	Web Engineering	2.00	2.00
4	CSE 356	Web Engineering Sessional	0.75	1.50
5	CSE 357	Computer Networks	3.00	3.00
6	CSE 358	Computer Networks Sessional	0.75	1.50
7	CSE 359	Compiler Design	3.00	3.00
8	CSE 360	Compiler Design Sessional	0.75	1.50
9	CSE 361	Mathematical Analysis for Computer Science	3.00	3.00
10	CSE 352	Web and Mobile Application Development Sessional	1.50	3.00
		Total	**18.50**	**23.00**

No. of Theory Courses: **5**
No. of Sessional Courses: **5**
Total Contact Hour: **23** (14+9)
Total Credit: **18.50**

Level 4 Semester I

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 403	Artificial Intelligence	3.00	3.00
2	CSE 404	Artificial Intelligence Sessional	0.75	1.50
3	CSE 405	Computer Graphics and Image Processing	3.00	3.00
4	CSE 406	Computer Graphics and Image Processing Sessional	1.50	3.00
5	CSE 4**	Option I	3.00	3.00
6	CSE 4**	Option I Sessional	0.75	1.50
7	CSE 4**	Option II	3.00	3.00
8	CSE 4**	Option II Sessional	0.75	1.50
9	CSE 408	Technical Writing and Presentation Skill Development Sessional	1.50	3.00
10	CSE 402	Project and Thesis Sessional	1.50	3.00
		Total	**18.75**	**25.50**

No. of Theory Courses: **4**
No. of Sessional Courses: **6**
Total Contact Hour: **25.50** (12+12.50)
Total Credit: **18.75**

Level 4 Semester II

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	CSE 453	Multimedia System and Animation Techniques	3.00	3.00
2	CSE 454	Multimedia System and Animation Techniques Sessional	0.75	1.50
3	CSE 455	Computer Ethics and Cyber Law	2.00	2.00
4	MGT 405	Industrial Management	3.00	3.00
5	CSE 4**	Option III	3.00	3.00
6	CSE 4**	Option III Sessional	0.75	1.50
7	CSE 4**	Option IV	3.00	3.00
8	CSE 4**	Option IV Sessional	0.75	1.50
9	CSE 452	Project and Thesis Sessional	3.00	6.00
		Total	**19.25**	**24.50**

No. of Theory Courses: **5**
No. of Sessional Courses: **4**
Total Contact Hour: **24.50** (14+10.50)
Total Credit: **19.25**

Total Credits required for the Degree of B. Sc. (Engineering) in CSE is 154.75

Option I

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	**CSE 409**	Advanced Database Management System	3.00	3.00
2	**CSE 410**	Advanced Database Management System Sessional	0.75	1.50
3	**CSE 411**	Advanced Algorithm Design	3.00	3.00
4	**CSE 412**	Advanced Algorithm Design Sessional	0.75	1.50
5	**CSE 413**	Management Information System	3.00	3.00
6	**CSE 414**	Management Information System Sessional	0.75	1.50
7	**CSE 415**	Mobile and Wireless Communication	3.00	3.00
8	**CSE 416**	Mobile and Wireless Communication Sessional	0.75	1.50
9	**CSE 417**	Communication Engineering	3.00	3.00
10	**CSE 418**	Communication Engineering Sessional	0.75	1.50

Option II

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	**CSE 419**	System Analysis and Design	3.00	3.00
2	**CSE 420**	System Analysis and Design Sessional	0.75	1.50
3	**CSE 421**	Software Testing and Quality Assurance	3.00	3.00
4	**CSE 422**	Software Testing and Quality Assurance Sessional	0.75	1.50
5	**CSE 423**	Graph Theory	3.00	3.00
6	**CSE 424**	Graph Theory Sessional	0.75	1.50
7	**CSE 425**	Cryptography and Network Security	3.00	3.00
8	**CSE 426**	Cryptography and Network Security Sessional	0.75	1.50
9	**CSE 427**	Simulation and Modelling	3.00	3.00
10	**CSE 428**	Simulation and Modelling Sessional	0.75	1.50

Option III

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	**CSE 459**	Data Mining and Warehousing	3.00	3.00
2	**CSE 460**	Data Mining and Warehousing Sessional	0.75	1.50
3	**CSE 461**	Cloud Computing	3.00	3.00
4	**CSE 462**	Cloud Computing Sessional	0.75	1.50
5	**CSE 463**	VLSI Design	3.00	3.00
6	**CSE 464**	VLSI Design Sessional	0.75	1.50
7	**CSE 465**	Digital System Design	3.00	3.00
8	**CSE 466**	Digital System Design Sessional	0.75	1.50
9	**CSE 467**	Parallel and Distributed System	3.00	3.00
10	**CSE 468**	Parallel and Distributed System Sessional	0.75	1.50

Option IV

Serial No.	Course Code	Course Title	Credit	Hour(s) per week
1	**CSE 469**	Machine Learning and Pattern Recognition	3.00	3.00
2	**CSE 470**	Machine Learning and Pattern Recognition Sessional	0.75	1.50
3	**CSE 471**	Natural Language Processing	3.00	3.00
4	**CSE 472**	Natural Language Processing Sessional	0.75	1.50
5	**CSE 473**	Human and Computer Interaction	3.00	3.00
6	**CSE 474**	Human and Computer Interaction Sessional	0.75	1.50
7	**CSE 475**	Robotics	3.00	3.00
8	**CSE 476**	Robotics Sessional	0.75	1.50
9	**CSE 477**	Bioinformatics	3.00	3.00
10	**CSE 478**	Bioinformatics Sessional	0.75	1.50

Detailed Syllabus (B.Sc. (Engineering) in CSE)

(Effective from Jan-Jun, 2017)

Level 1 Semester I

CSE 101: Fundamentals of Computer and Computing

2.00 Credits, 2 Hours/Week

Introduction: History and revolution, Basic organization of computer, Types of computer, Number systems, Types of memory, Types of software, Operating system, Databases, Application packages. **Peripheral Devices:** Input device, Output device, Storage, Display, Bus. **Computer Networks:** Computer networks, WWW, Network card and accessories, Brief idea on network operating systems and popular NOS like- Windows NT, UNIX, Linux. **Application Packages:** Different application packages like Word processing, Spreadsheet analysis, Data base handling. **Number Systems:** Binary, Octal and Hexadecimal; Addition, Subtraction, Multiplication, Division. **Codes:** BCD, Excess three and Gray codes; Error detecting codes and Error correcting codes. **Programming Concept:** Problem analysis, Algorithm build-up, Flowcharts and Pseudo-coding, Data types, Expressions, Control flow.

CSE 102: Fundamentals of Computer and Computing Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 101.**

Books:

1. **Anita Goel**, *Computer Fundamentals*, Pearson, 2010.
2. **Timothy O'Leary**, **Linda O'Leary**, *Computing Essentials,* 2014 Complete Edition, McGraw-3 Hill/Irwi, 2013.
3. **K. L. James**, *Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance*, Prentice-Hall of India Pvt. Ltd, 2013.
4. **Peter Norton**, *Introduction to computers*, 6th edition, 2006.
5. **Michael Price**, *Computer Basics in Easy Steps*, In Easy Steps Limited, 2011.

CSE 103: Discrete Mathematics

3.00 Credits, 3 Hours/Week

Logics and Proofs: Propositional logic, Applications of propositional logic, Propositional equivalences, Predicates and Quantifiers, Nested quantifiers, Rules of inference, Introduction to proofs. **Set, Function, Sequence, Summation and Matrix:** Sets, Set operations, Functions, Sequences and summations, Zero–One matrices, Boolean product. **Number Theory:** Divisibility and modular arithmetic, Integer representations and Algorithms, Primes and Greatest Common Divisors (GCD), Modular exponentiation. **Induction:** Mathematical induction. **Counting:** The basics of counting, the pigeonhole principle, Permutations and Combinations, Binomial coefficients and identities, Generalized permutations and combinations. **Recursion:** Applications of recurrence relations. **Inclusion-Exclusion:** Inclusion–Exclusion. **Relations:** Relations, their properties, Representing relations. **Graphs:** Graphs and graph models, Graph terminology and special types of graph, Euler and Hamilton paths. **Trees:** Spanning trees, Rooted trees, Binary trees, Huffman trees, Tree traversing.

Books:

1. **Kenneth Rosen**, *Discrete Mathematics and Its Applications*, McGraw-Hill Science/Engineering/Math, 7th edition, 2011.
2. **Seymour Lipschutz**, Marc Lipson, *Schaum's Outline of Discrete Mathematics*, McGraw-Hill, 3rdedition, 2009.
3. **Gary Chartrand, Ping Zhang**, *Discrete Mathematics*, Waveland Pr Inc, 1stedition, 2011.
4. **David J. Hunter**, *Essentials of Discrete Mathematics*, Jones and Bartlett Learning, 2ndedition, 2010.
5. **Ronald L. Graham, Donald E. Knuth, Oren Patashnik**, *Concrete Mathematics: A Foundation for Computer Science*, Addison-Wesley Professional, 2ndedition, 1994.

MAT 101: Mathematics I (Calculus and Co-ordinate Geometry)

3.00 Credits, 3 Hours/Week

Integral Calculus: Definitions of integration, Integration by the method of substitutions, Integration by parts, Standard integrals, Integration by the method of successive reduction, Definite integrals and its properties and use in summing series, Walli's formula, Improper integrals, Beta function and Gamma function, Area under a plane curve in Cartesian and polar co-ordinates, Area of the region enclosed by two curves in Cartesian and polar co-ordinates, Trapezoidal rule, Simpson's rule. Arc lengths of curves in Cartesian and polar co-ordinates, parametric and pedal equations, Volume of solids of revolution, Area of surface of revolution. **Differential Calculus:** Limits, Continuity and Differentiability. Successive differentiation of various types of functions, Leibniz's theorem, Rolle's theorem, Mean value theorem in finite forms, Taylor's and Maclaurin's theorems in finite and infinite forms, Lagrange's form of remainders, Cauchy's form of remainder, Expansion of functions, Evaluation of indeterminate forms by L'Hospital's rule, Partial differentiation, Euler's theorem, Tangent and Normal, Subtangent and subnormal in Cartesian and polar co-ordinates, Maximum and minimum values of functions of single variable, Points of inflexion, Curvature, Radius of curvature, Center of curvature. **Co-ordinate Geometry:** Transformation of co-ordinates axes and its uses, Equation of conics and its reduction to standard forms, Pair of straight lines, Homogeneous equations of second degree, Angle between a pair of straight lines, Pair of lines joining the origin to the point of intersection of two given curves, circles, System of circles, Orthogonal circles, Radical axis, Radical center, Properties of radical axes, Coaxial circles and limiting points, Equations of parabola, Ellipse and hyperbola in Cartesian and polar co-ordinates, Chord of contact, Chord in terms of its middle points, Pole and polar parametric co-ordinates, Diameters, Conjugate diameters and their properties, Director circles and asymptotes.

Books:

1. **Howard Anton, Irl C. Bivens, Stephen Davis**, *Calculus*, Wiley, 10thedition, 2012.
2. **Michael Spivak**, Calculus, Publish or Perish, 4thedition, 2008.
3. **Daniel Kleppner, Norman Ramsey**, *Quick Calculus: A Self-Teaching Guide*, John Wiley and Sons, 2ndedition, 1985.
4. **Henry B. Fine**, *Coordinate Geometry*, Forgotten Books, 2012.
5. **Chandramouli Mahadevan**, *Coordinate Geometry*, Create Space Independent Publishing Platform, 2011.

PHY 103: Physics (Electricity, Magnetism, Optics, Waves and Oscillations)
3.00 Credits, 3 Hours/Week

Charge, Electric Field and Gauss's Law: Simple phenomena in electrostatics, Electrostatic induction and charge density, Coulomb's law, Electric field and field strength, Point charge in an electric field, Dipole in an electric field, Electric flux, Gauss's law and some applications, Electric potential, Potential due to a point charge, Equipotential surfaces, Potential energy, Potential gradient, Capacitance and its calculation, Parallel plate capacitor with dielectric, Dielectric and Gauss's law, Electric vectors, Energy stored in an electric field. **Electric Current, Simple Circuits and Electrical Measurements:** Current and Ohm's law,E.M.F. and potential difference, Kirchhoff's laws, Whetstone bridge, Single loop and multi loop circuits, Simple RC and RL circuits, Kirchhoff's laws, the potentiometer, Moving coil Galvanometer, Ammeter, Voltmeter, Multimeter, Wattmeter and Energy meter, Measurements of Voltage, Current, Resistance, Inductance, Capacitance, Power and Energy. **Magnetic Field and Force on Current:** Coulomb's law, Magnetic field and field strength, Magnetic force on current, Ampere's law, Directions of current and field, Maxwell's cork screw rule, Fleming's left hand rule, Magnetic field near long wire, Magnetic field for solenoid, Biot-savart law. Faraday's law of electromagnetic induction, Fleming's right hand rule, Lenz's law. **Magnetic Properties of Matter:** Poles and dipoles, Coulomb's law for magnets and Gauss's theorem of magnetism, Dia-magnetism, Para-magnetism and Ferro-magnetism, Magnetomotive force and field intensity, Concept of self and mutual inductance, Coefficient of magnetic coupling, Rise of current and decay of current in Inductive circuit, Energy in magnetic field, Inductance in series and parallel, Hysteresis and eddy current losses. **Optics:** Refraction and total internal reflection, Group velocity and Phase velocity of light, Dispersion, Interference, Holography, Fresnel and Fraunhofer diffraction, Polarization of lightwave. **Waves and Oscillations:** Differential equation of a simple harmonic oscillator, Total energy and average energy, Combination of simple harmonic oscillations, Lissajous figures, Spring mass system, Calculation of time period of torsional pendulum, Damped oscillation, Determination of damping co-efficient. Forced oscillation, Resonance, Two-body oscillations, Reduced mass, Differential equation of a progressive wave, Power and intensity of wave motion, Stationary wave, Group velocity and phase velocity, Architectural acoustics, Reverberation and Sabine's formula.

PHY 104: Physics (Electricity, Magnetism, Optics, Waves and Oscillations) Sessional
1.50 Credits, 3 Hours/Week

Laboratory works based on **PHY 103.**

Books:

1. **David Halliday, Robert Resnick**, *Physics Part-II*, Wiley Eastern Limited, 1992.
2. **Edward M. Purcell, David J. Morin**, *Electricity and Magnetism*, Cambridge University Press, 3rdedition, 2013.
3. **Grant R. Fowles**, *Introduction to Modern Optics*, Dover Publications, 2ndedition, 1989.
4. **D. N. Vasudeva**, *Fundamentals of Magnetism and Electricity*, S. Chand and Company Limited, 1998.
5. **Wayne M. Saslow**, *Electricity, Magnetism and Light*, Academic Press, 1stedition, 2002.
6. **David Halliday, Robert Resnick and Jearl Walker,** *Fundamentals of Physics Extended*, John Wiley and Sons Co.(USA), 10thedition, 2013.

AIE 105: Basic Mechanical Engineering

3.00 Credits, 3 Hours/Week

Thermodynamics: Zeroth, First and Second laws of Thermodynamics, Thermodynamics system and processes, Irreversibility and availability, Entropy, Sources of energy, Conventional and renewable, IC engines, Refrigeration and Air Conditioning systems, Kinematics and dynamics of particles and Rigid bodies, Forces in trusses and frames. **Heat-Transfer:** Modes of heat transfer, One dimensional heat conduction, Resistance concept and electrical analogy.

Books:

1. **Dowling, Norman E**. *Mechanical Behavior of Materials*. Pearson, 2012.
2. **R.K. Rajput**. *Thermal Engineering*. Laxmi Publications, 2010.
3. **Pravin Kumar.** *Basic Mechanical Engineering*. Pearson, 2010.

ENG 101: Communicative English

2.00 Credits, 2 Hours/Week

Reading: Skimming, Scanning, Interpretation, Reading short stories and Comprehension. **Writing:** Punctuation, Indenting, Abbreviation, Capitalization, Paragraph, Composition, Authorization letter, C.V writing. Notice, Memo, Tender, Précis, Report, Free composition, Creative writing. **Grammar:** Parts of speech, Phrase, Clause, Sentence, Right form of verb, Preposition, Correction, Joining, Changing. **Phonetics and Phonology:** Phonetics, Phonology, Vowel, Consonant, IPA transcription.

Books:

1. **Dr. Moniruzzaman,** *A Study of English Language*, Friend's Book Corner, 2006.
2. **Dr. JohirulHaque, MdAtaulHaque, S M Amanullah,** *Language*, Friend's Book Corner, 3rd edition, 1985.
3. **M. Swan**, *Practical English Usage*, Oxford University Press, 1980.
4. **G. Leech,** *A Communicative English Grammar*, Longman Publication, Singapore, 1975.
5. **F. Palmer,** *The English Verbs*, Routledge, London, UK, 2016.
6. **J.C. Nesfield,** *English Grammar Series*, Radha Publishing House, Calcutta, Revised Edition, 1997.
7. **Maurice Imhoof,** *From Paragraph to Essay*, Longman, 1975.

ENG 102: Communicative English Sessional

0.75 Credits, 1.5 Hours/Week

Listening: Pronunciation, Audio listening, Vowel measurement. **Speaking:** Social English practice, Verbal and non-verbal communication, Regular practice in the class. **Presentation:** Presentation skill.

Books:

1. **Ann Baker,** *Ship or Sheep?*, Cambridge University Press, 3rd edition, 2006.

2. **D. Jones,** *The Pronunciation of English*, Cambridge University Press, 4th Indian Reprint, 1991.
3. **SM Amanullah,** *A Guide to Correct Speech*, Friend's Book Corner, 2010.

Level 1 Semester II

CSE 151: Structured Programming Language

3.00 Credits, 3 Hours/Week

Introduction to Structured Programming Paradigm, Understanding the Components of a C program: Basic I/O, Data type, Conditional logic, Switch case, Character, ASCII value, Reading and writing character, Integer to character conversion. **Operators:** Arithmetic, Relational, Logical and Bitwise operators, Operator precedence and associativity, Arithmetic expression evaluation, Short cut operator. **Functions–I:** Basic functions, Void functions with no parameters. **Loops:** Looping basic, Necessity of loops, while loop, Loop condition, Body, Initialization, Increment, For Loops, Part of for loops, do while loop, Entry controlled loops, Exi tcontrolled loops, Examples, Formulating problems using loops. **Formatted I/O:** Specifying width using format specifier in printf and scanf in details. **Nested Loop:** Nesting of two loops, Example, Nesting of independent loops inside one, Example, Nesting of more than two loops. **Functions–II:** Functions with return type and trivial parameters, Local and global variables, Call by value, Library functions, Header files concept. **Arrays:** Basics of array, Necessity, Declaration, Accessing through indices, Accessing using loops, Initialization, Example, Two dimensional arrays, Declaration, Initialization, Accessing through loops, Example, Multidimensional arrays, Example. **Functions–III:** Passing arrays in a function as parameter, Call by reference, Recursion, Scope visibility and lifetime of variable. **Strings:** Basics, Difference between string and character array, I/O, Basic operations without using library functions, Array of strings. **String Library:** Basic string operations, Length, Compare, Concatenate, Substring, Reverse. **Structures:** Basics, Necessity, Declaration, Accessing, Initialization, Array of structures. **Pointers:** Basics, Uses, Pointer operation, Call by reference using pointers, Pointer for 1D/2D/3D array, Structure, Pointer expression, Array of pointers, Function returning pointers. **Dynamic Memory Allocation:** Basics, Uses, Malloc, Free, Calloc, Realloc. **File Operation:** Basics, Uses, File opening, Closing, File I/O, Use of redirect operator to write in file or read from file. **Preprocessors and Macros**.

CSE 152: Structured Programming Language Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 151.**

Books:

1. **Mike McGrath**, *C Programming in Easy Steps*, In Easy Steps Limited, 4th edition, 2012.
2. **Harry. H. Chaudhary**, *Absolute Beginner's Guide to C Programming: With 2000+ C Codes And 23+ Complete Chapter's*, Create Space Independent Publishing Platform, 2014.
3. **Stephen G. Kochan**, *Programming in C*, Addison-Wesley Professional, 4th edition, 2014.
4. **B. W. Kernighan** and **D. M. Ritchie**, *The C Programming Language*, 2nd Edition, Prentice Hall, 1988.
5. **Herbert Schildt**, *Teach Yourself C*, McGraw -Hill Osborne Media, 3rd edition, 1997.

CSE 153: Digital Logic Design

3.00 Credits, 3 Hours/Week

Overview: Introductory concepts, Number systems and codes, **Logic Circuits:** Gates, Boolean algebra, De Morgan's theorem, Half and full adders, Subtractor, Sum of products and product of sums, Mapping technique, Karnaugh map, Minimization of logic circuits. **Combinational Circuits:** Encoders and decoders, Comparators, Parity generator, Multiplexers, Demultiplexers. **Sequential Circuits:** State table, State diagram and State reduction, S-R, M/S, JK, D and T Flip-flops and Latches, Register, Asynchronous and synchronous counter, Counter applications, Memory, PAL, PLA. **Converters:** Analog to Digital (A/D) and Digital to Analog (D/A) conversion techniques.

CSE 154: Digital Logic Design Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 153.**

Books:

1. **Thomas L. Floyd**, *Digital Fundamentals*, PHI, 11th edition, 2014.
2. **Ronald J. Tocci**, **Neal Widmer**, **Greg Moss**, *Digital Systems: Principles and Applications*, Prentice Hall, 11th edition, 2010.
3. **William J. Dally**, **R. Curtis Harting**, *Digital Design: A Systems Approach*, Cambridge University Press, 2012.
4. **M. Morris Mano**, **Michael D. Ciletti**, *Digital Design: With an Introduction to the Verilog HDL, PHI*, 5th edition, 2012.
5. **Dr. Hafiz Faruque**, **Ahmed Sharif**, *Computer Hardware and Digital Electronics*, M. R. S. Sharif Publishing, 2007.

EEE 155: Introduction to Electrical Engineering

3.00 Credits, 3 Hours/Week

Resistor: Properties, Types of resistors, Ohm's Law, Power, Energy, Efficiency, etc. **Series DC Circuits:** Kirchhoff's voltage law, Voltage divider rule, Power distribution, Voltage regulation, Voltage sources in series, etc. **Parallel DC Circuits:** Conductance and resistance, Kirchhoff's current law, Current divider rule, Open circuit, Short circuit, Voltage sources in parallel, etc. **DC Series - Parallel Network:** Reduce and return approach, Block diagram approach, Ladder networks. **Methods of Analysis for DC Networks:** Current source, Source conversion, Current sources in series and parallel, Branch- Current analysis, Mesh analysis, Nodal analysis, Bridge network and Y-• and •-Y conversions. **Network Theorems (DC):** Superposition, Thevenin's, Norton's, Maximum power transfer, Milliman's, Substitution, Reciprocity, etc. **Capacitor:** Electric field, Capacitance, Dielectric strength, Leakage current, Types of capacitors, Charging and discharging phase, Energy stored by a capacitor, Capacitors in series and parallel. **Inductor:** Magnetic field, Inductance, Types of inductors, Faraday's law and Lenz's law, Inductors in series and parallel. R-L, R-C and R-L-C circuits with DC input. **Introduction to Sinusoidal Alternating Waveforms:** Definitions, General format for the sinusoidal voltage or current, Phase relations, Average and RMS values etc. Ordinary and frequency response of basic R, L and C elements, Average power and Power factor, Rectangular and Polar form, Phasors.

EEE 156: Introduction to Electrical Engineering Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **EEE 155.**

Books:

1. **R. L. Boylestad**, *Introductory Circuit Analysis*, Prentice Hall, 2010.
2. **R. M. Kerchner**, G**. F. Corcoran**, *Alternating Current Circuits*, Wiley Eastern Limited, 1994.
3. **K. C. A. Smith**, **R. E. Alley**, *Electrical Circuits: An Introduction*, Cambridge University Press, 1992.
4. **J. Nagarath**and **D. P. Kothari**, *Electric Machines*, Tata McGraw-Hill, 1999.
5. **F. Puschstein**, **T. C. Lloyd**, **A. G. Conrad**, *Alternating Current Machines*, Asia Publishing House, 1996.

AIE 106: Engineering Drawing and Auto CAD Sessional

1.50 Credits, 3 Hours/Week

Technical Lettering: One point, Projection of points and straight lines, Projection of simple solids, Cylinders, Cones, Parallelepiped and Pyramids in orthographic and isometric projections, **Perspective Projection:** Principles of perspective projection by orthographic method and Vanishing point.

MAT 105: Mathematics II (Matrix, Ordinary and Partial Differential Equations and Series Solutions)

3.00 Credits, 3 Hours/Week

Matrices: Definition of matrix, Different types of matrices, Algebra of matrices, Adjoint and inverse of a matrix, Elementary transformations of matrices, Matrix polynomials, Calay- Hamilton theory with uses of rank and nullity, Normal and canonical forms, Solution of linear equations, Eigenvalues and eigenvectors. **Ordinary Differential Equation (ODE):** Definition, Formation of ODE, Degree and order of ODE, Solution of first order and first degree ODE with various methods, Solution of first order and higher order homogeneous and Non-homogeneous differential equations with constant coefficients, Engineering applications. **Partial Differential Equations (PDE):** Four rules for solving simultaneous equations of the form, Lagrange's method of solving PDE of order one, Integral surfaces passing through a given curve, Nonlinear PDE of order one (complete, particular, singular and general integrals): standard forms f(p,q) = 0, z = px + qy + f(p,q), f(p,q,z) = 0, fÂ1(x,p) = f2(y, q),Charpit's method, Second order PDE, Homogeneous and Non-homogeneous linear equations with constant coefficients, Solution by separations of variables. **Series Solution:** Solution of differential equations in series by the method of Frobenius, Bessel,s functions, Legendre's polynomials and their properties.

Books:

1. **Hans Schneider, George Phillip Barker,** *Mathematics, Matrices and Linear Algebra*, Dover Publications, 2nd edition, 1989.

2. **Morris Tenenbaum, Harry Pollard**, *Ordinary Differential Equations*, Dover Publications, 1985.
3. **Peter Olver**, *Introduction to Partial Differential Equations*, Springer, 2014 edition.
4. **Dennis G. Zill, Warren S Wright**, *Differential Equations with Boundary-Value Problems*, Cengage Learning, 8th edition, 2012.
5. **Denis Serre**, *Matrices: Theory and Applications*, Springer Science and Business Media, 2012.

SOC 103: Society and Technology

2.00 Credits, 2 Hours/Week

Introduction: Sociology, Common sense and Science, Meaning of technology, Relationship among society, Science and technology, Human technology interaction, Technology and behaviour. **Social Complexities and Technological Change:** Elman's service's stage of social complexity, Relationship between social complexity and technological innovation, Population size and how they affect for diffusion of technologies. **Modern Technology and Contemporary Society (Bangladesh):**Innovation and diffusion of technology, The attributes of innovation and their rate of adaptation, Uses and impacts of technologies in various social aspects and changing society (creation of social inequality-mass media and stratification),Advancement of society (e-commerce, e-banking, e-governance), Industrialization, Hi-tech park and e-waste, Political activism on internet, Impacts of technology on workplace. **The Information Technological Revolution:** Technology, society and historical change, The historical sequence of the information technology revolution, The creation of the internet, The self in the information society, Technologies of the life,Types of society (pre-industrial, industrial and post-industrial).**Globalization, Technology and Social Change:** Global social change, Technology and the future (computer, technology, privacy and censorship in a global village),Medical, Biotechnology and Genetics technology, Technology and war (first and second world war and contemporary),Robotics in warfare or replacement of workforce, Advanced service, Information flows and globalcity. **Population, Environment and Technology:** Technology, Environmental problems and Sustainable development from sociological perspective. **The New Economy based on Technology:** Globalization of markets for goods and services, Informational production and Selective globalization of science and technology. **The Transformation of Work and Employment:** Network, Jobless and Flex-timers, The maturity of the informational society, Employment projection in the twenty-first century, The effects of information technology on employment, Towards a jobless society. **Communication Revolutions and Mass Media:** Cyber world and life, The self, Reality and virtual reality, Cybercrime (meaning, types, cause, effects, solution and respective laws).

Books:

1. **Manuel Castells,** *The rise of the network society: The information age: Economy, society and culture*, Vol. 1. John Wiley and Sons, 2011.
2. **Michael Adas,** *Machines as the measure of men: Science, technology and ideologies of Western dominance*, Cornell University Press, 1990.
3. **Wenda K. Bauchspies, Jennifer Croissant, Sal Restivo,** *Science, Technology and Society: A Sociological Approach*, Wiley-Blackwell, 2006.

Level 2 Semester I

CSE 201: Object Oriented Programming

3.00 Credits, 3 Hours/Week

Introduction: Object oriented programming overview. **Object Oriented Concepts:** Modeling problems using object oriented concepts, Introduction to UML; Encapsulation, Inheritance and Polymorphism; Object Oriented vs. Procedural programming, Basics of object oriented programming language. **Objects and Classes:** Concept of Class and object, Attributes and functions, Constructors and destructors, Functions or methods, Overloading methods, Access control, Special considerations in different languages. **I/O:** Stream and files. **Inheritance:** Inheriting classes, Subclass, Super class, Access control, Inheritance hierarchy, Overriding, Dynamic binding, Abstract class, Inner classes, Special considerations in different languages, Multiple inheritance, Interface. **Exception and exception handling:** Exception handling fundamentals, Exception types, Chained exception, Creating own exception subclasses. **Generics or Templates:** Generic class and data type; Special considerations in different languages. **Package/Namespace:** Understanding and implementing package/namespace. **Case Study using Object Oriented Programming.**

CSE 201: Object Oriented Programming Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 201.**

Books:

1. **Dimitrios Kalemis**, *The Fundamental Concepts of Object-OrientedProgramming*, Create Space Independent Publishing Platform, 1st edition, 2013.
2. **James Keogh**, **Mario Giannini**, *OOP Demystified*, McGraw-Hill Osborne Media, 1st edition, 2004.
3. **Matt Weisfeld**, *The Object-Oriented Thought Process*, Addison-Wesley Professional, 4th edition, 2013.
4. **Tony Gaddis**, **Judy Walters**, **Godfrey Muganda**, *Starting Out with C++: Early Objects*, Addison-Wesley, 8th edition, 2013.
5. **Tony Gaddis**, *Starting Out with Java: From Control Structures through Objects*, Addison-Wesley, 5th edition, 2012.

CSE 203: Data Structures

3.00 Credits, 3 Hours/Week

Introduction: Basic terminology of elementary data organization, Data structures, Data structures operations, Algorithms, Mathematical notation and functions, Algorithmic notation, Control structures, Complexity of algorithms, Asymptotic notations, Sub algorithms, Variables, Data types, etc. **Linear Data Structures:** Arrays, Records and Pointers, Linked lists, Stacks, Queues, Recursion. **Non-linear Data Structures:** Binary tree representation using array and pointers, Traversal of binary tree, Binary search tree (BST) representation, Basic operations on BST, Heap, Min-heap, Max-heap, Fibonacci-heap, Applications-priority queue, Heap sort, Segmented tree, General Tree implementation, Application of general tree-file system, AVL tree (rotation, insertion), Graph, Graph representation and Basic operations on graph. **Traversing a graph:** Breadth-first search (BFS), Depth-first search (DFS),Graph-coloring. **String Processing:** Basic terminology, Storing strings, Character data type, String operations, Word

processing, Pattern matching algorithms, etc. **Sorting and Searching:** Introduction, sorting, Insertion sort, Selection sort, Merging, Merge-sort, Radix sort, Searching and data modification, Hashing, etc. in detail. **Data Structure with C/C++/Java:** Implementing data structures and their operations with C, C++ using STL and Java.

CSE 204: Data Structures Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 203.**

Books:

1. **Seymour Lipchutz**, *Data Structures with C (Indian Adapted Edition)*, TataMcGraw-Hill Education Private Limited, 2011.
2. **Narasimha Karumanchi**, *Data Structures and Algorithms Made Easy: Data Structure and Algorithmic Puzzles*, CreateSpace Independent Publishing Platform, 2nd edition, 2011.
3. **Noel Kalicharan**, *Data Structures in C*, Create Space Independent Publishing Platform, 1st edition, 2008.
4. **Ford, Topp,** *Data Structures with C++ using STL*, 2nd edition, Prentice Hall, 2002.
5. **Ford, Topp,** *Data Structures with Java*, 1st edition, Prentice Hall, 2005.

CSE 205: Numerical Methods

2.00 Credits, 2 Hours/Week

Introduction: Numerical computing, Errors in computation, Stability and convergences. **Roots of Nonlinear Equations**: Bisection, False position and Newton-Raphson method. **Solution of Linear Equations:** Gaussian elimination, Gauss-Jordan method, Jacobi's method, Gauss-Seidal method. **Regression:** Linear and exponential. **Interpolation:** Lagrange and Newton polynomials. **Numerical Differentiation and Integration:** Differentiating Continuous functions, Tabulated functions, Difference tables, Richardson extrapolation, Mid-point method, Trapezoidal and Simpson's 1/3 and 3/8 rules. **Numerical Solution of Ordinary Differential Equation:** Euler's method, Taylor series, Picard, Runge-Kutta method. **Solution of Partial Differential Equations:** Determination of characteristics equation of a matrix using Fadeev-Leverrier method, Eigen value and Eigen vector and matrix inversion.

CSE 206: Numerical Methods Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 205.**

Books:

1. **E Balagurusamy**, *Numerical Method*, Tata McGraw-Hill,2000.
2. **Robert J**. **Schilling** and **Sandra L Harries**, *Applied Numerical Method for Engineers*, Thomson Books, 2002.
3. **Steven C. Chapra**and **Raymond P. Canale**, *Numerical Method for Engineers*, McGrawHill, 2002.
4. **Amos Gilat**, **Vish Subramaniam**, *Numerical Methods with MATLAB*, Wiley, 2nd edition, 2010.
5. **S. Balachandra Rao** and**C. K. Shantha**, *Numerical Methods*, 2000.
6. **S.S. Sastry**, *Introductory Methods of Numerical Analysis*, Fourth Edition, PHI Learning Pvt.

Ltd., 2012.

EEE 209: Electronic Devices and Circuits

3.00 Credits, 3 Hours/Week

Introduction to Semiconductors: Properties, bonds and types of semiconductors. **Semiconductor Diodes and Special Purpose Diodes:** The PN junction diode: Formation, properties and V-I characteristics, Basic constructions, Characteristics, operations and uses of special diodes: Light-emitting diode (LED), Zener diode etc. **Diode Application:** Half-wave and full-wave rectifiers– operation and efficiency, Ripple factor, Filter circuits – Capacitor input filter, LC filter and Π-filter, Clipping and Clamping circuits, Voltage regulation and regulator circuits - Zener diode and Transistor voltage regulator. **Bipolar Junction Transistors:** NPN and PNP transistors, Amplifying and switching actions of transistor, Transistor characteristics in CB, CE, CC configurations, Transistor load line and Operating point. **BJT Biasing:** Faithful amplification, Inherent variation of transistor parameters and Thermal runway, Stabilization and stability factor, Methods of BJT biasing, Analysis and design of biasing circuits. **Single Stage Transistor Amplifier:** Single stage amplifier circuit, Phase reversal, DC and AC equivalent circuits, Load line analysis, Voltage gain and Power gain, Classification of amplifiers, Amplifier equivalent circuits. **Field Effect Transistors:** Classification of FET, Construction, Operation and characteristics of JFET and MOSFET, Transfer characteristics and Shockley's equation, DC biasing of JFET. **Power Electronics:** Operations, Characteristics and applications of industrial electronics devices: SCR (Silicon Controlled Rectifier), TRIAC, DIAC etc. **Feedback Techniques and Op-Amps:** Concepts-negative and positive feedback, Characteristics and Gain with negative voltage and current feedback**,** Emitter follower, Basic Op-Amps- Characteristics, inverting, non-inverting, integrators, differentiators, summing amplifiers. **Oscillators:** Theory of oscillation and characteristics of different oscillators. **Introduction to IC fabrication.**

EEE 210: Electronic Devices and Circuits Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **EEE 209.**

Books:

1. **R. L. Boylestad**, **L. Nashelsky**, *Electronic Devices and Circuit Theory*, PHI, 1999.
2. **S. Sedra**, **K. C. Smith**, *Microelectronic Circuits*, Oxford University Press, 2005.
3. **R. K. Mozumder**, *Principles of Electronic Circuits*, Systech Publications, 2006.
4. **David A. Bell**, *Fundamentals of Electronic Devices and Circuits*, Oxford University Press, 5th edition, 2009.
5. **D. L. Schilling** and **C. Belove**, Electronic Circuits, McGraw-Hill Book Company, 1989.

MAT 201: Mathematics III (Vector, Complex Variable, Fourier Analysis and Laplace Transformation)

3.00 Credits, 3 Hours/Week

Vector: Vector and scalar quantity, Linearly dependent and independent vector differentiation, Gradient, Divergence and Curl; Vector integration, Line integrals, Surface integrals, Volume integrals, The divergence theorem of Gauss, Stoke's theorem, Green's theorem in the plane, Related integral theorem, General Coordinates. **Complex Variable:** Complex number system, General functions of a complex variable, Limits and continuity of a function of complex variable and related theorems, Complex differentiation and the Cauchy-Riemann Equations, Cauchy's Integral Theorem, Cauchy's Integral Formula, Liouville's Theorem, Taylor's Theorem and Laurent's Theorem. Singular points, Residue, Cauchy's Residue Theorem, Evaluation of residues. **Fourier Analysis:** Real and complex form of

Fourier series, Finite transform, Fourier Integral, Fourier transforms and their uses in solving boundary value problems of wave equations. **Laplace Transforms:** Definition of Laplace transform and inverse Laplace transform, Property of Laplace transform, Laplace transform of Derivatives and Integrals, Unit-step function, Dirac-Delta function, Periodic function, Some special theorems on Laplace transforms, Solutions of D.E and evaluation of improper integral use Laplace transform.

Books:

1. **George E. Hay**, *Vector and Tensor Analysis*, Dover Publications,2012.
2. **Murray Spiegel, Seymour Lipschutz, John Schiller, Dennis Spellman**, *Schaum's Outline of Complex Variables*, McGraw-Hill, 2nd edition, 2009.
3. **Gerald B. Folland**, *Fourier Analysis and Its Applications*, American Mathematical Society, 2009.
4. **Phil Dyke,** *An Introduction to Laplace Transforms and Fourier Series*, Springer, 2nd edition, 2014.
5. **Wilbur R. LePage**, *Complex Variables and Laplace Transform for Engineers*, Dover Publications, 2010.

STT 227: Statistics (Introduction to Statistics and Probability)

3.00 Credits, 3 Hours/Week

Statistics: Introduction, uses and scope of statistics, Variable, Types and sources of data. **Presentation of Data:** Construction of frequency distribution table, Different graphs and diagrams, stem and leaf plot, Box and Whisker plot. **Characteristics of Data:** Different measures of central tendencies, Different measures of dispersions, Moments, Skewness and kurtosis, Trimmed mean,Robust measure. **Bivariate Data Analysis:** Definition and types of correlation, Calculation of correlation coefficient, Rank correlation, Definition of regression analysis and regression line, Simple and multiple regression analysis. **Probability Theory:** Concept of probability, Definition of probability by different approaches, Additive and multiplicative rules, Conditional probability, Bayes theorem. **Probability Distribution:** Distribution function, Expectation, Moment generating function, Cumulant generating function. **Discrete Probability Distributions:** Bernoulli, Binomial, Poisson, Geometric, Hypergeometric distributions. **Continuous Probability Distributions:** Normal, Uniform, Exponential, Gamma, Beta distributions. **Limit Theorems:** Markov's and Chebyshev's inequality, Central limit theorem, Laws of large numbers.

Books:

1. **N. Weiss,** *Introduction to statistics,* 7th edition. Addison Wesley, 2007.
2. **M.N. Islam,** *An Introduction to Statistics and Probability*, 4th edition, Mullick and Brothers, Dhaka, 2011.
3. **R.G.D. Steel, J.H. Torrie** and **D.A. Dickey,** *Principles and Procedures of statistics*, 3rd edition, WCB McGraw-Hill, Boston, 1997.
4. **M. G. Kendall, A. Stuart,** *An Introduction to the Theory of Statistics*, Vol. I, Oxford University Press, London, 1986.
5. **P. Newbold, W.L. Carlson** and **B. Thome,** *Statistics for Business and Economics*, 5th edition, Prentice-Hall, Inc, 2003.
6. **D. R. Mason, A. D. Lind,** *Statistical Techniques in Business and Economics*, 9th edition, Irwin, 1996.
7. **R. L Anderson, T. A. Bencroft,** *Statistical Theory in Research*, McGraw-Hill, New York, 1977.

Level 2 Semester II

CSE 254: Object Oriented Programming (Java) Sessional

1.50 Credits, 3 Hours/Week

Introduction to Java programming, Object-Oriented programming, Dynamic memory allocation, Inheritance, Interface and Polymorphism, Exception handing, Files, Thread programming, Client-Server programming, GUI, Understanding Java enterprise level works using IDE.

CSE 255: Algorithms Analysis and Design

3.00 Credits, 3 Hours/Week

Introduction: Introduction to Algorithms, Role of algorithms in computing with respect to state of the art researches. **Complexity Analysis and Recurrence Relation:** Asymptotic notations, Growth of a function, Methods to solve recurrence relation- Substitution method, Recursion tree method, Master method. **Divide-and-Conquer:** Binary search, Powering a number, Fibonacci numbers, Matrix multiplication, Strassen's algorithm for matrix multiplication. **Sorting:** Insertion sort, Merge sort, Quick sort, Randomized quick sort, Decision tree, Counting sort, Radix sort. **Order Statistics:** Randomized divide and conquer; Worst case linear time order statistics. **Graph:** Representation, Traversing a graph, Topological sorting, Connected components. **Dynamic Programming:** Elements of DP: Optimal substructure, Overlapping sub problem; Longest Common Subsequence finding problem, Matrix Chain Multiplication. **Greedy Method:** Greedy choice property, Elements of greedy strategy, Activity selector problem, Minimum spanning tree: Prims algorithm, Kruskal algorithm; Huffman coding. **Shortest Path Algorithms:** Dynamic and greedy properties, Dijkstra's algorithm with its correctness and analysis, Bellman-ford algorithm, All pair shortest path: Warshall's algorithm, Johnson's algorithm. **Network Flow:** Maximum flow, Max-flow-min-cut,Bipartite matching. **Backtracking/Branch-and-Bound:** Permutation, Combination, 8-queen problem and 15-puzzle problem. **Geometric Algorithm:** Segment-segment intersection, Convex-hull, Closest pair problem. And NP Completeness, NP hard and NP complete problems.

CSE 256: Algorithms Analysis and Design Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 255.**

Books:

1. **T.H. Cormen**, **C.E. Leiserson**, **R.L. Rivest** and **C. Stein**, *Introduction to Algorithms*, 2nd edition, McGraw-Hill, New York, 2001.
2. **Leendert Ammeraal**, *Algorithms and Data Structures in C++*, Wiley.
3. **Udi Manber**, *Introduction to Algorithms: A Creative App roach (Hardcover)*, Addison-Wesley (January 1, 1989).
4. **M.R. Garey**and **D.S. Johnson**, *Computers and Intractability: A Guide to the Theory of NP Completeness*, W.H. Freeman, San Francisco, CA, 1979.
5. **Anany V. Levitin**, *Introduction to the Design and Analysis of Algorithms (Paperback)*, Addison Wesley, 1st edition (October 30,2002).
6. **Sahni Horowitz**, *Fundamentals of Computer Algorithms*, Universitiespress.

CSE 257: Theory of Computation and Concrete Mathematics

3.00 Credits, 3 Hours/Week

Introduction: Basic concepts, Automata theory, Computability theory, etc, Mathematical notions and terminology: Sets, Sequences and Tuples, Functions and Relations, Graphs, Strings and languages, Boolean logic, etc, **Proofs:** Concepts of definition, Theorem and proofs, Finding proofs, Types of proofs: Proof by construction, Proof by contradiction and Proof by induction. **Automata and Languages:** Regular languages, Finite automata, Nondeterminism, Regular expressions, Non-regular languages, etc, Context-free languages: Context-free grammars, Pushdown automata, Non-context-free languages, etc. **Computability Theory:** The Church-Turing thesis, Turing machines, Variants of Turing machines, The definition of algorithm- Hilbert's problems, etc; Decidability: Decidable languages, The Halting problem, etc; Reducibility: Undecidable problems from language theory, Post correspondence problem (PCP), Mapping reducibility, etc; Advanced topics in computability theory: The recursion theorem, Decidability of logical theories, Turing reducibility, A definition of information, etc.
Complexity Theory: Time complexity: Measuring complexity, The class P, The class NP, NP-completeness, Additional NP-complete problems, etc; Space complexity: Savitch's theorem, the class PSPACE, PSPACE-completeness, The classes L and NL, NL-completeness, NL equals coNL, etc; Intractability: Hierarchy theorems, Relativization, Circuit complexity, etc; Advanced topics in complexity theory: Approximation algorithms, Probabilistic algorithms, Alternation, Interactive proof systems, Parallel computation, Cryptography, etc. **Concrete Mathematics:** Recurrence, Sums, Number Theory, Generating functions, Discrete probability, Asymptotics.

CSE 258: Theory of Computation and Concrete Mathematics Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 257.**

Books:

1. **Michael Sipser**, *Introduction to the Theory of Computation*, Cengage Learning, 3rd edition, 2012.
2. **J. Glenn Brookshear**, *Theory of Computation: Formal Languages,Automata,and Complexity*, Prentice Hall, 1st edition, 1989.
3. **Peter Linz**, *An Introduction to Formal Languages and Automata*, 4th edition, Jones and Bartlett Publishers, Inc., 2006.
4. **Martin Davis**, **Ron Sigal**, **Elaine J. Weyuker**, *Computability, Complexity and Languages: Fundamentals of Theoretical Computer Scienc*e, Morgan Kaufmann, 2nd edition, 1994.
5. **Harry R. Lewis** and **Christos H. Papadimitriou**, *Elements of The Theory of Computation*, 2nd edition, Pearson Education, 1998.
6. **Ronald L. Graham**, **Donald E. Knuth**, **Oren Patashnik**, *Concrete Mathematics: A Foundation for Computer Science*, Addison-Wesley Professional, 2nd edition, 1994.

CSE 259: Computer Architecture and Organization

3.00 Credits, 3 Hours/Week

Micro-computer Organization and Its Basic Components: Carry look ahead adders, Carry save adder, Multipliers (e.g. Booth's algorithm), Divider, Fixed and Floating point (IEEE754) number representations, Finite State Machine (FSM) representation. **Basic Accumulator based CPU**: Organization, Instruction set, Programming considerations, RISC and CISC Processors- Instruction Sets, Addressing modes. **Introduction to the Basic MIPS:** Instruction set. **Fixed Point ALUs:** Combinational and sequential ALUs, ALU expansion. **Floating Point Arithmetic Circuits**: Pipelined processing, Systolic arrays, Resolving structural, Data, Control and Name hazards, Analyzing processor performance, Memory mapping (e.g. RAM, cache), Non-blocking cache memories, Memory protection, Translation and Virtualization, Synchronization, Consistency and Coherence, Direct-mapped and

Associative caches, Write-through and write-back caches, Pipelined caches,Analyzing memory performance. **Processor Architecture**: Superscalar execution, Out-of-order execution, Register renaming, Memory disambiguation, Branch prediction, Speculative execution, Multithreaded, VLIW and SIMD processors. **Hardwired and Microprogrammed Control Design.** Buses, Bus arbitration, I/O control, Interrupts and Direct Memory Access (DMA), Virtual memory mapping and Addressing.

Books:

1. **DavidA. Patterson**, **JohnL. Hennessy**, *Computer Organization andDesign:The Hardware/Software Interface*, Morgan Kaufmann, 5th edition, 2013.
2. **John L. Hennessy**, **David A. Patterson**, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann, 5th edition, 2011.
3. **William Stallings**, *Computer Organization and Architecture*, Prentice Hall, 9th edition, 2012.
4. **Douglas E. Comer**, *Essentials of Computer Architecture*, Addison-Wesley, 1st edition, 2004.
5. **John P. Hayes**, *Computer Architecture*, McGraw-Hill International Educations, 1998.
6. **V. Carl Hamacher, Safwat G. Zaky**, **Zvonko G. Vranesic**, *Computer Organization*, McGraw-Hill Publication.

ECE 259: Digital Electronics and Pulse Techniques

3.00 Credits, 3 Hours/Week

Digital Electronics: Diode logic gates, Transistor switches, Transistor gates, MOS gates; Logic Families: TTL, ECL, IIL and CMOS logic with operation details, Propagation delay, product and Noise immunity, Open collector and High impedance gates, Electronic circuits for flip-flops, Counters and Register, Memory systems, PLAs, A/D and D/A converters with applications, S/H circuits, LED, LCD and Optically coupled oscillators, Non-linear applications of OP AMPs and Analog switches. **Pulse Techniques:** Linear wave shaping: Diode wave shaping techniques, Clipping and clamping circuits, Comparator circuits, Switching circuits, Pulse transformers, Pulse transmission, Pulse generation, Monostable, Bistable and Astable multivibrators, Schmitt trigger, Blocking oscillators and Time-base circuit, Timing circuits, Simple voltage sweeps, Linear currentsweeps.

ECE 260: Digital Electronics and Pulse Techniques Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **ECE 259.**

Books:

1. **Jacob Millman and Herbert Taub,** *Pulse, Digital and Switching Electronics*, McGraw-Hill, 2012 edition.
2. **Robert F. Coughlin and Frederick F. Driscoll,** *Operational amplifiers and linear integrated circuits*. Prentice-Hall, Inc., 3rd edition.
3. **Ronald J Tocci,** *Digital Systems: principles and applications*. Pearson Education India, 4th edition, 1980.
4. **M. Morris Mano,** *Digital Logic and Computer Design*, Prentice Hall of India, 1987.
5. **Samuel C. Lee,** *Digital circuits and logic design*, Prentice Hall of India, 1976.
6. **V. K. Jain,** *An Introduction to Switching Theory and Digital Electronics*. Khanna Publishers, 1983.
7. **Stephen D. Brown,** *Fundamentals of digital logic with Verilog design*. Tata McGraw-Hill Education, 2007.

ACT 205: Financial and Managerial Accounting

2.00 Credits, 2 Hours/Week

Financial Accounting: Basic Accounting concepts, Accounting as an Information System, Computerized accounting system, Conceptual framework of accounting, Double entry mechanism, Accounting equation, Introduction to Journal Accounting, Posting to ledger accounts, Preparing trial balance, Adjusting entries, Preparing an adjusted trial balance, Preparing financial statements. **Cost and Management Accounting:** Cost concepts, Cost classifications and Cost functions, Job order costing, Preparing job cost sheet, Cost allocation, Cost volume profit analysis, Variable costing Vs. absorption costing, Short term investment **Decision:** Relevant and Differential costanalysis.

Books:

1. **Jerry J. Weygandt, Donald E. Kiesoand Paul D. Kimmel,** *Accounting Principles*, John Wiley and Sons, 11th edition, 2013.
2. **Ray Garrison, Eric Noreen and Peter Brewer,** *Managerial Accounting*, McGraw-Hill / Irwin, 14th edition, 2011.

CSE 252: Application Development Sessional

1.50 Credits, 3 Hours/Week

In this sessional course, students will carry out a project work that is based on C language or Object Oriented Programming (OOP) approach such as C++ or Java. Any project that includes the implementation of data structure and uses standard algorithms (e.g. gaming project using graphics.h library) is preferable. Also, innovative project ideas that require different types scripting/programming languages or programming tools can be accepted with respect to the consent of the Chairman of the Department and/or supervisor. Every project should maintain a goal so that it can be used as a useful tool in the IT fields. Teachers must have to ensure every project is unique. Innovative project idea should get extra weight to prevent imitating old projects.

Level 3 Semester I

CSE 303: Database

3.00 Credits, 3 Hours/Week

Introduction: Database system concept, Purpose of database system, View of data, Data models, Conventional file processing, Transaction management, Storage management, Database administrator. **Database Model:** Entity-relationship model, Relational model, Network model, Hierarchical model. **Database Design:** Functional dependencies and normal forms, Object-oriented databases, Distributed database, Multimedia database, Object- relational database, Intelligent database. **Database languages:** SQL, Relational algebra, Integrity constraint, PL/SQL, Some applications of SQL and PL/SQL. **File System Structure:** File organization and retrieval, File indexing, Hashing. **Database Components:** Data dictionary, Security, Transaction, Recovery, Concurrency control.

CSE 304: Database Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 303.**

Books:

1. **A. Silberschatz**, **Henry F. Korth**, **S. Sudarshan**, *Database System Concepts*, McGraw-Hill, 2010.
2. **NenadJukic**, **Susan Vrbsky**, **SvetlozarNestorov**, *Database Systems: Introduction to Databases and Data Warehouses*, Prentice Hall, 1st edition, 2013.
3. **Ignatius Fernandez**, *Beginning Oracle Database 12c: From Novice to Professional*, Apress, 2nd edition, 2015.
4. **Ben Forta**, *MySQL Crash Course*, Sams Publishing, 2005.
5. **David Kroenke, David J. Auer**, *Database Processing: Fundamentals, Design and Implementation*, Prentice Hall, 13th edition, 2013.

CSE 305: Software Engineering

3.00 Credits, 3 Hours/Week

Concepts of Software Engineering: Software (S/W) Engineering paradigms, Different phases of software system development, Different types of information, Qualities of information. **Project Management Concepts:** S/W process and project metrics, S/W project planning, Risk analysis and management, Project scheduling and tracking. **Analysis Concepts and Principles:** Requirement analysis, Analysis modeling, Data modeling. **Design Concepts and Principles:** Architectural design and User interface (UI) design. **Object Oriented Software Design and Development:** Iterative development and the Unified process. Sequential waterfall life cyle, Inception, Use case (UC) model for requirement writing, Elaboration using system Sequence diagram (SD), Domain model, Visualizing concept classes, UML diagrams, Interaction and collaboration diagram for designing software, Designing objects with responsibilities, GRASP patterns with general principles in assigning responsibilities, Information expert, Creator, Low coupling and High cohesion, Creating design class diagrams and mapping design to codes. **Advanced GRASP Patterns:** Polymorphism, Pure fabrication, Indirection, Project variation. **GoF Design Patterns:** Adapter, Factory, Singleton, Strategy, Composite, Façade and Observer. **S/W Testing:** White box and Black box testing, Basis Path Testing, Testing for specialized environment. **S/W Testing Strategies:** Unit testing, Integration testing, Validation testing, Regression testing, System testing and Art of debugging. **Analysis of System Maintenance and Upgrading:** Software repair, Downtime, Error and faults, Specification and correction, Maintenance cost models, Documentation. **S/W Quality Assurance:** Quality factors, S/W quality measures, Cost impact of S/W defects, Concepts of S/W reliability, Availability and safety, Function based metrics and bang metrics, Metrics for analysis and design model. Metrics for source code, testing and maintenance.

Books:

1. **Ian Sommerville**, *Software Engineering*, Addison-Wesley, 9th edition, 2010.
2. **Roger S. Pressman**, *Software Engineering*, McGraw-Hill International Edition, 2001.
3. **David Alex Lamb**, *Software Engineering*, Prentice-Hall International Editions, 1998.
4. **David Kung**, *Object-Oriented Software Engineering: An Agile Unified Methodology*, McGraw-Hill Science/Engineering/Math, 1st edition, 2013.
5. **Capers Jones**, *Software Engineering Best Practices: Lessons from Successful Projects in the Top Companies*, McGraw-Hill Osborne Media, 1st edition, 2009.

CSE 307: Microprocessor and Interfacing

3.00 Credits, 3 Hours/Week

Microprocessors: Concept of microprocessor, Evolution of microprocessors. Internal architecture of Intel 8085, 8086/8088 microprocessors: Instruction set and format. Programming in machine and assembly languages, Interrupt structure, DMA, I/O operation, Microprocessor based system design, Coprocessor, Multiprocessor system, Intel 80286, 80386 microprocessors: Memory management scheme, Protection mechanism, 80386 modes. **Next Generation Microprocessors**: Intel core architecture, Intel processors: Dual core, Core 2 duo, Core 2 quad, Core i3, Core i5, Core i7, Mobile microprocessors, ARM, Helio, Atometc. **Microcontrollers:** Microcontroller and embedded systems, 8051 microcontroller architecture, operation and instruction set.

Interfacing: Introduction to I/O organization of a typical computer, Computer peripheral interfacing input and output devices (Stepper Motor, Transducers, motors etc.). Microcomputer ports: Serial, Parallel, Mouse, etc. Bus System: ISA, EISA, PCI AGP, Memory Bus. Centronics, SCSI, USB and GPIB standards, Wireless interfacing and Optical computing devices.

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CSE 308: Microprocessor and Interfacing Sessional

1.50 Credits, 3 Hours/Week

Laboratory works based on **CSE 307.**

Books:

1. **Mohamed Rafiquzzaman**, *Microprocessors and Microcomputer-Based System Design*, 1995.
2. **Douglas V. Hall**, *Microprocessors and Interfacing: Programming and Hardware*, 1994.
3. **Ramesh S. Gaonkar**, *Microprocessor Architecture Programming and Applications with the 8085/8080A*, 1995.
4. **F. F Driscoll, R. F. Couglin** and **R. S**. **Villanucci,** *Data Acquisition and Process Control with the M68HCII Micro controller*, McMillan, 1994.
5. **Muhammad A. Mazidi, Janice Gillispie Mazidi,** *80X86 IBM PC and Compatible Computers: Assembly Language, Design and Interfacing*, Vols.1 and 2, 4th edition, Prentice Hall, 2002.
6. **Jyoti Snehi**, *Computer Peripherals and Interfacing*, Laxmi Publications, 2006.
7. **K. M. Bhurchandi, A. K. Ray**, *Advanced Microprocessors and Peripherals: With ARM and an Introduction to Microcontrollers and Interfacing*, Tata McGraw Hill Education Private Limited, 3rd edition, 2012.
8. **K. L. James**, *Computer Hardware: Installation, Interfacing, Troubleshooting and Maintenance*, Prentice-Hall of India Pvt. Ltd, 2013.

ECE 311: Data Communication

3.00 Credits, 3 Hours/Week

Introduction: Basic concept of information, Overview on data communication, Entropy, Information rate, Channel and channel capacity, Transmission modes, Transmission impairments, Guided and unguided media, Fiber optics communication, Satellite communications: frequency bands and characteristics. **Data Encoding and Multiplexing:** Sampling principal, Nyquist sampling rate, PAM, PWM, PPM, PCM, DPCM, Delta modulation, A-law and μ-law commanding, ASK, FSK, PSK and QPSK, NRZ, Bipolar AMI, Manchester, QAM, B8ZS, HDB3 coding, Constellation, Bit error rate (BER), Concepts of multiplexing, FDM, TDM. **Data Link Control:** Flow control, Error detection, Error control, HDLC, Other data link control protocols. **Circuit Switching and Packet Switching:** Switching network, Circuit switching network, Circuit switching concepts, Routing in CS, Control signaling, Packet switching principles, Routing in PS, X.25. **ATM and Frame Relay:** Protocol architecture, ATM logical connection, ATM cells, Transmission of ATM cells, ATM service categories, ATM adaptation Layer, Frame Relay. **ISDN:** Overview, ISDN channels, ISDN protocols, Broadb and ISDN.

Books:

1. **Behrouz Forouzan**, *Data Communications and Networking*, McGraw–Hill Science/Engineering/Math, 5th edition, 2012.
2. **William Stallings**, *Data and Computer Communications*, Prentice Hall, 10th edition, 2013.
3. **Fred Halsall**, *Data Communications*, Computer Networks and Open Systems, Pearson Education, 2005.
4. **S. Haykin**, *Communication Systems*, LPE, 2006.
5. **Prakas C. Gupta**, *Data Communications*, Prentice Hall of India, 1998.

ECN 305: Economics

2.00 Credits, 2 Hours/Week

Introduction: Definition and scope of economics, basic concepts and tools used in economics, Economic problem– Scarcity and choice, Opportunity cost, Factors of production, Microeconomics vs. macroeconomics, Production possibility frontier. **Demand and Supply:** Concepts of demand and supply, Laws of demand and supply, Shifting demand and supply curves, Market equilibrium, Price ceiling and price floor, Elasticity of demand and supply. **Theory of Consumer Behavior:** Utility analysis of demand, Law of diminishing marginal utility, Cardinal vs. ordinal utility, Indifference curve analysis, Properties of indifference curves, Budget constraints, Consumer's equilibrium. **Market:** Structure of markets, Characteristics of different types of markets, Perfect competition, Monopoly, Oligopoly. **National Income:** Introduction to macroeconomics, GNP-concept and measurement, GNP and NI, NI and personal disposable income, GNP and spending, Nominal and real GNP, Comparing income levels in different countries, Growth, Productivity, Fiscal Policy, Monetary Policy. **Inflation and Unemployment:** Definitions, measures of inflation, Types of inflation, Unemployment– Definitions and types, inflation-unemployment trade off.

Books:

1. **R. A. Arnold,** *Economics*, South Western Publishing Company, 8th edition, 2007.
2. **A. Koutsoyiannis,** *Modern Microeconomics*, Palgrave Macmillan, 2nd revised edition, 2003.
3. **N. G. Mankiw,** *Principles of Economics*, Thomson South Western Publishing, 4th edition, 2006.
4. **P. A. Samuelson and W D Nordhaus,** *Economics*, McGraw-Hill USA, 18th edition, 2005
5. **J. E. Stiglitz** and **C. E. Walsh,** *Principles of Microeconomics*, W, W Norton and Co Inc. USA, 2005.
6. **Dornbusch, Rudiger et al,** *Macroeconomics*, McGraw-Hill International, 9th edition, 2004.

CSE 302: Software Development Sessional

1.50 Credits, 3 Hours/Week

The goal of this course is to develop software in application level by using knowledge such as database system, software engineering, data structure etc. The software will mainly database oriented and follow the software engineering practices. In daily life, we face different problem that may be solved by automated system. At the start of the semester students will have to prepare to develop a software on a particular topic. They also have to mention the reason of development of such software. They are also required to follow the procedure of software engineering such as collection of user requirements by

visiting different organization, institution or company. They will use any of the high label programming such as Java, Visual C++ or Visual Basic as front-end and Oracle, SQL Server, My SQL or MS Access asdatabase back-end.

Project should maintain a goal which reflect contemporary IT trends. Every project must possess innovative ideas and should contain basic level of research work. Teachers must have to ensure every project is unique. Innovative project idea should get extra weight to prevent imitating old projects. Projects that meet the software/hardware requirements of HSTU or any other IT organization are highly preferable.

Some examples of software are:

1. House hold accounting - for budgeting of a particular family.
2. Library management system - to run a library.
3. Payroll system.
4. Lubricating oil management system.
5. Super shop management system.
6. To perform other experiments relevant to this course.

Level 3 Semester II

CSE 353: Operating System

3.00 Credits, 3 Hours/Week

Introduction: Operating system (OS) concept, Computer system structures, Operating system structures, Operating system operations, Protection and security, Special-purpose systems. **Fundamentals of OS:** OS services and components, Multitasking, Multiprogramming, Time sharing, Buffering, Spooling. **Process Management:** Process concept, Process scheduling, Process state, Process management, Inter-process communication, Interaction between processes and OS, Communication in client-server systems, Threading, Multithreading, Process synchronization. **Concurrency Control:** Concurrency and race conditions, Mutual exclusion requirements, Semaphores, Monitors, Classical IPC problem and solutions. Dead locks: Characterization, detection, recovery, avoidance and prevention. **Memory Management**: Memory partitioning, Swapping, Paging, Segmentation. Virtual memory concepts, Overlays, Demand paging, Performance of demand paging, Page replacement algorithm, Allocation algorithms. **Storage Management**: Principles of I/O hardware, Principles of I/O software, Secondary storage structure, Disk structure, Disk scheduling, Disk management, Swap-space management, Disk reliability, Stable storage implementation. **File Concept:** File support, Access methods, Allocation methods, Directory systems, File protection, Free space management. **Protection and Security**: Goals of protection, Domain of protection, Access matrix, Implementation of access matrix, Revocation of access rights, The security problem, Authentication, Onetime passwords, Program threats, System threats, Threat monitoring, Encryption, Computer-security classification. **Distributed Systems:** Types of distributed operating system, Communication protocols, Distributed file systems, Naming and transparency, Remote file access, Stateful vs. stateless service, File replication. **Case Studies:** Study of a representative operating systems. **System Programming:** Introduction to system programming (Linux / Unix), Shell Programming, C Language for system programming, Make and make files, Process and signals, Threads, Inter process Communications, X-Window Programming, Principle of single and multi user operating systems.

CSE 354: Operating System Sessional

0.75 Credits, 1.5 Hours/Week

Thread Programming: Creating thread and thread synchronization. **Process Programming:** The process ID, Running a new process, Terminating a process, Waiting for terminated child processes, Users and groups, Sessions and process groups. **Concurrent Programming:** Using fork, exec for multi-task programs. **File Operations:** File sharing across processes, System lock table, Permission and file locking, Mapping Files into memory, Synchronized, Synchronous and asynchronous operations, I/O schedulers and I/O performance. **Communicating across Processes:** Using different signals, Pipes, Message queue, Semaphore, Semaphore arithmetic and Shared memory.

Books:

1. **William Stallings**, *Operating Systems: Internals and Design Principles*, Prentice Hall, 8th edition, 2014.
2. **Abraham Silberschatz**, **Peter B. Galvin, Greg Gagne**, *Operating System Concepts*, Wiley, 9thedition, 2012.
3. **Andrew S. Tanenbaum**, *Modern Operating Systems*, Prentice Hall, 4thedition, 2014.
4. **Ann McHoes**, **Ida M. Flynn**, *Understanding Operating Systems*, C engage Learning, 5thedition, 2007.
5. **Brian Stuart**, *Principles of Operating Systems: Design and Applications*, C engage Learning, 1stedition, 2008.

CSE 355: Web Engineering

2.00 Credits, 2 Hours/Week

Introduction to Web Engineering: Requirements engineering and modeling web applications (Web App), Web application architectures, Technologies and tools for web applications, Testing and maintenance of web applications, Usability and performance of web applications, Security of web applications, The semantic web. **Understanding the Web Application:** Web engineering introduces a structured methodology utilized in software engineering to web development projects. The course addresses the concepts, methods, technologies and techniques of developing web sites that collect, organize and expose information resources. Topics covered include requirements engineering for web applications, design methods and technologies, user interface (UI) design, usability of web applications, accessibility, testing, metrics, operation and maintenance of Web applications, security and project management. Specific technologies covered in this course include client-side (XHTML, JavaScript and CSS etc.) and server-side (Perl and PHP etc.). Using the described concepts students should be able to understand the Web engineering concepts behind the frameworks of Joomla, Drupal, WordPress etc. **Server-Side Technology:** LAMP, Web application frameworks (Silverlight, Adobe Flex etc.), Web 2.0 and Web APIs. **Front-End Technology:** HTML, XHTML, XML. CSS styling, Layout, Selector, Document object modeland JavaScript. **Client-Programming:** Web APIs with JavaScript (Google Ajax API, JQueryetc). **MVC:** Understanding Model, View and Controller (MVC) model. **Understanding Web APIs:** REST, XML, JSON, RSS parsing etc. **JavaScript Exercise:** The goal of this assignment is to allow you to explore and use as many of JavaScript's objects, methods and propertiesas possible in a small assignment. Some functions must be written from scratch. Other functions, appropriately attributed, may be downloaded from the web and used as a part of the system or as the basis for your own functions. **PHP Exercise:** Build a set of PHP scripts that perform some dynamic server side functionality. **Understanding Plug-ins:** Development of a Firefox, Chrome or other web browser extension.

CSE 356: Web Engineering Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 355.**

Books:

1. **Gustavo Rossi, Oscar Pastor, Daniel Schwabe, Luis Olsina**, *Web Engineering: Modelling and Implementing Web Applications*, Springer, 2008 edition.
2. **Jason Beaird**, **James George**, *The Principles of Beautiful Web Design*, Site Point, 3rd edition, 2014.
3. **Jessica Miller, Victoria Kirst, Marty Stepp**, *Web Programming Step by Step*, Step by Step Publishing, 2nd edition, 2012.
4. **Jon Duckett**, *HTML and CSS: Design and Build Websites*, Wiley, 1st edition, 2011.
5. **Tris Hussey**, *Word Press Absolute Beginner's Guide*, Que Publishing, 1st edition, 2014.

CSE 357: Computer Networks

3.00 Credits, 3 Hours/Week

Introduction: Introduction to Computer networks, Network goals, Applications of networks, Network structure, Network architectures, The OSI reference model, Data transmission in the OSI model, OSI terminology, The ARPANET. **Local Area Network:** LAN Technology- Architecture and Topology. **Wired LANs:** Ethernet and Fast-ethernet, Token ring, FDDI. **Wireless LANs:** IEEE 802.11, Bluetooth. Backbone networks, Virtual LANs. **Wide Area Network:** SONET, Virtual Circuit Networks- Frame relay, ATM and ATM LANs. **Network Layer:** Logical addressing. **Internet Protocol:** Internetworking, Routing protocol, IPv4 and IPv6. **Address Mapping, Error Reporting and Multicasting:** ICMP, IGMP, ICMv6. Delivery, Forwarding and routing. **Transport Layer:** Process-to-Process delivery, Transport services, Protocol mechanisms, TCP, UDP, SCTP, Congestion and QoS. **Application Layer:** Domain Name System (DNS), Abstract Syntax Notation One (ASN.1), Network Management- SNMP v2, Electronic mail- SMTP and MIME, Uniform Resource Locator (URL) and Universal Resource Identifier (URI), Hypertext Transfer Protocol (HTTP). **Wireless and Mobile Networking**: Wireless Networking: Issues and trends, Wireless physical layer concepts, Wireless Cellular Networks, Mobile IP - IPv4, IPv6, TCP over wireless. Ad Hoc Networks: Issues and routing, Wireless Sensor Networks (WSN), Wireless mesh and multi-hop relay networks, Wireless network security, Energy management in Ad Hoc wireless networks. **Network Security:** Security requirements and attacks, Privacy with conventional encryption, Message authentication and Hash functions, Public-key encryption and digital signatures, Ipv4 and Ipv6security.

CSE 358: Computer Networks Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 357.**

Books:

1. **Andrew S. Tanenbaum**, **David J. Wetherall**, *Computer Networks*, Prentice Hall, 5th edition, 2010.
2. **Nader F. Mir**, *Computer and Communication Networks*, Prentice Hall, 1st edition, 2006.
3. **Jr. Kenneth C. Mansfield, James L. Antonakos**, *Computer Networking from LANs to WANs: Hardware, Software and Security*, C engage Learning, 1st edition, 2009.
4. **Darril Gibson**, *Microsoft Windows Networking Essentials*, Sybex, 1st edition, 2011.
5. **Troy McMillan**, *Cisco Networking Essentials*, Sybex, 1st edition, 2011.

CSE 359: Compiler Design

3.00 Credits, 3 Hours/Week

Introduction to Compilers: Introductory concepts, types, applications and phases of a compiler. **Lexical Analysis:** Role of the lexical analyzer, Input buffering, Token specification, Recognition of tokens, Symbol tables. **Parsing:** Parser and its role, Context free grammars (CFG),Top-down parsing. **Syntax-Directed Translation:** Syntax-directed definitions, Construction of syntax trees, Top-down translation. **Type checking:** Type systems, Type expressions, Static and dynamic checking of types, Error recovery. **Run-time Organization:** Run-time storage organization, storage strategies. **Intermediate Code Generation:** Intermediate languages, declarations, assignment statements. **Code Optimization:** Basic concepts of code optimization, Principal sources of optimization and Code generation. **Features of Some Common Compilers:** Characteristic features of C, Pascal, Fortranand Java compilers.

CSE 360: Compiler Design Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 359.**

Books:

1. **Parag H. Dave**, **Himanshu B. Dave**, *Compilers: Principles and Practice*, Dorling Kindersley (India) Pvt. Ltd. (Pearson education), 1st edition, 2012
2. **Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman**, *Compilers: Principles, Techniques and Tools*, PEARSON Education, 2nd edition, 2006.
3. **Allen I. Holub**, *Compiler Design In C*, Prentice-Hall of India (PHI) Private Limited, 1990.
4. **M. TIM JONES**, *GNU/LINUX Application Programming*, Charles River Media, Inc, 2005.
5. **Henk Alblas** and **Albert Nymeyer**, *Practice and Principles of Compiler Building with C*, Prentice-Hall of India (PHI) Private Limited, 1996.

CSE 361: Mathematical Analysis for Computer Science

3.00 Credits, 3 Hours/Week

Linear Models: Introduction to linear models, Modeling and measurement scales, Central tendency, Univariate graphs, Bivariate graphs, Covariance, Z-scores and Correlation, Ordinary least squares, Sampling distributions and Statistical inference, Confidence intervals and hypothesis testing, Type I and type II errors, Multiple regressions, Auto correlation, Cross- correlation and Covariance functions, Correlation and covariance matrices. **Laplace Transforms**: Forward transform, Inverse transform and Examples of transform pairs. The Laplace transform of a differential equation, the use of Laplace transforms for the solution of initial value problems, Existence and uniqueness of Laplace transforms. **Fourier Transforms:** Properties of Fourier series, Fourier sine and cosine series, Fourier transform of continuous and discrete signals, Fourier Coefficients and orthogonally, General periodic functions, Odd and even functions, Fourier transform of continuous and discrete signals, The discrete Fourier transform and the FFT algorithm. **Stochastic Processes:** Introduction, Poisson and Exponential processes, Deterministic and nondeterministic processes, Ensemble and time averages, Stationary processes. **Markov Chains:** Introduction, Finite Markov chain, Continuous time Markov chain, Eigenvalues and Eigenvectors, Birth-Death Process, State transition matrix, Initial probability distribution, Probability distribution after K trials, Regular Markov chains, Long run behavior of a Markov chain, absorbing Markov chains, Gamblers ruin problem, Fundamental Matrix, Finding steady state distribution vector–

Eigenvector approach, Z-transform approach. **Queuing Model:** Basics of Queuing process, Kendall's notation, Queue throughput, Efficiency or access probability, PASTA, Little's formula, M/M/1/K queue, M/M/c queue, M/M/c/c queue, D/M/1/B queue, M/D/1/B queue. Networks of Markovian queues: Open Jackson network. **Linear Optimization:** Concept of optimization, Objective function and constraints, Linear optimization, Sensitivity analysis, Duality theory, Linear Programming in standard form and their duals, LP with equalities and inequalities. **Application of Number Theory.**

Books:

1. **Robert Dautray**, **Jacques-Louis Lions**, *Mathematical Analysis and Numerical Methods for Science and Technology*, Springer.
2. **Donald Gross**, **John F. Shortle**, **James M. Thompson**, **Carl M. Harris**, *Fundamentals of Queueing Theory*, 4th edition, Wiley Publication.
3. **Dautray, Robert and Jacques-Louis Lions**, *Mathematical Analysis and Numerical Methods for Science and Technology: Volume 1 Physical Origins and Classical Methods*. Springer Science and Business Media, 2012.
4. **Eric Lehman and Tom Leighton**, *Mathematics for Computer Science*, The MIT Press, 2004.

CSE 352: Web and Mobile Application Development Sessional

1.50 Credits, 3 Hours/Week

The goal of this course is to develop web and/or mobile application by using knowledge such as database system, software engineering etc. The application will mainly database oriented and follow the software engineering practices. In daily life, we face different problem that may be solved by automated system. At the start of the semester students will have to prepare to develop an application on a particular topic. They also have to mention the reason of development of such application. They are also required to follow the procedure of software engineering such as collection of user requirements by visiting different organization/institution or company. They will use any of the high label programming such as ASP/JSP/PHP as front-end and Oracle, SQL Server, My SQL, SQLite or MS Access as back-end for web applications. And for mobile application, they can use any of the conventional OS (such as Android, iOS or Windows) to develop a standalone or web collaborative application.

Project should maintain a goal which reflect contemporary IT trends. Every project must possess innovative ideas and should contain basic level of research work. Teachers must have to ensure every project is unique. Innovative project idea should get extra weight to prevent imitating old projects. Projects that meet the software/hardware requirements of HSTU or any other IT organization are highly preferable.

Some examples of web and mobile application are:

1. Online Shopping Store.
2. Student Management System.
3. Online Bus Ticket Reservation System.
4. e-Commerce Website.
5. On-line Library Management System.
6. Android Quiz App
7. Friend Tracker App
8. Game App
9. To perform other experiments relevant to this course.

Level 4 Semester I

CSE 403: Artificial Intelligence

3.00 Credits, 3 Hours/Week

What is Artificial Intelligence: The Artificial Intelligence (AI) problems, The underlying assumption, Technique. **Problems, Problem Spaces and Search:** Defining the problem as a state space search, Production system, Problem characteristics. **Heuristics Search Techniques:** Generate and Test, Hill climbing, Best First Search, Problem reduction, Constraint satisfaction, Means-Ends analysis. **Knowledge Representation Issues:** Representation and mappings, Approaches to knowledge representation, Issues in knowledge representation. **Using Predicate Logic:** Representing simple facts in logic, Representing Instance and Isa relationships, Computable functions, Predicates, Resolution. **Representing Knowledge Using Rules:** Procedural vs. declarative knowledge, Logic programming, Forward vs. backward reasoning and Matching. **Game Playing:** Overview, The Mimimax search procedure, Adding Alpha-Beta cutoffs, Additional refinements, Iterative Deepening. **Planning:** Overview, An example Domain: The Blocks World, Components of a planning system, Goal stack planning. **Understanding:** What is Understanding, What makes understanding hard, Understanding as constraint satisfaction. **Natural Language Processing:** Introduction to Natural Language Processing (NPL), Syntactic processing, Semantic analysis, Discourse and pragmatic processing. **Expert Systems:** Representing and using domain knowledge, Expert system shells explanation, Knowledge acquisition. **Fuzzy Logic:** Fuzzy and Crisp logic, Membership functions, Fuzzy sets, Hedges.

CSE 404: Artificial Intelligence Sessional

0.75 Credits, 1.5 Hours/Week

Students have to understand the functionalities of intelligent agents and how the agents will solve general problems. Students have to use a high-level language (Python, Prolog, LISP) to solve the following problems: **Backtracking:** State space, Constraint satisfaction, Branch and bound. Example: 8-queen, 8-puzzle, Crypt-arithmetic. **BFS and Production:** Water jugs problem, The missionaries and cannibal problem. **Heuristic and Recursion:** Tic-tac-toe, Simple bock world, Goal stack planning, The tower of Hanoi. **Question Answering:** The monkey and bananas problem.

Books:

1. **Stuart J. Russel** and **Peter Norvig**, *Artificial Intelligence – A Modern Approach*, Prentice-Hall of India (PHI), New Delhi, 2003.
2. **Dan W. Patterson**, *Introduction to Artificial Intelligence and Expert Systems*, Prentice- Hall of India (PHI), New Delhi, 2003.
3. **S. Rajasekaran**, **G.A. Vijayalakshmi Pai**, *Neural networks, Fuzzy logic and Genetic Algorithm*, Prentice-Hall of India, New Delhi, 2004.
4. **Ivan Bratko**, *PROLOG: Programming for Artificial Intelligence*, Pearson Education, 2001.
5. **Patrick Henry Winston**, **Berthold Klaus Paul**, *LISP*, Pearson Education, 1989.
6. **Carl Townsend**, *Introduction to Turbo Prolog*.

CSE 405: Computer Graphics and Image Processing

3.00 Credits, 3 Hours/Week

Computer Graphics Programming: OpenGL. **Camera Analogy:** Viewing, Windowing, Clipping. **Projective Transformation (Raytracing):** Orthogonal projection, Perspective projection. **Vector:** Normal vector, View vector. **Matrix:** 2D and 3D rotation and translation matrix, **Raster Graphics:** Line drawing, Anti-aliasing, Polygon filling algorithms. **Hidden Surface Removal:** Buffering. **Lighting and Surface Property:** Diffused light, Ambient light, Specular light, Lighting models for reflection. **Shading:** Flat shading, Lambert shading, Phongshading. **Texture Mapping:** Texture fundamentals .**Animation:** Real time animation. **Image Processing:** Image Fundamentals. **Image Enhancement:** Background, Enhancement by

Point-processing, Spatial filtering, Enhancement in frequency domain, Color image processing. **Image Restoration:** Degradation model, Diagonalization of circulant and Block-circulant matrices, Algebraic approach to restoration, Inverse filtering, Geometric transformation. **Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-oriented segmentation, The use of motion in segmentation. **Image Compression**.

CSE 406: Computer Graphics and Image Processing Sessional

1.50 Credits, 3 Hours/Week

Tool to use for lab: OpenGL, MATLAB, C/C++, JAVA, Python etc.

1. Line Drawing: Bresenhams
2. Region Filling: Scan Line Algorithm
3. Transformation: 2D and 3D translation, Rotation, Scaling
4. Clipping: Line and Polygon
5. Projection: Perspective and Parallel
6. Animation: Morphing
7. Image Manipulation
8. Image Enhancement
9. Image Segmentation

Books:

1. **T. Theoharis**, **G. Papaioannou**, **N. Platis**, **N. M. Patrikalakis**, *Graphics and Visualization: Principles and Algorithms*, A K Peters/CRC Press, 2007.
2. **Zhigang Xian**, **Roy A. Plastock,** *Schaum's Outline of Computer Graphics*, The McGraw-Hill Companies, 2nd edition, 2000.
3. **Angel**, *Interactive Computer Graphics: A Top-Down Approach Using OpenGL*, Addison-Wesley, 4th edition, 2005.
4. **Francis S. Hill Jr**., **Stephen M. Kelley**, *Computer Graphics Using Open GL*, PEARSON Education, 3rd edition, 2006.
5. **James D. Foley**and**ries van Dam, Steven K. Feiner**, **John F. Hughes**, *Computer Graphics: Principles and Practice in C*, Addison-Wesley Professional, 2nd edition, 1995.
6. **A. K. Jain**, *Fundamentals of Digital Image Processing*, Prentice Hall, 1990.
7. **Rafael C. Gonzalez**, **Richard E. Woods**, *Digital Image Processing*, Prentice Hall, 3rd edition, 2007.
8. **Rafael C. Gonzalez**, **Richard E. Woods**, **Steven L. Eddins**, *Digital Image Processing Using MATLAB*, Gatesmark Publishing, 2nd edition2009.
9. **Oge Marques**, *Practical Image and Video Processing Using MATLAB*, Wiley – IEEE Press, 1st edition, 2011.
10. **Mark Nixon**, *Feature Extraction and Image Processing for Computer Vision*, Academic Press, 3rd edition, 2012.

CSE 408: Technical Writing and Presentation Skill Development Sessional

1.50 Credits, 3 Hours/Week

Issues of technical writing and effective oral presentation in Computer Science and Engineering, Writing styles of definitions, propositions, theorems and proofs. **Preparation of Reports, Research papers,**

Theses and Books: Abstract, Preface, Contents, Citation, Bibliography and Index. Writing of book reviews and referee reports. **Writing Tools:** LaTeX, Diagram drawing software, Presentation tools.

Books:

1. **Gerald J. Alred, Charles T. Brusaw, Walter E. Oliu**, *Handbook of Technical Writing*, St. Martin's Press, 10th edition,2011.
2. **Angelika H. Hofmann**, *Scientific Writing and Communication: Papers, Proposals and Presentations*, Oxford University Press, 1st edition, 2009.
3. **Richard L. Sullivan, Jerry L. Wircenski**, *Technical Presentation Workbook*, ASME Press, 3rd edition, 2010.
4. **Leo Finkestain**, *Pocket book of Technical writing for Engineers and Scientists*, McGraw-Hill, 2004.
5. **Heather Silyn-Roberts**, *Writing for Science and Engineering: Papers, Presentations and Reports*, Elsevier, 2nd edition, 2012.

CSE 402: Project and Thesis Sessional

1.50 Credits, 3 Hours/Week

Research/Study of problems in the field of Computer Science and Engineering to explore a research/project topic and to conduct significant research/project work under a department supervisor, independently or in group. For this, the student must first identify a faculty member to oversee his/her work and then write a proposal to the department chair outlining the means and objectives of the project. The proposal must be approved by the intended department supervisor and department chair prior to commencement of the term. At the end of the term, the student must submit a detailed report and/or give a presentation of the results, before the final course grade may be awarded. Department should take appropriate steps to archive all the researches/projects and keep tracks to maintain the genuineness of the works.

Level 4 Semester II

CSE 453: Multimedia System and Animation Techniques

3.00 Credits, 3 Hours/Week

Multimedia: Introduction, coding and compression standards (RLC, Entropy coding, Arithmetic coding, PCM, DPCM, JPEG, MPEG, H.264 etc.), Architecture issues in multimedia. Operating systems issues in multimedia: Real-time OS issues, Synchronization, Interrupt handling. Database issues in multimedia: Indexing and storing multimedia data, Disk placement, Disk scheduling, Searching for a multimedia document. Networking issues in multimedia: Quality-of-service guarantees, Resource reservation, Traffic specification, Shaping and monitoring, Admission control, Multicasting issues, Session directories, Protocols for controlling sessions. Security issues in multimedia: Digital water-marking, Partial encryption schemes for video streams. Multimedia applications: Audio and video conferencing, Video on demand, Voice over IP. **Introduction to Animation:** Classic and nontraditional animation techniques: Stop motion, Cut-paper, Direct-on-film and Drawing techniques. Interactive media. Sound Design: Scoring, Mixing and Sound image synchronization. Computer Animation: Study of modeling, Motion, Transformation, Lighting and Texturing, Expression in time and motion, 3D Animation Techniques, Special effects and motion graphics.

CSE 454: Multimedia System and Animation Techniques Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 453.**

Books:

1. **T.M. Savage**, **K.E. Vogel**, *An Introduction to Digital Multimedia*, Jones and Bartlett Learning, 2nd edition, 2013.
2. **Tay Vaughan**, *Multimedia: Making It Work*, McGraw-Hill Osborne Media, 9thedition, 2014.
3. **Sugata Mitra**, **Gaurav Bhatnagar**, *Introduction to Multimedia Systems*, Academic Press, 1stedition, 2001.
4. **Richard Williams**, *The Animator's Survival Kit: A Manual of Methods, Principles, and Formulas for Classical, Computer, Games, Stop Motion and Internet Animators*, Faber and Faber, 2ndrevised edition, 2012.
5. **Mary Murphy**, *Beginner's Guide to Animation: Everything you Need to Know to get Started*, Watson-Guptill, 2008.

CSE 455: Computer Ethics and Cyber Law

2.00 Credits, 2 Hours/Week

Privacy: Introduction, Threats, Issues, Technical methods of protection, Philosophy, Policies. Communications issues and cryptography: Computer errors and failures, Accountability, Liability, Risks, Comparisons with other technologies, Importance of professionalism. Freedom of speech: Attempts to censor the Internet, Library filters, International issues. Anonymity, Spam. Intellectual property: Copyright and fair use. Copyright vs. patent vs. trade secret. "Piracy" of software, music, movies, etc. Copy protection techniques and controversies. DMCA controversies. Free software, Free-speech issues. **Computer Crime:** Hacking, Online scams, Fraud, Civil liberties online, Security,Viruses. Computers in the workplace: Effects on employment, Telecommuting. Employee monitoring, Email privacy. Societal issues: Community, Access to computing, Gender and race issues. Bad technologies. Ethical issues for computer professionals, Professional code of practice.

Books:

1. **Brian Craig**, *Cyberlaw: The Law of the Internet and Information Technology*, Prentice Hall, 1stedition, 2012.
2. **Terrell Ward Bynum**, **Simon Rogerson**, *Computer Ethics and Professional Responsibility*, WeilyBlackwel, 1stedition, 2003.
3. **W. Stallings**, *Cryptography and Network Security Principles and Practice*, Prentice-Hall, New Jersey, 1999.
4. **Deborah G. Johnson**, *Computer Ethics*, Pearson, 4thedition, 2009.
5. **Jonathan Rosenoer**, *CyberLaw: The Law of the Internet*, Springer, 1996 Edition.

MGT 405: Industrial Management

3.00 Credits, 3 Hours/Week

Business System: Business and its importance, Characteristics, Business objectives, Essentials of successful business and businessperson, Components of business, Business and economic system. **Organization and Environment:** Definition of organization and environment, Characteristics of organization, Key forces of business environment, Relationship among organization and environment, Social responsibility and business ethics, International business and globalization. **Management:** Management and its features, The evolution and schools of management thought, Functions of management, Roles and levels of management. **Organizing:** Definition and its importance, Formal and informal organization, Process of organizing, Theory and principles of organizing, Departmentalization,

Span of control, Job design, Organization structure and Chart authority and power, Responsibility and delegation, Forms of organization, Co-ordination. **Industrial Engineering:** Definition and its objectives, Contributions to industrial engineering, Functions of industrial engineering, Techniques of industrial engineering, Place of industrial engineering in an Organization, System approach in industrial engineering. **Productivity:** Introduction and concept, Relation between production and productivity, Benefits from productivity, Dynamic of productivity, Productivity measures, Factors influencing productivity, Productivity improvement techniques. **Linear Programming:** Definition, Applications in business, Methods to determine optimal solution. **Break Even Analysis:** Introduction, Assumptions, Principles of break-even analysis, Approaches to construction of break-even chart, Limitations of break-even analysis. **Network Analysis:** Features of network analysis, Methods of network analysis, concepts and technique of PERT and CPM.

Books:

1. **Marland T. Telsang,** *Industrial and Business Management*, McGraw-Hill, 2001.
2. **Marland T. Telsang,** *Industrial Engineering and Production Management*, S Chand, 2nd revised edition, 2006.
3. **K. K. Ahuja**, *Industrial Management and Organizational Behaviour*, Khanna Publishers.

CSE 452: Project and Thesis Sessional

3.00 Credits, 6 Hours/Week

Research/Study of problems in the field of Computer Science and Engineering to explore a research/project topic and to conduct significant research/project work under a department supervisor, independently or in group. For this, the student must first identify a faculty member to oversee his/her work and then write a proposal to the department chair outlining the means and objectives of the project. The proposal must be approved by the intended department supervisor and department chair prior to commencement of the term. At the end of the term, the student must submit a detailed report and/or give a presentation of the results, before the final course grade may be awarded. Department should take appropriate steps to archive all the researches/projects and keep tracks to maintain the genuineness of the works.

OPTION I

CSE 409: Advanced Database Management System

3.00 Credits, 3 Hours/Week

Introduction: Object oriented database, Data model, Design, Languages. **Object Relational Database:** Complex data types, Querying with complex data types, Design. **Distributed Database:** Levels of distribution transparency, Translation of global queries to fragment queries, Optimization of access strategies, Management of distributed transactions, Concurrency control, Reliability, Administration. **Parallel Database:** Different types of parallelism, Design of parallel database. **Multimedia Database Systems:** Basic concepts, Design, Optimization of access strategies, Management of multimedia database systems, Reliability. **Database Warehousing/Data Mining:** Basic concepts and algorithms.

CSE 410: Advanced Database Management System Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 409.**

Books:

1. **Scott Urman,** *Oracle 8i advanced PL/SQL programming, Oracle* Press/Osborne/ McGraw-Hill, 1999.
2. **Carlo Zaniolo,** *Advanced database systems*, Morgan Kaufmann, 1997.
3. **Connolly, Thomas M. and Carolyn E. Begg,** *Database systems: a practical approach to design, implementation and management*, Pearson Education, 2005.
4. **M. Tamer Özsu and Patrick Valduriez**, *Principles of distributed database systems*, Springer Science and Business Media, Prentice Hall, 3rd edition, 2011.
5. **Vijay Kumar and Meichun Hsu**, *Recovery mechanisms in database systems*, Prentice Hall PTR, 1997.
6. **A. Hadzilacos, P. Bernstein and N. Goodman**, *Concurrency Control and Recovery in Database Systems Reading,* 1987.

CSE 411: Advanced Algorithm Design

3.00 Credits, 3 Hours/Week

Introduction: **Review of NP-Completeness**: The class P, NP, NPC, Encoding, Polynomial Verification, Polynomial reduction, Proving NP-Completeness. **Randomized Algorithms**: Review of Randomized Quick Sort. Randomized Min-Cut, Las Vegas and Monte Carlo algorithms, Randomized complexity classes, Approximation algorithms, Review and concept of lower bound, Lower bound for sorting, Constant-factor approximation algorithms, FPTAS, Inapproximability, LP based approximation algorithms, Randomized approximation algorithms. **Amortized Analysis**: Different Methods: Aggregate analysis, Accounting method, Potential method, Examples: PUSH, POP, MULTIPOP, Binary counter, Dynamic tables. **Online Algorithms**: Competitive analysis, Online paging problem, Randomized online algorithms, Adversary models, Marker algorithm. **Bioinformatics Algorithms**: Introduction and Genome Sorting. **Quantum Computing**, Quantum bits (Qbits), Quantum gates and circuits, Quantum algorithms, Quantum parallelism. **Practical Computing and Heuristics**: Back tracking, Branch and Bound. **Parallel/Distributed/Multithreaded Algorithms**: Preamble, The basics of dynamic multithreading, Recursive Fibonacci number computation. **Parameterized Algorithms:** Fixed parameter tractability, Parameterized algorithm (Buss algorithm) for Vertex Cover.

CSE 412: Advanced Algorithm Design Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 411.**

Books:

1. **T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein**, *Introduction toAlgorithms*, McGraw-Hill, New York, 2nd edition, 2001.
2. **Ellis Horowitz, Sartaz Shanny**, *Computer Algorithms*, 2nd edition.
3. **Donald Ervin Knuth**: *The art of computer programming: sorting and searching*, Vol. 3. Pearson Education, 3rd edition, 1998.
4. **Weiss Mark Allen**, *Data Structures and Algorithm Analysis in C++*, Pearson Education India, 2007.
5. **Ammeraal Leendert,** *Algorithms and data structures in C++*, John Wiley and Sons, Inc., 1996.
6. **Udi Manber**, *Introduction to Algorithms: A Creative Approach* (Hardcover), Addison

Wesley, 1989.
7. **M.R. Garey and D.S. Johnson**, *Computers and Intractability: A Guide to the Theory of NP-Completeness*, W.H. Freeman, San Francisco, CA, 1979.
8. **Anany V. Levitin**, *Introduction to the Design and Analysis of Algorithms (Paperback)*, Addison Wesley, 1st edition, 2002.

CSE 413: Management Information System

3.00 Credits, 3 Hours/Week

Management Information System: Introduction, Roles and Applications. **E-Business**: Types of Business Information Systems, Collaboration, Teamwork and Leadership. **Management:** Managerial levels, Functional areas and roles of managers. Supplier and customer relationship management, Knowledge Management system, Supply chain management. **Organization:** Structure, Culture and politics, Business process and business strategy, Market trends and competitors. **IT Infrastructure:** Components, H/W and S/W trends, Management issues to build an efficient IT infrastructure, Online communication. **Business Intelligence:** Database and information management, Establishing information policy, Securing intellectual properties, Ensuring data quality, Intelligent Techniques. **E-commerce**: Types, Applications, Digital goods, Digital market, Digital payment methods, Marketing and branding through digital media, E-commerce website. **Ethical and Social Issues:** Cyber vandalism and Cyber laws, Employee monitoring. **Enhancing Decision Making:** Types, Decisions on different managerial levels, Decision making process, Business intelligence and Analytics capabilities.

CSE 414: Management Information System Sessional

0.75 Credits, 1.5 Hours/Week

Case Study on managing projects and topics based on theory.

Books:

1. **Kenneth C. Laudon, Jane Price Laudon and Mary Elizabeth Brabston**, *Management information systems*, Vol. 8. Upper Saddle River, NJ: Prentice Hall, 2011
2. **George Westerman, Didier Bonnet and Andrew McAfee**, *Leading digital: Turning technology into business transformation*, Harvard Business Press, 2014.
3. **James A. O'Brien and George M. Marakas**, *Management information systems*, McGraw-Hill Irwin, 2006.
4. **Gerald V. Post and David Lee Anderson**, *Management information systems*, McGraw- Hill Education, 2005.

CSE 415: Mobile and Wireless Communication

3.00 Credits, 3 Hours/Week

Aspects of radio wave propagation for fixed and mobile communication systems.Cellular system design. Large-scale and small-scale propagation models, Multipath fading, Link- budget, Interference and frequency reuse, Multiple access schemes and System capacity. Trunking and grade of service, Wireless network planning and operation. Architecture and operation of 2G cellular mobile systems, 2.5 G and 3G technologies. Special techniques/Diversity, Equalization, Interleaving and Smart antenna.

CSE 416: Mobile and Wireless Communication Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 415.**

Books:

1. **Clint Smith**, **Daniel Collins**, *Wireless Networks*, McGraw-Hill Professional, 3rdedition, 2014.
2. **Vijay. K. Garg**, *Wireless Communication and Networking*, Morgan Kaufmann Publishers, 2007.
3. **Andreas F. Molisch**, *Wireless Communications*, Wiley, 2ndedition, 2010.
4. **Jack L. Burbank**, **Julia And rusenko**, **Jared S. Everett**, **William T.M. Kasch**, *Wireless Networking: Understanding Internetworking Challenges*, Wiley-IEEE Press, 1stedition, 2013.
5. **K. Daniel Wong**, *Fundamentals of Wireless Communication Engineering Technologies*, Wiley, 1stedition, 2012.

CSE 417: Communication Engineering

3.00 Credits, 3 Hours/Week

Introduction: Data communications, Networks, Internet, Protocols and Standards. **Network Models:** OSI Model, TCP/IP Protocol suite, Addressing. **Data and Signals:** Analog and digital data, Analog and digital signals, Time and frequency domain, Transmission impairments, Data rate limits, Performance. **Digital Transmission:** Digital-to-Digital conversion, Analog-to-Digital conversion and Transmission Modes. **Analog Transmission:** Digital-to-Analog Conversion, Analog-to-Analog Conversion. **Multiplexing and Spread Spectrum:** FDM, WDM, TDM, STDM, Digital subscriber line (DSL), FHSS, DSSS. **Transmission Media:** Guided and Unguided media. **Switching:** Circuit switching, Packet switching. **Data Link Layer:** Error detection and correction, Data link control, Framing, Flow and Error control. **Multiple Access:** CSMA, CSMA/CD, CSMA/CA, FDMA, TDMA, CDMA.

CSE 418: Communication Engineering Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 417.**

Books:

1. **A. Behrouz Forouzan**, *Data communications andnetworking*, Tata McGraw-Hill Education, 2006.
2. **William Stallings and Moumita Mitra Manna**, *Data and computer communications*, Vol. 6. Englewood Cliffs, NJ: Prentice hall, 9thedition, 1997.
3. **Wayne Tomasi**, *Electronic communications systems: fundamentals through advanced*, Prentice Hall PTR, 1987.
4. **John Proakis, Maoud Salehi**, *Digital Communication*, 5thedition.
5. **Andreas F. Molisch**, *Wireless communications*, Vol. 34, John Wiley and Sons, 2012.
6. **Simon Haykin and Moher Michael**, *Modern wireless communications*, Prentice Hall, 2005.
7. **George Kennedy and Bernard Davis**, *Electronic communication systems*, Vol. 20, Tata McGraw-Hill Publishing Co. Ltd., New Delhi,1985.

OPTION II

CSE 419: System Analysis and Design

3.00 Credits, 3 Hours/Week

System structure, People, Processes and data, Databases, Personal system, Centralized system and Distributed system, Types and qualities of information. **Analysis:** Information requirements, Steps of systems, Feasibility and technical facilities, Systems development approaches, Development process, Processing types and systems, Management process. **System Development Life Cycle (SDLC):**Linear or Waterfall cycle, Iterative cycles. **System Design and Modeling:** Logical and physical design, User interface design, Interface design tools, User interface evaluation, Introduction to process modeling, Introduction to data modeling. **System Design Techniques:** Document flow diagrams, Data flow diagrams (DFD) and structure charts. **Object Modeling:** Modeling behavior, Design of real-time system, Project management and documentation. Analysis of system maintenance and upgrading, Software reuse, Productivity tools, Ethics and Privacy.

CSE 420: System Analysis and Design Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 419.**

Books:

1. **M. Morris Mano**, *Digital Logic and Computer Design*, Prentice Hall of India,1987.
2. **Grady Booch**, *Object -Oriented Analysis and Design with Applications*, Addison- Wesley Professional, 3rd edition, 2007.
3. **Jeffrey Whitten** and **Lonnie Bentley**, Systems *Analysis and Design Methods*, Irwin Professional Publishing, 2005.
4. **Mahesh P. Matha**, *Object-Oriented Analysis and Design Using UML – An Introduction to Unified Process and Design Patterns*, Prentice-Hall of India Private Limited, 2008.
5. **Alan Dennis**, **Barbara Haley Wixom**, **Roberta M. Roth**, *Systems Analysis and Design*, Wiley, 4th edition, 2008.
6. **Howard Podeswa**, *UML For The IT Business Analyst*, Course Technology PTR, 2nd edition 2009.

CSE 421: Software Testing and Quality Assurance

3.00 Credits, 3 Hours/Week

Definition and concept of Software quality assurance (SQA),Quality models, Specification of quality requirements, Product development and delivery issues, Software development processes and maturity. **Software Quality Management Process:** Total quality management, Improvement cycle, SQA planning and management, Organizing the SQA effort, Software verification and validation, Typical software development errors, Fagan inspections, Software audit. **Software Testing:** Testing objectives and testing fundamentals, Testing theory, Coverage criteria, Equivalence class testing, Value-based testing, Decision table, Syntax and state transition testing, Statement and path testing, Branch and condition testing, Data flow testing, Thread-based testing, Integration and integration testing, System testing, Testing in object oriented systems, Test tools and test automation, Test management, Problem reporting and Corrective action.

CSE 422: Software Testing and Quality Assurance Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 421.**

Books:

1. **Robert Furtell**, **Donald Shafer**, and **Linda Shafer**, *Quality Software Project Management*, Prentice Hall, 2001.
2. **Robert Binder**, **Addison Wesley**, *Testing Object–Oriented Systems: Models, Patterns and Tools*, 1999.
3. **G. Schulmeyer et al**, *Handbook of Software Quality Assurance*, 2007.
4. **Paul Ammann** and **Jeff Offut**, Introduction *to Software Testing,* Cambridge University Press, 2008.
5. **Andreas Zeller**, *Why Programs Fail: a Guide to Systematic Debugging*, Morgan Kaufmann, 2005.
6. **Murali Chemuturi**, *Mastering Software Quality Assurance: Best Practices, Tools and Techniques for Software Developers*, J. Ross Publishing, 1st edition, 2010.

CSE 423: Graph Theory

3.00 Credits, 3 Hours/Week

Graph Theory: Fundamental concepts, Varieties of graphs, path, cycles and components; Degrees and distances, Clique. **Trees:** Properties, Spanning trees, Forests, Centroids, Generation of trees and cycles, Ent cycles and co-cycles. **Connectivity:** Vertex and edge connectivity, Blocks, Eccentricity, Menge's Theorem. **Traversability:** Eulerian graphs, Kuratowski's theorem, Embedding graphs on surfaces, Genus, Thickness and crossing number. **Graph Coloring:** Vertex coloring, Edge coloring, Chromatic number, Five color theorem, Four color conjecture, Critical graph. **Homomorphism Digraph:** Different connectedness, Oriented graphs-tournaments, Network flows and related algorithms. Groups, Polynomials and graph enumeration, Matching and factorization, Perfect graphs, Ramsey number and Ramsey theorem, Forbidden graph theory and Miscellaneous applications.

CSE 424: Graph Theory Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 423.**

Books:

1. **Douglas B. Brent West**, *Introduction to Graph Theory*, Prentice Hall, 2nd edition, 2000.
2. **Gary Chartrand**, **Ping Zhang**, *Introduction to Graph Theory*, 1st edition, The McGraw-Hill Companies, 2004.
3. **Mark de Berg**, **Mark Overmars**, **Otfried Schwarzkopf**, **M. van Kreveld**, *Computational Geometry: Algorithms and Applications*, Springer-Verlag New York, 2/e, LLC, 2005.
4. **Joseph O'Rourke**, *Computational Geometry in C (Cambridge Tracts in Theoretical Computer Science)*, Cambridge University Press, 2/e, 2000.
5. **Robin J. Wilson**, *Introduction to Graph Theory*, Pearson Education, Ltd., 4th edition, 1996.

CSE 425: Cryptography and Network Security

3.00 Credits, 3 Hours/Week

Introduction: Key security concepts, Various types of threats, Policy vs. mechanism. Security policy life cycle. Vulnerabilities, Controls, Organizational context, Security policy.**Human Factors in Security Policy:** Basic risk analysis structure, Implementation of security plan, Integration of physical and logical security, Internet and Email use policies, Computer security incident response team (CSIRT), Security auditing. **Basic Applied Cryptography:** Historical ciphers, Modern ciphers like AES and RSA,

Symmetric cryptography, Cryptanalysis, Stream ciphers and RC4, Cipher block modes of operation, Key distribution, Differential cryptanalysis. **Public Key Cryptography:** Diffie-Hellman key exchange, RSA algorithm, Ellipticcurve cryptography (ECC), Security services, Secure hash functions, SHA security hash functions. **Key and Identity Management Including Certificate Management:** Key exchange and random numbers, Key/identity management, Kerberos, PKI, Digital signature, Hierarchical x.509,Web of trust. **Authentication:** Password based authentication, Token based authentication, Biometric authentication, Remote user authentication, Security issues for user authentication. **Access Control:** Access control principles, Access control policies, Discretionary access control, Role based access control, Role based access control reference model, Access control matrix, Unix access control, Windows access control, capabilities. **Internet Security:** Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 security, Keberos, X.509,Wireless security. **Database Security:** Database access control, Inference, Database encryption, Cloud security. **Denial-of-Service (DOS) Attacks:** Flooding attacks, DDOS attacks, Reflector and amplifier attacks, Defense against DOS. **Trusted Operating System:** The Bell-LaPadula model for computer security, Formal models for computer security, Trusted systems, Assurance and evaluation. **Program Security and Design Principles:** Software security issues, Handling program input, Writing safe program code, Interacting with operating system. **System Evaluation:** Assurance and evaluation. **Malicious Software:** Types of Malicious Software (Malware), Infected content, Vulnerability exploits, Social engineering, System corruption, Bots, Zombie, Key loggers, Phasing, Spyware, Backdoors, Counter measures. **Forensics Physical Security:** Physical security prevention and mitigation measures, Recovery from physical security breaches, Integration of physical and logical security. **Legal and Ethical Issues in Computer Security:** Cybercrime, Intellectual property, Privacy, Ethical issues.

CSE 426: Cryptography and Network Security Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 425.**

Books:

1. **William Stallings**, *Cryptography and Network Security: Principles and Practice*,Pearson Education Ltd, 7th edition, 2017.
2. **Behrouz A. Forouzan**, *Cryptography and Network Security*, McGraw -Hill, 2007.
3. **Atul Kahate**, *Cryptography and Network Security*, 2nd edition, McGraw -Hill, 2008.
4. **Jonathan Katz, Yehuda Lindell**, *Introduction to Modern Cryptography*, CRS Press, 2007.
5. **Doug Stinson**, *Cryptography: Theory and Practice*, CRS Press, 2011.
6. **W. Stallings,** *Cryptography and Network Security Principles and Practice*, Prentice Hall, New Jersey, 1999.
7. **Julia H. Allen**, *The CERT Guide to System and Network Security Practices*, Addison-Wesley Professional, 1st edition, 2001.
8. **C. Kaufman, R. Perlman and M. Speciner**, *Network Security: Private Communication in a Public World*, Prentice Hall, 2nd edition, 2002.
9. **J. F. Kurose and K. W. Ross**, *Computer Networking: A Top - Down Approach Featuring the Internet*, Pearson Education Asia, 3rd edition, 2005.
10. **J. Schiller**, *Mobile Communications*, Pearson Education Asia, 2nd edition, 2004.

CSE 427: Simulation and Modeling

3.00 Credits, 3 Hours/Week

Simulation Modeling Basics: Systems, Models and simulation, Classification of simulation models, Steps in a simulation study. **Concepts of Discrete-event simulation:** Event-scheduling vs. process-interaction approaches, Time-advance mechanism, Organization of a discrete-event simulation model,

Continuous simulation models, Combined discreet-continuous models, Monte Carlo simulation, Simulation of queuing systems. **Building a Valid and Credible Simulation Models:** Validation principles and techniques, Statistical procedures for comparing real-world observations and simulated outputs, Input modeling, Generating random numbers and random variants, Output analysis, Simulation languages, Analysis and modeling of some practical systems.

CSE 428: Simulation and Modeling Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 427.**

Books:

1. **Jerry Banks**, **John S. Carson**, **Barry L. Nelson**, **David M. Nicol**, *Discrete-Event System Simulation*, Pearson Education, 2001.
2. **Geoffrey Gordon**, *System Simulation*, Prentice-Hall, 1978.
3. **Averill M. Law**, **W. Dabid Kelton**, *Simulation Modeling and Analysis*, McGraw-Hill, 1982.
4. **Narsingh Deo**, *System Simulation with Digital Computer*, Prentice-Hall, 1983.
5. **Reuven Y. Rubinstein**, **Alexander Shapiro**, **Benjamin Melamed**, *Modern Simulation and Modeling*, Wiley, John and Sons, 1998.
6. **Bernard P. Zeigler, Bernard Zeigler, Herbert Praehofer**, *Theory of Modeling and Simulation*, Academic Press, 2nd edition, 2000.

OPTION III

CSE 459: Data Mining and Warehousing

3.00 Credits, 3 Hours/Week

Data Warehousing: Basic concepts, Difference between operational Database (DB) and Data Warehouse (DW), Multi-tiered architecture of DW, Enterprise warehouse, Data mart and virtual warehouse. **Data Warehouse Modeling:** Data cube and OLAP. **Data Cube:** A multidimensional data model, Stars, Snowflakes. **Fact Constellations:** Schemas for multidimensional databases, Dimensions and measures. **Typical OLAP Operations:** Roll-up, slice and dice, Data warehouse design and usage, Data warehouse implementation, Data generalization by attribute oriented indexing. **Mining Frequent Patterns:** Definitions and background, Market basket analysis, Methods for mining frequent patterns- (i) Apriori algorithm (mining frequent item sets using candidate generation, Improving the efficiency of Apriori), (ii) FP-growth algorithm (mining frequent item sets without candidate generation), (iii) Mining frequent items using vertical data format, Mining closed and maximal frequent item sets, Mining frequent patterns in data streams. **Mining Association Rules and Correlation:** Mining association rules, Generating association rules from frequent item sets, Mining correlations from association rules, Significance of correlation mining in presence of association rules, Pattern evaluation methods. **Various Correlation Measures:** Lift, Chi square, all_conf, max_conf, cosine and Kulc, Their performance and applicability analysis. **Mining Sequential Patterns:** Concepts and primitives, Applications, Domains, Mining methods in transactional databases (i) Apriori based approaches (GSP, SPADE), (ii) Pattern growth based (Prefix Span), closed and maximal sequential patterns. Mining sequential patterns in biological databases, Web access databases and time series databases.

CSE 460: Data Mining and Warehousing Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 459.**

Books:

1. **J. Han** and **M. Kamber**, *Data Mining: Concepts and Principles*.
2. **Tan**, **Steinbach** and **Kumar**, *Introduction to Data Mining*, Addison Wesley, 2006.
3. **Max Bramer**, *Principles of Data Mining (Undergraduate Topics in Computer Science)*, Springer, 2007.
4. **Ian H. Witten**, **Eibe Frank**, *Data Mining: Practical Machine Learning Tools and Techniques*, Morgan Kaufmann, 2005.
5. **J. Han** and **Michiline Kamber,** *Data Mining: Concepts and Techniques*, Simon Fraser University, Canada.

CSE 461: Cloud Computing

3.00 Credits, 3 Hours/Week

Introduction to Cloud Computing: Definition and applications including benefits, challenges and risks, Enabling technologies and system models for cloud computing. **Cloud Computing Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) and emerging XaaS. **Types of Cloud Computing:** Public cloud, private cloud and hybrid clouds, Cloud OSs and platforms. **Cloud Architectures:** Architectural design of cloud computing, Interaction among infrastructure provider, business providers and the customers, Roles of cloud broker, Tradeoffs between costs and Customer satisfactions, Federated Clouds.**VM Resource Provisioning:** Static and dynamic resource provisioning approaches, HARMONY architecture, Capacity provisioning approaches. **Scalability and Fault Tolerant Issues:** Scalable computing, Energy optimization vs. fault tolerant service platforms, Performance, QoS, Power management in Cloud Computing data centers. **Principles of Virtualization Platforms:** VMW are ESX Memory Management**,** Security and Privacy issues in the cloud. **Introduction to Mobile Cloud Computing:** Architecture and applications of MCC, Code partitioning, Code offloading and VM migration techniques.

CSE 462: Cloud Computing Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 461.**

Books:

1. **Kai Hwang, Jack Dongarra** and **Geoffrey C. Fox**, *Distributed and cloud computing: from parallel processing to the internet of things*, Morgan Kaufmann, 2013.
2. **Nikos Antonopoulos** and **Lee Gillam,** *Cloud computing: Principles, systems and applications*, Springer Science and Business Media, 2010.
3. **Borivoje Furht** and **Armando Escalante**, *Handbook of cloud computing*, Vol. 3. New York: Springer, 2010.
4. **Anthony T.Velte, et al**., *Cloud computing: a practical approach*, New York: McGraw- Hill, 2010.
5. **Rajkumar Buyya, James Broberg** and **Andrzej M. Goscinski,** *Cloud computing:*

Principles and paradigms, Vol. 87. John Wiley and Sons, 2010.
6. **John W. Rittinghouse** and **James F. Ransome**, *Cloud computing: implementation, management and security*, CRC press, 2016.

CSE 463: VLSI Design

3.00 Credits, 3 Hours/Week

Current State of VLSI: Fabrication and size metrics, Performance metrics, System complexity. **Introduction to MOS Technology:** nMOS, pMOS and CMOS, Transistors, CMOS Fabrication. **Design Approaches:** Fabrication steps, Stick diagrams, Design rules and Layout, Contact cuts, Double metal MOS process rules and MOS Circuits. **Delay Analysis:** Inverter delay and its analysis, Delay of different sequential and combinational circuits. **Design Automation and VLSI:** Layout, Placement, Routing, Silicon compilation. **Switch Logic:** Pass transistors and Transmission gates. **Gate Logic:** The inverter, Two-input nMOS, CMOS and BiCMOS Gate design, Design of parity generator and multiplexers. Registers, Counters and Memory realizations, One transistor and three transistors dynamic RAM cell design. **Hierarchical View of VLSI System Design:** Behavioral description high level synthesis scheduling, Allocation and data path synthesis. **Logic Synthesis**: Multilevel minimization and PLA reduction of regular structure circuits. **Testing:** Testing of VLSI, Testing of stuck-at fault, Testing of PLAs. **FPGA:** Introduction to FPGA.

CSE 464: VLSI Design Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 463.**

Books:

1. **Neil H. E. Weste** and **Kamran Eshraghian**, *Principle of CMOS VLSI Design, A System Perspective*, Pearson Education, 2004.
2. **Neil H. E. Weste**, **David Harris**, **Ayan Banerjee**, *CMOS VLSI Design*, Pearson Education, 2006.
3. **R. Jacob Baker**, *CMOS Circuit Design, Layout, and Simulation*, Wiley–IEEE Press, 3rd edition, 2010.
4. **Doughlas A. Puckneill** and **Kamran Eshraghian**, *Basic VLSI Design*, Prentice Hall of India, 2003.
5. **LindaE. M. Brackendury**, *Design of VLSI Systems, A practical Introductions*, M. Macmillan, 1987.

CSE 465: Digital System Design

3.00 Credits, 3 Hours/Week

Design using TTL, ECL and CMOS components, Design of memory subsystem using SRAM and DRAM, Design of various components of a computer, ALU, memory and control unit: Hardwired and micro programmed, Microprocessor based designs, Computer bus standards, Microprocessor based design, Design using special purpose controllers, Design of real-time systems, Use of VHDL in design.

CSE 466: Digital System Design Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 465.**

Books:

1. **Thomas L. Floyd**, *Digital Fundamentals*, PHI, 11th edition, 2014.
2. **Ronald J. Tocci**, **Neal Widmer**, **Greg Moss**, *Digital Systems: Principles and Applications*, Prentice Hall, 11th edition, 2010.
3. **William J. Dally**, **R. Curtis Harting**, *Digital Design: A Systems Approach*, Cambridge University Press, 2012.
4. **M. Morris Mano**, **Michael D. Ciletti**, *Digital Design: With an Introduction to the Verilog HDL*, PHI, 5th edition, 2012.
5. **Dr. Hafiz Faruque**, **Ahmed Sharif**, *Computer Hardware and Digital Electronics*, M. R. S. Sharif Publishing, 2007.
6. **M. Morris Mano,** *Digital Logic and Computer Design*, Prentice Hall of India, 1987.

CSE 467: Parallel and Distributed System

3.00 Credits, 3 Hours/Week

Distributed System Models: High performance computing, Grid computing, Cloud computing, Many core computing, Many task computing. **Programming Systems and Models:** Processes and threads, Map Reduce, Workflow systems, Virtualization techniques, **Distributed Storage andFile Systems:** Data intensive computing, Distributed hash tables, **Consistency and Replication:** Reasons for replication, Consistency models, Data centric consistency models, Client centric consistency models, Consistency protocols. **Fault Tolerance:** Byzantine failure and k-fault tolerant systems, Performance analysis and tuning, scalability and performance studies, Scheduling, Storage systems, Synchronization and tools (Cuda, Swift, Globus, Condor, Amazon AWS, Open Stack, Cilk, gdb, threads, MPICH, OpenMP, Hadoop, FUSE).**Parallel Architectures:** Parallel algorithms and architectures, Parallel I/O, Performance analysis and tuning, Power and Programming models (data parallel, task parallel, process-centric, shared/distributed memory).**Multithreaded Programming:** GPU architecture and programming, Message passing interface (MPI), Heterogeneity, Interconnection topologies, Load balancing, Memory consistency model, Memory hierarchies.

CSE 468: Parallel and Distributed System Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 467.**

Books:

1. **David E. Culler, Jaswinder Pal Singh** and **Anoop Gupta**, *Parallel computer architecture: a hardware/software approach*, Gulf Professional Publishing, 1999.
2. **S. A. Tanenbaum and Van M. Steen**, Distributed Systems: Chap7 Fault-Tolerant, 2002.
3. **George F. Coulouris, Jean Dollimore**and **Tim Kindberg**, *Distributed systems: concepts and design*, Pearson Education, 2005.
4. **David E. Rumelhart, James L. McClelland** and **PDP Research Group**, *Parallel distributed processing*, Vol. 1. IEEE, 1988.
5. **Gregory R. Andrews**, *Foundations of multithreaded, parallel, and distributed programming*, Vol. 11. Reading: Addison-Wesley, 2000.

OPTION IV

CSE 469: Machine Learning and Pattern Recognition

3.00 Credits, 3 Hours/Week

Machine Learning: Introduction to Machine Learning (ML). Regression Analysis: Logistic regression, Linear regression. Classification Techniques: Supervised and unsupervised classification, Neural networks (NN), Support vector machines (SVM), Classification trees, Rule based learning, Instance based learning, Reinforcement learning, Ensemble learning, Negative correlation learning, Evolutionary algorithms, Genetic algorithm. Statistical Performance Evaluation Techniques of Learning Algorithms: Bias-variance tradeoff, Practical applications of machine learning. **Pattern Recognition:** Introduction to Pattern Recognition (PR), Statistical and neural pattern recognition, Bayesian decision theory, Linear classifiers, Nonlinear classifiers, Parametric estimation techniques, Non-parametric estimation techniques, Template matching techniques, Context dependent classification, Markov models, Hidden Markov models, Syntactic pattern recognition, Clustering algorithms and Principal component analysis.

CSE 470: Machine Learning and Pattern Recognition Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 469.**

Books:

1. **Christopher M. Bishop**, *Pattern Recognition and Machine Learning*, Springer ,2007.
2. **Sergios Theodoridis, Konstantinos Koutroumbas**, *Pattern Recognition*, Academic Press, 4th edition, 2008.
3. **Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas**, **Dionisis Cavouras,** *Introduction to Pattern Recognition: A Matlab Approach*, Academic Press, 1st edition, 2006.
4. **Mehryar Mohri**, **Afshin Rostamizadeh**, **Ameet Talwalkar**, *Foundations of Machine Learning*, The MIT Press, 2012.
5. **Ethem Alpaydin**, *Introduction to Machine Learning*, The MIT Press, 3rd edition, 2014.
6. **Tom. M. Mitchel**, *Machine Learning*, McGraw Hill.

CSE 471: Natural Language Processing

3.00 Credits, 3 Hours/Week

Introduction: Words: Regular expressions and automata, Words and transducers, N-Grams, Parts-of-Speech tagging, Hidden Markov and Maximum entropy models. **Syntax:** Formal grammars, Syntactic parsing, Statistical parsing, Features and unification, Language and complexity. **Semantics and Pragmatics:** The representation of meaning, Computational semantics, Lexical semantics, Computational lexical semantics, Computational discourse. **Applications:** Information extraction, Question answering and summarization, Dialogue and conversational agents, Machine translation.

CSE 472: Natural Language Processing Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 471.**

Books:

1. **Daniel Jurafsky, James H. Martin**, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, Prentice Hall, 1st edition, 2000.

2. **Christopher D. Manning andHinrichSchütze**, *Foundations of statistical natural language processing*, Vol. 999, Cambridge: MIT press, 1999.
3. **James Allen**, *Natural language understanding*. Pearson, 1995.
4. **Peter Jackson and Isabelle Moulinier**, *Natural language processing for online applications: Text retrieval, extraction and categorization*, Vol. 5. John Benjamins Publishing, 2007.

CSE 473: Human and Computer Interaction

3.00 Credits, 3 Hours/Week

User Interface Development: Iterative design, Rapid prototyping, Low-fidelity interactive prototyping, Comparative evaluation of multiple interfaces, Evaluation of user interface, Heuristic evaluation. **UI Design Models:** System model, Interface model, User model. **Usability:** Consistency, Simplicity, Learnability, Efficiency, Safety, Ergonomics, Aesthetics. **Accessibility:** Kinds of impairments, Assistive technology, Universal design, Accessibility APIs. **Internationalization and Localization:** Translation, Text direction, Sort order, Formatting, Color conventions, Icons. **User Research Methods:** Experiments, Experiment design techniques, Feld study and Survey. **Multimodal Signal Processing:** Recognize human emotions through combination of spoken language, Gestures, Facial expressions, Case studies.

CSE 474: Human and Computer Interaction Sessional

0.75Credits, 1.5 Hours/Week

Laboratory works based on **CSE 473.**

Books:

1. **Andy Downton**, *Engineering the Human-Computer Interface (Essex Series in Telecommunications and Information Systems)*, McGraw Hill, 1993.
2. **Alan Dix**, *Human-computer interaction*, Springer US, 2009.
3. **Ben Shneiderman**, *Designing the user interface: strategies for effective human-computer interaction*, Pearson Education India, 2010.
4. **Bonnie A. Nardi**, *Context and consciousness: activity theory and human-computer interaction*, The MIT Press, 1996.

CSE 475: Robotics

3.00 Credits, 3 Hours/Week

Introduction: What is a robot, Types of robots, Robotics and AI, Automation and autonomy architectures. **Robot Hardware:** Sensors, Effector. **Robotic Mapping:** Localization, Monte Carlo localization, Multi-object localization. **Robotic Navigation and Locomotion:** Motion planning, Dynamics and Control. **Human-Robot Interaction:** Natural language learning. **Multi-Agents:** Tasks and teams.

CSE 476: Robotics Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 475.**

Books:

1. **JohnJ. Craig**, *Introductiontorobotics:mechanicsandcontrol*,Vol.3.UpperSaddle River: Pearson Prentice Hall, 2005.

2. **Richard P. Paul**, *Robot manipulators: mathematics, programming and control: the computer control of robot manipulators*, 1981.
3. **Nils J. Nilsson**, *Artificial intelligence: A modern approach*, Prentice Hall, 1996.
4. **Ronald C. Arkin**, *Behavior-based robotics*, The MIT press, 1998.
5. **King Sun Fu, Ralph Gonzalez** and **CS George Lee**, *Robotics: Control Sensing,* Tata McGraw-Hill Education, 1988.
6. **Luc. Jaulin**, *Applied interval analysis: with examples in parameter and state estimation, robust control and robotics*, Vol. 1. Springer Science and Business Media, 2001.

CSE 477: Bioinformatics

3.00 Credits, 3 Hours/Week

Cell Concept: Structural organization of plant and animal cells, Nucleus, Cell membrane and cell wall. **Cell Division:** Introducing Chromosome, Mitosis, Meiosis and production of haploid/diploid cell. **Nucleic Acids:** Structure and properties of different forms of DNA and RNA, DNA replication. **Proteins:** Structure and classification, Central dogma of molecular biology. **Genetic Code:** A brief account. **Genetics:** Mendel's laws of inheritance, Organization of genetic material of prokaryotes and eukaryotes, C-Value paradox, Repetitive DNA, Structure of chromatin-euchromatin and heterochromatin, Chromosome organization and banding patterns, Structure of gene: Intron, exon and their relationships, Overlapping gene, Regulatory sequence (*lac* operon), Molecular mechanism of general recombination, Gene conversion, Evolution and types of mutation, Molecular mechanisms of mutation, Site-directed mutagenesis, Transposons in mutation. **Introduction to Bioinformatics:** Definition and history of Bioinformatics, Human genome project, Internet and Bioinformatics, Applications of Bioinformatics. **Sequence Alignment:** Dynamic programming, Global vs. local, scoring matrices, the blast family of programs, Significance of alignments, Aligning more than two sequences, Genomes alignment, Structure-based alignment. **Hidden Markov Models in Bioinformatics:** Definition and applications in Bioinformatics, Examples of the Viterbi, The forward and the backward algorithms, Parameter estimation for Hidden Markov Models (HMMs). **Trees:** The Phylogeny problem, Distance methods, parsimony, bootstrap, Stationary Markov processes, Rate matrices, Maximum likelihood, Fleckenstein's post-order traversal. **Finding Regulatory Elements:** Finding regulatory elements in aligned and unaligned sequences, Gibbs sampling. **Introduction to Microarray Data Analysis:** Steady state and time series microarray data, from microarray data to biological networks, Identifying regulatory elements using microarray data. **Pi Calculus:** Description of biological networks, Stochastic Pi calculus, Gillespie algorithm.

CSE 478: Bioinformatics Sessional

0.75 Credits, 1.5 Hours/Week

Laboratory works based on **CSE 477.**

Books:

1. **Neil C. Jones** and **Pavel Pevzner**, *An introduction to bioinformatics algorithms*, The MIT Press, 2004.
2. **Jean-Michel Claverie** and **Cedric Notredame**, *Bioinformatics for dummies*, John Wiley and Sons, 2011.
3. **Martin Gollery**, *Bioinformatics: Sequence and Genome Analysis*, David W. Mount. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2004.
4. **David W. Mount**, *Bioinformatics: Sequence and Genome Analysis*, 2nd edition.
5. **Warren J. Ewens**and **Gregory R. Grant**, *Statistical methods in bioinformatics: an introduction*, Springer Science and Business Media, 2006.
6. **Cynthia Gibas**and **Per Jambeck**, *Developing bioinformatics computer skills*, O'Reilly

Media, Inc., 2001.
7. **Pierre Baldi, SrenBrunak**, *Bioinformatics: The Machine Learning Approach*, The MIT Press, 2nd edition, 2001.
8. **Pavel Pevzner**and **Ron Shamir**, *Bioinformatics for biologists*, Cambridge University Press, 2011.