Syllabus for:

Session: 2017-2018 and Onwards
Degree: B.Sc (Engg.) in ICT
Department of Information and Communication Technology (ICT)

B.Sc. (Engg.) in Information and Communication Technology (ICT):

The Department of Information and Communication Technology (ICT) offers a 4-year program of Bachelor of Science (Engg.) in Information and Communication Technology (ICT). To become a graduate in this field one has to complete 160 credit hours.

The program is designed to satisfy the growing demand for IT professionals throughout the country. `It gives students the opportunity to obtain a broad-based knowledge of Computer Science, Communication Engineering and Information Technology. Moreover there are sufficient number of Mathematics, Electrical Engineering, Communication Engineering, Basic Sciences, Commerce and Arts Courses.

Program Duration:

MBSTU introduces two semesters (each semester of six months) in one academic year. Therefore, the whole program can be completed in 8 semesters (i.e. 4 years).

Course Structure:

Course Type	No. of Courses	Credit Hours
Core Courses:		
A. ICT Courses		
I. Theory	34	98
II. Lab work	25	25
III. Project work	02	02
IV. Research Project	02	06
B. Mathematics Courses (MATH)	05	15
C. Physics Courses (PHY)	01	03
D. Statistics	01	02
E. Business (Financial and Managerial Accounting)	01	02
Arts and Humanities Courses (HUM)	04	07
Total:	**77**	**160**

Semester Wise Credit Hour:

S/N	Year	Semester	No. of Course		Credit Hour		Total
			Theory	**Lab**	**Theory**	**Lab**	
1.	First	First	6	2	18	2	20
2.	First	Second	5	4	15	4	19
3.	Second	First	6	4	17	4	21
4.	Second	Second	7	3	19	3	22
5.	Third	First	5	4	15	4	19
6.	Third	Second	6	2	18	2	20
7.	Fourth	First	5	6	15	6	21
8.	Fourth	Second	4	6	12	6	18
		Total:	**44**	**33**	**127**	**33**	**160**

* Including Research Project.

Mawlana Bhashani Science and Technology University
Santosh, Tangail

Department of Information and communication Technology
Proposed Syllabus for the B.Sc. (Engg.) in ICT
Session 2017-2018
Total Credit: 160.00 (1 Credit = 14 Hours)

FIRST YEAR FIRST SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT – 1101	Basic Electrical Circuit	3.00	00.00	3.00
ICT – 1102	Basic Electrical Circuit Lab	00.00	1.00	1.00
ICT – 1103	Computer Programming	3.00	00.00	3.00
ICT – 1104	Computer Programming Lab	00.00	1.00	1.00
ICT – 1105	Physics	3.00	00.00	3.00
ICT – 1107	Mathematics-I (Differential and Integral Calculus)	3.00	00.00	3.00
ICT – 1109	Technical Communicative English	3.00	00.00	3.00
	Option-I (Select any one course)	3.00	00.00	3.00
Total		**18.00**	**2.00**	**20.00**

Optional-I (Select Any One)

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT – 1111	Technology, Environment and Society	3.00	00.00	3.00
ICT – 1113	Sociology	3.00	00.00	3.00
ICT – 1115	Legal Issues and Management for Engineers	3.00	00.00	3.00

FIRST YEAR SECOND SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT-1201	Electronic Devices and Circuit Theory	3.00	00.00	3.00
ICT-1202	Electronic Devices and Circuit Theory Lab	00.00	1.00	1.00
ICT-1203	Programming with C++	3.00	00.00	3.00
ICT-1204	Programming with C++ Lab	00.00	1.00	1.00
ICT-1205	Data Structure	3.00	00.00	3.00
ICT-1206	Data Structure Lab	00.00	1.00	1.00
ICT-1207	Discrete Mathematics	3.00	00.00	3.00
ICT-1209	Matrices and Co-ordinate Geometry	3.00	0.00	3.00
ICT-1210	Software Development Project-I	0.00	1.00	1.00
	Option-II (Select any one)			0.00
Total		**15.00**	**4.00**	**19.00**

Option-II (Select Any One Non-Credit Course)

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT-1211	Bhashani Studies	2.00	00.00	00.00
ICT-1213	Bangladesh Studies	2.00	00.00	00.00

SECOND YEAR FIRST SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT-2101	Operational Amplifier and Timer Circuits	3.00	0.00	3.00
ICT-2102	Operational Amplifier and Timer Circuits Lab	0.00	1.00	1.00
ICT-2103	Digital Logic Design	3.00	0.00	3.00
ICT-2104	Digital Logic Design Lab	0.00	1.00	1.00
ICT-2105	Object Oriented Programming with Java	3.00	0.00	3.00
ICT-2106	Object Oriented Programming with Java Lab	0.00	1.00	1.00
ICT-2107	Algorithm Design and Analysis	3.00	0.00	3.00
ICT-2108	Algorithm Design and Analysis Lab	0.00	1.00	1.00
ICT-2109	Differential Equation and Vector Calculus	3.00	0.00	3.00
ICT-2111	Statistics	2.00	0.00	2.00
Total		**17.00**	**4.00**	**21.00**

SECOND YEAR SECOND SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT-2201	Computer Organization and Architecture	3.00	0.00	3.00
ICT-2203	Computer Based Numerical Methods	3.00	0.00	3.00
ICT-2204	Computer Based Numerical Methods Lab	0.00	1.00	1.00
ICT-2205	Advanced Java and Mobile Application	3.00	0.00	3.00
ICT-2206	Advanced Java and Mobile Application Lab	0.00	1.00	1.00
ICT-2207	Database Management Systems	3.00	0.00	3.00
ICT-2208	Database Management Systems Lab	0.00	1.00	1.00
ICT-2209	Complex Variables and Fourier Analysis	3.00	0.00	3.00
ICT-2211	Economics	2.00	0.00	2.00
ICT-2213	Financial and Managerial Accounting	2.00	0.00	2.00
Total		**19.00**	**3.00**	**22.00**

THIRD YEAR FIRST SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT – 3101	Data Mining	3.00	0.00	3.00
ICT – 3103	Analog and Digital Communication	3.00	0.00	3.00
ICT – 3104	Analog and Digital Communication Lab	0.00	1.00	1.00
ICT – 3105	Microprocessor and Assembly Language	3.00	0.00	3.00
ICT – 3106	Microprocessor and Assembly Language Lab	0.00	1.00	1.00
ICT – 3107	Theory of Computation	3.00	0.00	3.00
ICT – 3109	Operating Systems	3.00	0.00	3.00
ICT- 3110	Operating Systems Lab	0.00	1.00	1.00
ICT – 3112	Software Development Project-II	0.00	1.00	1.00
Total		**15.00**	**4.00**	**19.00**

THIRD YEAR SECOND SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	Lab	
ICT – 3201	Microwave Engineering	3.00	0.00	3.00
ICT – 3203	Compiler Design	3.00	0.00	3.00
ICT – 3205	Computer Peripheral and Interfacing	3.00	0.00	3.00
ICT – 3206	Computer Peripheral and Interfacing Lab	0.00	1.00	1.00

Course Code	Course Title	Theory	Lab	Credit
ICT – 3207	Computer Networks	3.00	0.00	3.00
ICT – 3208	Network Planning and Designing Lab	0.00	1.00	1.00
ICT – 3209	Software Engineering	3.00	0.00	3.00
ICT – 3211	Bio-Informatics	3.00	0.00	3.00
Total		**18.00**	**2.00**	20**.00**

FOURTH YEAR FIRST SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	*Lab*	
ICT – 4000	Research Thesis/Project	0.00	3.00	3.00
ICT – 4101	Telecommunication Engineering	3.00	0.00	3.00
ICT – 4103	Simulation and Modeling	3.00	0.00	3.00
ICT - 4105	Cryptography and Cyber Law	3.00	0.00	3.00
ICT – 4107	E-Commerce and Web Programming	3.00	0.00	3.00
ICT – 4108	Internet and Web Programming Lab	0.00	1.00	1.00
ICT – 4110	Research Methodology	0.00	1.00	1.00
	Optional-IV	3.00	0.00	3.00
	Optional-IV Lab	0.00	1.00	1.00
Total		**15.00**	**6.00**	**21.00**

Optional-IV (Select Any One)

Course Code	Course Title	Class hours/week		Credit
		Theory	*Lab*	
ICT – 4111	Digital Image Processing	3.00	00.00	3.00
ICT – 4112	Digital Image Processing Lab	0.00	1.00	1.00
ICT – 4113	Embedded Systems Design	3.00	00.00	3.00
ICT – 4114	Embedded Systems Design Lab	0.00	1.00	1.00
ICT – 4115	Distributed and Parallel Processing	3.00	00.00	3.00
ICT – 4116	Distributed and Parallel Processing Lab	0.00	1.00	1.00

FOURTH YEAR SECOND SEMESTER

Course Code	Course Title	Class hours/week		Credit
		Theory	*Lab*	
ICT – 4000	Research Thesis/Project	0.00	3.00	3.00
ICT – 4201	Wireless and Mobile Communication	3.00	0.00	3.00
ICT – 4202	Wireless and Mobile Communication Lab	0.00	1.00	1.00
ICT – 4203	Optical Communication	3.00	0.00	3.00
ICT – 4205	Digital Signal Processing	3.00	0.00	3.00
ICT – 4206	Digital Signal Processing Lab	0.00	1.00	1.00
	Optional-V	3.00	0.00	3.00
	Optional-V Lab	0.00	1.00	1.00
Total		**12.00**	**6.00**	**18.00**

Optional-V (Select Any One)

Course Code	Course Title	Class hours/week		Credit
		Theory	*Lab*	
ICT – 4207	VLSI Design	3.00	0.00	3.00
ICT – 4208	VLSI Design Lab	0.00	1.00	1.00
ICT – 4209	Communication Management	3.00	00.00	3.00
ICT – 4210	Communication Management Lab	0.00	1.00	1.00
ICT – 4211	Artificial Intelligence	3.00	00.00	3.00
ICT – 4212	Artificial Intelligence Lab	0.00	1.00	1.00
ICT – 4213	Software Quality Assurance and Testing	3.00	00.00	3.00
ICT – 4214	Software Quality Assurance and Testing Lab	0.00	1.00	1.00

FIRST YEAR FIRST SEMESTER

ICT – 1101   Basic Electrical Circuit   Credit – 3.00
Contact hr/Week: 3

Network Circuit and Analysis: Fundamental electric concepts and measuring units, D.C. voltage, D.C Current, Resistance and power, dependent and independent sources, Series, Parallel, Series-Parallel circuits, Open and short circuits, Star-Delta conversion.
Networks Theorems: Superposition theorem, Thevenins theorem, Norton's theorem, Maximum Power Transfer theorem, Millman's theorem.
Basic Passive Elements: Resistor, Capacitor and Inductors in series and parallel, Transient in capacitive network, charging phase and discharging phase, RLC circuits.
Magnetic circuits: Introduction to magnetic circuits, Solution of magnetic circuits, Hysteresis and eddy current losses.
Fundamental of AC and the basic elements and phasor: Generation of the ac voltage and current; The sine wave; General format of sinusoidal voltage and currents; Phase and Algebraic representation of sinusoids; Average and RMS value; Frequency Response of the Basic elements; Average Power and Power factor; Complex Numbers: Rectangular and Polar form; Series and Parallel ac circuits; Series-Parallel ac circuits.
Resonance: Series and Parallel resonant circuit, Selectivity, Quality Factor.

Recommended Books:

Sl.	Book Name		Author Name
1.	Introductory Circuit Analysis	:	Robert L. Boylested
2.	Lesson's in Electrical Circuit	:	Tony R. Kuphaldt
3.	Electrical Circuits	:	W. Nilson& S.A. Riedel
4.	Introductory Circuitry for Electrical and Computer Engineering	:	Nilson
5.	Principles of electrical circuits	:	Alexander

ICT – 1102   Basic Electrical Circuit Lab   Credit –1.00
Contact hr/Week: 2

Laboratory based on the course ICT-1101.

ICT – 1103   Computer Programming   Credit –3.00
Contact hr/Week: 3

Introduction: Definition of Software, its classification, Problem solving steps, Introduction of C and its structure, history and Characteristics, Introduction to keywords, constants and identifiers, Fundamental of C variable and data types, Rules of constants, Introduction to arithmetic, relational and logical operators, Introduction to expressions, Managing data input, Managing data output.
Control statements: Decision making and branching. *If* and *if… else* statements, Other control statements, *switch* and the '?:' operator, Decision making and looping. *While* looping, *Do…while* and *for* looping statements, Jump statement *goto, break* and *continue.*
Array: Introduction to arrays. One-dimensional array. Some sample programs, Two-dimensional array. Some sample programs, String handling in C and some examples.
String: Introduction to character Arrays and String, Declaring and Initializing String variables, Reading Strings from Terminal, Writing String to Screen, Putting String Together, Comparison of Two Strings, String Handling Functions, Table of Strings.
Function: Need for multifunction programs, Definition of Function, return values, types and some examples, Function Calls, Function Declaration, Calling functions and arguments, Nesting of Function, Recursions, passing arrays to functions, Passing string to function, The Scope, Visibility and Lifetime of Variables, Storage class.

Recommended Books:

Sl.	Book Name		Author Name
1.	Theory and Problems of Programmin with C	:	Byron S. Gottfried
2.	Teach Yourself C.	:	Herbert Schild
3.	How to Program	:	Deitel H. M. and Deitel
4.	The Waite Group's C Programming using Turbo C++	:	Robert Lafore
5.	Let Us C	:	YashavantKanetkar
6.	Turbo C/C++: The Complement Reference	:	Herbert Schildt
7.	Programming in ANSI C	:	E. Balagurusamy
8.	The C programming Language	:	C Kernighan & D.M. Ritchie

ICT-1104   Computer Programming Lab   Credit –1.00
Contact hr/Week: 2

Laboratory based on the course ICT-1103.

ICT-1105   Physics   **Credit – 3.00**
Contact hr/Week: 3

Solids and Semiconductors: Solids, Crystalline Solids, Amorphous Solids, Crystal lattice, Basis, Unit cell, Lattice Parameters, Single Crystals, Polycrystals, Energy Bands in Solids, and Semiconductors, Charge Carriers in Semiconductors, Intrinsic and Extrinsic Semiconductors, Doping, N-type and P-type semiconductors, Electron and Hole Concentrations in Intrinsic Semiconductor in Thermal Equilibrium, Fermi Levels in N-type and P-type Extrinsic Semiconductors, Electrical Conductivity, diffusion Current.

Wave and Oscillation: Simple harmonic motion, Combination of S.H.M. and Lissajous figures, Damped Oscillations, Forced Oscillations, and Resonance. Traveling waves, the principle of superposition, Wave velocity, Group velocity and phase velocity, Power and intensity in wave motion, Interference of waves, Diffraction of waves, Standing waves. Audible, Ultrasonic, Infrasonic and Supersonic waves; Propagation and speed of longitudinal waves, Traveling longitudinal waves, Standing longitudinal waves, Beats, The Doppler effect.

Electricity & Magnetisms: Electronics: Charge & Matter, Column's Law, The Electric Field, The electric field strength, Line of force, A dipole in an electric field, Gauss's Law, Gauss's law and Coulomb's law, Electrical Potential, Capacitance & Resistance, Ohmic& non Ohmic material. Electromagnetism: Magnetic fields, Magnetic Force on a current, The Hall effect.

Physical Optics: Theories of light; Hyugen's principle and construction. Interference of light; Young's double slit experiment, Fresnel bi-prism, Newton's ring, interferometers. Diffraction of light; Fresnel and Fraunhoffer diffraction, diffraction by single and double slit diffraction gratings. Polarization, production and analysis of polarized light, optical activity, optics of crystals, optical guiding properties in details.

Recommended Books:

Sl.	Book Name		Author Name
1.	Modern Physics	:	R. Murugeshan and KiruthigaSivaprasath
2.	Concepts of Modern Physics	:	A. Beiser
3.	Modern Engineering Physics	:	A. Vasudeva
4.	Solid State Physics	:	R. P. Singhal
5.	Electricity and Magnetism	:	R. Murugeshan
6.	A Textbook of Optics	:	N Subrahmanyam and BrijLal
7.	Optics and Spectroscopy	:	R. Murugeshan and KiruthigaSivaprasath
8.	Waves and Oscilation	:	BrijLal

ICT – 1107   Mathematics-I (Differential and Integral Calculus)   **Credit – 3.00**
Contact hr/Week: 3

Differential Calculus: Limits, continuity and differentiability; Successive differentiation of various types of functions; Leibniz's Theorem; Rolle's Theorem; Mean value Theorem 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; Asymptotes, curve tracing.

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; Intrinsic equation; Volume of solids of revolution; Volume of hollow solids of revolution by shell method. Area of surface of revolution; Jacobian, multiple integrals and their application.

Recommended Books:

Sl.	Book Name		Author Name
1.	Differential and Integral Calculas	:	B.C. Das & B. N. Mukherjee
2.	Calculas A New Horizon	:	Howard Anton and Stephen Devis
3.	EngineeringMathmatics	:	K.A. Stroud
4.	Advanced Calculas	:	M. R. Spiegel
5.	Calculus with Analytic Geometry	:	Earl W. Swokowski
6.	Advanced Engineering Mathematics	:	Erwin Kreyszig
7.	Integral Calculus	:	P. K Bhattacharjee

ICT – 1109   Technical Communicative English   **Credit – 2.00**
Contact hr/Week: 2

Grammar: Grammatical principles, modals, phrases & idioms, prefixes & suffixes, sentence structures, wh & yes/ no questions, conditional sentences.

Vocabulary: Technical & Scientific Vocabulary, defining terms.

Spoken English: Introduction to phonetic symbols, dialogue, responding to particular situations, extempore speech.

Reading: Comprehension of technical & non-technical materials skimming, scanning, inferring & responding to context.

Technical Writing: Paragraph & composition writing on scientific & other themes, report writing, research paper writing, library references.

Professional communication: Business letter, job application, memos, quotations, tender notice.

Recommended Books:

Sl.	Book Name		Author Name
1.	Prose of Our Time	:	Ahsanul Haque, S. I. Chawdhury & M. Shamsuddoha
2.	A Practical English Grammar	:	A. J. Thomson & A. V. Martinet:
3.	Technical Writing	:	John M. Lennon:
4.	Oxford Handbook of Commercial Correspondence	:	A. Ashley:
5.	Writing Scientific English	:	J. Swales:
6.	Complete Course in English	:	Robert J. Dixson:
7.	Essentials of Business Communications	:	Rajendra Pal & J. S. Korlahalli

Option-I (Select any one from I)

ICT – 1111 Technology, Environment and Society   Credit – 3.00
Contact hr/Week: 3

Definition of terminology – technology, environment and society; Interdependence of technology , environment and society; Growth of technologies and its contribution to human development; Technology and competitiveness; Technical change and worker's skills – effect of innovation on labor and employment's – the human element;

Current state of technology and its future use as an instrument of change in twenty first century; Environment, Concept of environment, concept of environmental impact, impact of technology and human upon the environment, impact of the environment upon human, change in the global climate; Water – its use and abuse; waste water, air pollution – past, present and future;

Solid waste –types, collection, disposal, potential uses for solid wastes; System for resource and energy recovery – renewable energy – scientific principle, technical implications and social implications Radiation hazards – radioactivity in human environments, disposal of under wastes.

Society factors leading to the growth of a society, rights of a citizen; Urban growth and decay; human impact on wildlife; Maintaining human habitat on earth; Population control- policies and prospects.

ICT – 1113 Sociology   Credit – 3.00
Contact hr/Week: 3

Define Sociology, Nature & Scope of Sociology. Development of Sociology, Relation with ICT.
Primary Concept: Society, Community, Association, and Institution.
Culture: Components of Culture, norms, values, folkways, mores, custom, fashion etc., Culture & Civilization Types of Society: Orientate & Occidental Society.
Social Institution: Family, Religion. Social Stratification & Mobility: functionalist & Conflict Perspective. Social change: Theories of social change.
Social Structure: Components of social Structure. Ethics of Bhashani. Bureaucracy as organ of modern state, Marxism, Power Authority, Pressure Group. Government effects of sociology on society.
Recommended Books:

Sl.	Book Name		Author Name
1.	Sociology	:	P.B. Horton, C.L. Hunt
2.	Sociology	:	R.T. Schaefer
3.	Sociology	:	B.B. Hess, E.W.Markson

ICT – 1115 Legal Issues and Management for Engineers   Credit – 3.00
Contact hr/Week: 3

Business and industrial law: Law of contract, elements of valid contract, Consideration, Parties competent to contact, Sale of goods, hire and purchase, Negotiable instrument.
Industrial law in Bangladesh: various ordinance payments of wages, legislation relating employment in industries, factories, shops and agriculture, trade union act.
Human resources management in business: Human factors and motivation, leadership, group decision making and communication, job gradation, process of performance appraisal and reward systems, managing information for decision and management information systems.
Marketing management: Understanding marketing management, developing marketing strategies, conducting marketing research, analyzing consumer and business market, identifying market segments and targets, dealing with competition.
Safety: Evolution of modern safety concepts, industrial hazards, safety and risk management, productivity, worker health and safety, proactive management techniques for safety management, safety standards and regulations for engineering work, fire safety, hazardous materials.

FIRST YEAR SECOND SEMESTER

ICT-1201 Electronic Devices and Circuit Theory   Credit – 3.00
Contact hr/Week: 3

Theory of semiconductor: Energy band diagram of conductor, insulator and semiconductor, intrinsic and extrinsic semiconductor, effects of temperature on extrinsic semiconductors, Drift, Diffusion and other carrier theory.
Semiconductors diodes: Theory of p-n junction as diode, Junction diode characteristics and applications, Zener diodes and its application, Schottky Barrier Diodes, Varactor Diodes, Photo Diodes, Tunnel diodes, PIN diode, LCD, Half wave and full wave rectification with filtering and voltage regulators and power supply design.

Bipolar Junction Transistor (BJT): PNP and NPN transistors, principles of operation, biasing and thermal stability, characteristics in different configurations, small signal analysis, BJT amplifiers, π-model, T-model, transistor switching time, equivalent circuits using transconductance parameter for low, medium and high frequency operation of BJT.

Field Effect Transistor (FET): Construction of JFET and MOSFET, characteristics and principles of operation, FET biasing, small signal analysis, introduction to CMOS and its application. Application of FETs as amplifier and switches, load line analysis, equivalent circuits using transconductance parameter for low, medium and high frequency operation of FETs, Ebers-Moll model view; design and analysis of single/multistage amplifiers, power amplifiers, differential amplifiers.

Industrial Semiconductor Device: Structure and basic operation of LED, SCR, UJT, DIAC, TRIAC, photo diodes, phototransistor, solar cells, Concept on vacuum devices.

Recommended Books:

Sl.	Book Name		Author Name
1.	Microelectronic Circuits	:	Sedra& Smith
2.	Electronic Devices & Circuits	:	Millman&Halkias
3.	Electronic Devices & Circuits	:	Bapat K N
4.	Functional Electronics	:	Ramanan
5.	Pulse Digital and Switching Waveforms	:	Millman&Taub
6.	Electronic Devices & Circuits	:	Allan Mottorshed
7.	Integrated Electronics	:	Millman&Halkias
8.	Electronic Devices & Circuit Theory	:	Boylestead&Neshelsky
9.	Electronic Circuits ,Discrete & Integrated" TMH	:	Schilling &Belove
10.	Priciples of Electronics	:	K Metha

ICT-1202 Electronic Devices and Circuit Theory Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-1201.

ICT-1203 Programming with C++   Credit – 3.00
Contact hr/Week: 3

Introduction: Structure (Definition of Structure, Union, Structure union applications, Declaring Structure Variables, Accessing Structures Members, Arrays within Structure, Self-referential Structure, Array of structure and some examples); Pointer (Understanding pointers, Pointers and arrays, Pointers and functions, pointers and structures, Some special features of C (Macros, Enumerations), Bitwise operations); File management (File management concept in C, Defining, opening and closing a file, Input/output operations in file, Error handling and command line arguments, Introduction to graphics, Drawing some geometric objects).

Basic of OOP: Introduction to C++ , the origin of C++, Basic structure of C++ programs, Variables, constants, operators and expressions, data types, Program control statements, recursion, Arrays and strings, pointers, Advanced data types, access modifiers, pointer to function, dynamic memory allocation, User defined data types, advanced operators. Object oriented programming: Concepts of object oriented programming, objects, polymorphism, inheritance, OPP with C++, Classes, parameterized constructors, friend functions, multiple inheritance, passing object to functions, arrays of objects, pointer to objects. Function and operator overloading, overloading constructor functions, references, Inheritance, virtual functions and polymorphism, C++'s I/O class library, C++ streams, creating insertors and extractors, formatting I/O, file I/O, Dynamic allocation using new and delete, Static class members, C++'s complex and BCD classes, the message based philosophy, using C++'s memory model, Using VROOMM overlay technology, Using command line compiler, compiling multiple file program.

Recommended Books:

Sl.	Book Name		Author Name
1.	Object Oriented Programming in C++	:	Robert Lafore
2.	Teach yourself C++	:	Herbert Schildt
3.	Object-Oriented Programming with C++	:	E Balagurusamy
4.	C++ Object Oriented Programming	:	Irvine
5.	The Complete Reference C++	:	P. Naughton and H. Schildt

ICT-1204 Programming with C++ Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-1203.

ICT-1205 Data Structure   Credit – 3.00
Contact hr/Week: 3

Introduction: Concept of data types, abstract data types.

Array: Insertion, Deletion, Matrix representation of arrays, Multidimensional arrays, Pointers arrays, Record structures, Representation of records in memory; parallel arrays. Sparse matrices. Usefulness of sparse matrices.

Stack and Queue: Push and Pop operations. Arithmetic expression: polish notation implementation using stack Queue: Insert and Delete operations. Double ended queue, Priority queue.

Recursion: Direct and indirect recursion, Simulation of recursion, Depth of recursion, Removal of recursion. Towers of Hanoi using recursion. Linked lists: One way and two way linked lists. Traversing, Searching, Insertion and Deletion operations. Concept of algorithm analysis.

Sorting and Searching: Bubble sort, Quick sort Merge sort, Selection sort, Inserting sort, Radix sort, Shell sort, linear searching, binary searching.

Tree: Binary Trees, Binary Search Trees: Traversing (inorder, preorder, postorder). Insertion and deletion operations in Binary search trees. Threaded Binary Tree, Application of trees. Set representation, decision trees, game trees and counting binary trees. B-tree and basic operations on B-tree. Binomial tree and binomial heap, operation on binomial heaps. Fibonacci heaps and operations. Heap sort. Huffman codes and compression algorithm. Disjoint set and operations and disjoint set forests forests.

Graphs: Graph representation, Adjacency matrix, Path matrix, Linked representation. Shortest paths: Warshall 's algorithm. Operations on graphs, traversing a graph, Spanning trees.

Symbol tables: Static and dynamic tree tables. Hashing: Hash function and overflow handling, Open hashing (Separate chaining), Close hashing (Open addressing), Linear probing, Quadratic probing, Double hashing.

Recommended Books:

Sl.	Book Name		Author Name
1.	Data structures	:	Edward M. Reinggold
2.	Algorithms in C	:	Robert Sedgwick
3.	Fundamentals of Data Structures	:	Horowitz E and Sahni S Galgotia
4.	Algorithms and Data Structures	:	Niklauswirth
5.	Data Structure	:	Seymour Lipschetz
6.	Data Structures Using C and C++	:	Y. Langsam, Augenstein, A. M. Tanenbaum

ICT-1206   Data Structure Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-1205.

ICT-1207   Discrete Mathematics   Credit – 3.00
Contact hr/Week: 3

Introduction: Set theory-Set operation, Representation of Sets, Algebraic Properties of set, computer representation of set, Logic-Prepositional Calculus, Logic and bit operation, Predicate and quantifier, Translating sentence into logical expressions

Function: Introduction of function, some important function, Properties of function, Sequence and summation, Relation-Representation of Relation, Properties of Relation, Some important Relations, Closures of relation.

Number Theory: Fundamental Theorem of Arithmetic, Modular Arithmetic; GCD, LCM, Prime Number, Congruence, Application of Congruence, Linear Congruence, Application of Number Theory, Mathematical Induction, Methods of Proof, First and Second principle of Mathematical induction.

Counting Principle: Basic Counting principle, Inclusion-Exclusion principle, Application of Sum rule and Product rule, Pigeon hole principle, Permutation Combination, Binomial Theorem.

Definition of Graph: Types of graphs, Representation of graph, Euler and Hamilton path, circuit, necessary and sufficient conditions.

Graph coloring: Isomorphism of graph, Tree- Comparison of tree and Graph, Spanning tree, algorithm of several trees, Application of trees, Tree Traversal, Trees and sorting.

Recommended Books:

Sl.	Book Name		Author Name
1.	Discrete Mathematics and its Applications	:	Kenneth H.Rosen
2.	Discrete Mathematics	:	Olympia Nicodemi
3.	Concrete Mathematics	:	Knuth
4.	Theory and Problems of Discrete Math	:	Seymour Lipschutz& Marc LarisLipson
5.	Discrete Mathematics in Computer Science	:	Donald F. Stanat& David F. McAllister
6.	Discrete Mathematical Structures	:	B. Kolman, R.C. Busby and S. Ross
7.	Elements of Discrete Mathematics	:	C. L. Liu

ICT-1209   Matrices and Co-ordinate Geometry   Credit – 3.00
Contact hr/Week: 3

Matrices: Definition of matrix; Different types of matrices; Algebra of matrices; Adjoint and inverse of a matrix; Elementary transformations of matrices; Determinants: Matrix polynomials; Calay-Hamilton theory with uses of rank and nullity; Normal and canonical forms; Solution of linear equations; Eigenvalues and eigenvectors.

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; Co-ordinate Geometry of three dimensions: System of co-ordinates, Distance of two points, Section formula, Projections, Directiones cosines, Equation's of planes and Lines.

Recommended Books:

Sl.	Book Name		Author Name
1.	Co-Ordinate Geometry	:	Md. Abdur Rahman
2.	Engineering Mathematics	:	K.A. Stroud
3.	Liner Algebra	:	Richard Bronson

4.	Calculus with Analytic Geometry	:	Earl W. Swokowski
5.	Matrices	:	P. N. Chatterjee
6.	Calculus and analytic geometry	:	Thomas, Finey
7.	Co-ordinate geometry & vector analysis	:	P. K. Bhattacharjee

ICT-1210   Software Development Project-I   **Credit – 1.00**
Contact hr/Week: 2

Students will develop a project work using C and C^{++} programs assigned by course teacher

Option-II (Select any one Non Credit Course)

ICT-1211   Bhashani Studies   **Credit – 2.00**
Contact hr/Week: 2

The Syllabus of this course is under construction

ICT-1213   Bangladesh Studies   **Credit – 2.00**
Contact hr/Week: 2

The Syllabus of this course is under construction

SECOND YEAR FIRST SEMESTER

ICT-2101   Operational amplifiers and Timer Circuits   **Credit – 3.00**
Contact hr/Week: 3

Operational amplifiers and applications: Linear application of op-amp,Feedback, gain, input and output impedances, Properties of an ideal Op-Amp, non-inverting and inverting amplifiers, integrator, differentiator, weighted summer and other applications of Op-Amp circuits, frequency response and bandwidth.
Oscillators circuits and wave generators: Phase shift oscillator, Wine Bridge, Crystal, Tune collector oscillators, Sinusoidal. Feedback, Comparators and Converters, Schmitt trigger.
Active Filters: Butterworth filters, Band-pass filters, Band Reject Filters, All pass Filters.
Linear wave shaping: Linear and non-linear wave shaping. Diode Wave Shaping Techniques, Clipping and Clamping circuits. Non-linear function circuits. Negative resistance switching, Voltage regulators, Pulse generation.
Timing Circuits: Bi-stable, monostable and astablemultivibrators, sweep and staircase generator, IC 555 and its application. Application of Op-Amp in timing circuits.VCO, PLL, blocking oscillators, practical op-amp ICs and advanced ICs.

Recommended Books:

Sl.	Book Name		Author Name
1.	Op amps and Linear Integrated circuits	:	R F Coughlin
2.	Design with operational Amplifiers Analog Ics	:	Sargio Franko
3.	Microelectronics	:	Millman&Grabel TMH
4.	Op-amps and Linear integrated Circuits	:	Gaykwad
5.	K R Botkar	:	Integrated circuits
6.	Analog Integrated Citcuits	:	Gray John
7.	Micro Electronics	:	Horstian
8.	Microelectronic circuit	:	Sedra& Smith
9.	Opamps and Linear integrated Circuits	:	D A Bell

ICT-2102   Operational amplifiers and Timer Circuits Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-2101.

ICT-2103   Digital Logic Design   **Credit – 3.00**
Contact hr/Week: 3

Basic Logic Circuits: Gates; Boolean Algebra; De Morgan's Theorem; Half and Full Adders, Sub tractor, Sum of products and Product of sums; Mapping technique; Karnaugh map; Minimization of Logic circuits.
Combinational Circuits: Encoders & Decoders; Comparator; Parity generator, ALU; Multiplexer, Demultiplexers.
Silicon integrated Logic Families: AND, OR, INVERTER, other logic families with TTL, TL, RTL, RCTL, TIL, ECL, IIL, SOS, FET, & CMOSTL families
Sequential Circuits: S-R, M/S, JK, D and T Flip-flops and Latches, Registers and Counters; Asynchronous and Synchronous counters, Different types of Registers; Counter application: Frequency and Digital Clock.
Memory Circuit & System: Introduction to memories; SAM; ROM; Static and Dynamic RAM, Flash memories, Charge coupled device and magnetic bubble memories. A/D Converter, D/A Converter.
Arithmetic of Computers: Constructing an Arithmetic Logic Unit, Multiplication, Division, Floating Point. The Processor: Data path and Control: Introduction, Building a Data path, A Simple Implementation Scheme, A Multicycle Implementation, Microprogramming: Simplifying Control Design.

Recommended Books:

Sl.	Book Name		Author Name
1.	Digital Integrated Electronics", McGraw Hill	:	Taub& Schilling
2.	Digital Circuits and Logic Design", Prentice Hall	:	Samuel C Lee
3.	Digital Computer Electronics", Tata McGraw Hill	:	A P Malvino
4.	Design with TTL Integrated Circuit", McGraw Hill	:	Morris & Miller
5.	Digital Hardware Design", McGraw Hill	:	Peatman
6.	Digital Systems, Principles and Applications ", Prentice Hall	:	Ronald J Tocci
7.	Switching Theory	:	Dr. V. K. Jain
8.	An engineering approach to Digital Design", Prentice Hall	:	William I Fletcher
9.	Switching and Finite automata Theory"TMH	:	ZviKohavi
10.	Digital system Design and Microprocessors" McGraw Hill	:	Hayes
11.	Digital Hard Ware Design", McGraw Hill	:	John B Peat man

ICT-2104   Digital Logic Design Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-2103.

ICT-2105   Object Oriented Programming With Java   **Credit – 3.00**
Contact hr/Week: 3

JAVA: Introduction to OOP, Data Types and Variables Operation and Expressions Features of Object Oriented Programming Control Structures, Decision Making, Looping, Branching
Arrays, String Vectors, Java Methods, Concept of classes and objects, Encapsulation ,Inheritance, Interfaces, Abstract Class and Multiple Inheritance, Polymorphism, Interfaces and Multiple Inheritance, API, Overriding, Overloading, Packages, Generics, Collections, Thread, Multithreading, Error and Exception Handling, Graphical User Interfaces, Java Applets, Files and Streams, Java Database Connectivity (JDBC), Servlet, JSP.

Recommended Books:

Sl.	Book Name		Author Name
1.	The Complete Reference java 2	:	P. Naughton and H. Schildt
2.	Java How to Program	:	Deitel&Deitel
3.	The Complete Reference, Java-2	:	Patrick Naughton, Herbert Schildt
4.	Programming with Java	:	E. Balagurusamy
5.	Teach Yourself Java-2 in 21 days	:	SAMS publications
6.	Programming with Java	:	A primer, E Balagurusamy
7.	How to Program Java	:	Deitel&Deitel.
8.	The Complete Reference Java 2	:	NaughtonSchildt

ICT-2106   Object Oriented Programming With Java Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-2105.

ICT-2107   Algorithm Design and Analysis   **Credit – 3.00**
Contact hr/Week: 3

Algorithm and Data structure: Algorithm, Properties of good algorithm, Data Structure, Application Areas of Algorithm. Complexity Analysis of Algorithms, Asymptotic Notations, Recurrences, Insertion Sort and its Complexity Analysis.
Divide and Conquer approach & Heaps: Divide and Conquer approach and Merge Sort, Algorithm of Merge Sort, Complexity Analysis Merge Sort, Quick Sort and its Algorithm, Complexity Analysis of Quick Sort, Heap Construction Algorithm, Heap sort, Application of Heap: Priority Queue.
Dynamic Programming: Algorithm of LCS**,** Dynamic Programming, Matrix Chain Multiplication Example, Algorithm of MCM, and Example of Longest Common Subsequence, Complexity Analysis
Greedy Algorithm: Greedy Algorithm, Activity Selection Problem, Huffman Codes and it's application, Knapsack problem, *NP*-Hard and *NP*-Complete Problems, Traveling Salesperson Problem, Complexity Analysis
Graphs basic & traversal techniques: Representation of Graphs, Breadth First Search, Depth First Search, Algorithm of BFS and DFS, Minimum Spanning Tree, Kruskal and Prims Algorithm, Complexity Analysis.
Shortest Path & Backtracking: Single Source Shortest Paths, Dijkstra's Algorithm, and Bellman-Ford Algorithm. All pair Shortest Path, Floyd Warshall Algorithm, Backtracking, *n*-Queen Problem, and Complexity Analysis, Branch and Bounds.
Computational Geometry & Number Theory: Computational Geometry, Line Segment Properties, Convex Hull, Graham Scan Algorithm of Convex Hull, Number Theory, GCD, Modular Arithmetic, Prime Number generation, Complexity Analysis.

Recommended Books:

Sl.	Book Name		Author Name
1.	Introduction to Algorithms	:	Cormen
2.	Computer Algorithms	:	Horowitz, Shanny
3.	The art of Computer Programming	:	D. E. Knuth
4.	Data Structure and Algorithm analysis in C++	:	M. Allen

ICT-2108   Algorithm Design and Analysis Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-2107.

ICT-2109   Differential Equation and Vector Calculus   Credit – 3.00
Contact hr/Week: 3

Ordinary Differential Equation (ODE): Degree and order of ordinary differential equations; Formation of differential equations; Solution of first order differential equations by various methods; Solution of first order but higher degree ordinary differential equations; Solution of general linear equations of second and higher orders with constant coefficients; Solution of homogeneous linear equations and its applications; Solution of differential equations of higher order when dependent and independent variables are absent; Solution of differential equation by the method based on factorization of operators.
Partial Differential Equations (PDE): Introduction. Linear and non-linear first order equations. Standard forms. Linear equations of higher order. Equations of the second order with variable coefficients. Wave equations. Particular solution with boundary and initial conditions.
Series Solution: Solution of differential equations in series by the method of Frobenius; Bessel's functions, Legendre's polynomials and their properties
Vector Algebra: Scalars and vectors, equality of vectors; Addition and subtraction of vectors; Multiplication of vectors by scalars; Scalar and vector product of two vectors and their geometrical interpretation; Triple products and multiple products; Linear dependence and independence of vectors.
Vector Calculus: Differentiation and integration of vectors together with elementary applications; Definition of line, surface and volume integrals; Gradient, divergence and curl of point functions, various formulae, Gauss's theorem, Stoke's theorem, Green's theorem.

Recommended Books:

Sl.	Book Name		Author Name
1.	Engineering Mathematics	:	K.A. Stroud
2.	Differential Equation	:	F. Ayres
3.	Further Engineering Mathematics	:	K.A.Stroud
4.	Differential Equation	:	B. D. Havog
5.	Vector Analysis	:	M. R Spiegel
6.	Advanced Engineering Mathematics	:	H. K. Das
7.	Differential Equation	:	BhuDev Sharma
8.	Differential Equation	:	Gupta and Sharma
9.	Applied Vector Analysis	:	Matiur Rahman

ICT-2111   Statistics   Credit – 2.00
Contact hr/Week: 2

Analysis of statistical data: Location, Dispersion and their measures, Skewness, Kurtosis and their measures, Moment and Cumulants and Practical examples.
Probability: Concept of probability, Sample Space, Events union and Intersection of Events. Probability of events, Loss of probability, Conditional probabilities. Bose Einstein Statistics. Bay's Theorem, Chebysec's Inequality and Practical examples.
Random variables and probability Distribution: Basic concepts, Discrete and continuous random variables, Density and distributional functions, Mathematical expectation and variance, Joint marginal and conditional density functions. Conditional Expectation and conditional variance. Moments and Cumulant generating functions. Characteristic function. Study of Binomial Poisson, Normal and Bivariate Normal distribution and Practical examples.
Linear Regression: Correlation, Rank correlation. Partial and Multiple correlations Linear Regression for two Variables, Principle of Least Squares Method, Lines of best fit, Residual Analysis and examples.
Test of Significance: Basic ideas of Null hypothesis, Alternative hypothesis, Type-I error Type-II error level of significance Degree of freedom, Rejection region and Acceptance region. Test of Single mean, Single variance, Two sample means and Variances. Test for 2×2 contingency tables, Independence test and practical examples.

Recommended Books:

Sl.	Book Name		Author Name
1.	Introductory Statistics	:	P.G.Hoel.
2.	Fundamentals of Statistics	:	S.G. Gupta
3.	Interpreting Data	:	A.J.B.Anderson
4.	The Elements of Probability Theory	:	H. Cramer
5.	Introduction to Probability and Statistics	:	D.V.Lindley
6.	Probability	:	S.Lipschutz.
7.	Probability with Statistical Applications	:	Mosteller, Rourke & Thomas
8.	Elements of Probability and Statistics	:	F.L.Wolf.
9.	Introductory Statistics	:	T.H. Wonnacot & R.J. Wonnacot
10.	An Introduction to the Theory of Statistics	:	Yule & M.G.Kendall

ICT – 2201   Computer Organization and Architecture   Credit – 3.00
Contact hr/Week: 3

Computer abstraction and technology: Introduction, Below Your Program, Under the Covers, Integrated Circuits: Fueling, Innovation. The roll of performance: Introduction, Measuring Performance, Relating the Metrics, Choosing Programs to, Evaluate Performance, Comparing and Summarizing Performance.

Language of the Machine: Introduction, Operations of the Computer Hardware, Operands of the Computer Hardware, Representing Instructions in the Computer, Instructions for Making Decisions, Supporting Procedures in Computer Hardware, Beyond Numbers, Other Styles of MIPS Addressing.

Arithmetic of Computers: Introduction, Signed and Unsigned Numbers, Addition and Subtraction, Logical Operations, Constructing an Arithmetic Logic Unit, Multiplication, Division, Floating Point. The Processor: Data path and Control: Introduction, Building a Data path, A Simple Implementation Scheme, A Multicycle Implementation, Microprogramming: Simplifying Control Design.

Enhancing performance with pipelining: An Overview of Pipelining, A Pipelined Data path, Pipelined Control, Data Hazards and Forwarding, Data Hazards and Stalls, Branch Hazards. Multiprocessors: Introduction, Programming Multiprocessors, Multiprocessors Connected by a Single Bus, and Multiprocessors Connected by a Network, Clusters, and Network Topologies.

Memory Organization: Introduction, Characteristics of memory systems, Main memory design, Memory hierarchy, Cache memory, Virtual memory and memory management concepts.

Recommended Books:

Sl.	Book Name		Author Name
1.	Computer Architecture and Organization	:	J. P. Hayes
2.	Fundamentals of Computer System Architecture	:	Dr. M. Rafiquzzaman
3.	Microprocessor, Architecture, Programming & Application with 8085	:	Romesh S. Gaonkar
4.	Computer Architecture	:	ShafwatZaky
5.	Computer Organization and Design	:	John Hennesy, David Patterson

ICT – 2203   Computer Based Numerical Methods   Credit – 3.00
Contact hr/Week: 2

Introduction: Significant figure, Rounding off numbers, Error in Numerical Calculation. Solution of Algebraic and Transcendental Equation, Interpolation with equal and unequal intervals- Missing values, Newton's binomial expansion formula, Newton's forward and backward interpolation formula. Central difference interpolation formulae, inverse interpolation.
Numerical Differentiation: Derivate using Newton's forward backward and Stirling's formula.
Numerical Integration: General quadrature formula for equidistant ordinates. Trapezoidal rule, Simpson's one-third rule, Simpson's three-eight rules, Weddle's rule.
Numerical solution of ordinary differential equations: Taylor's series method, Euler's method, Adams Bashforth Moulton method, Runge-Kutta method.
Solution of linear equations: Gauss-elimination method, Iteration methods. Gauss-Seidel method, Gauss-Jordan method.
Curve Fitting: objective of fitting a curve, fitting a straight line, fitting a parabola

Recommended Books:

Sl.	Book Name		Author Name
1.	Numerical Analysis, New Age International (P) Limited	:	G. Shanker Rao
2.	Numerical Methods	:	Mathus
3.	Numerical methods for Engineer.	:	Steven C Chapra
4.	The Engineering of Numerical Software.	:	Webb Miller
5.	Simplified Fortran Guide.	:	K. R. Jackson

ICT – 2204   Computer Based Numerical Methods Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-2203.

ICT-2205   Advanced Java and Mobile Application   Credit – 3.00
Contact hr/Week: 2

Java Database Connectivity: JDBC Product, Types of Driver, Two tier Client/Server Model, Three tier Client/Server Model, Basic steps of JDBC, Creating and Executing SQL statement, The Result Set Object, Working with Database Meta Data, Interface
Servlets: Servlet Interaction & Advance Servlet, Life Cycle of Servlets, Java Servlet Development Kit, Javax.servlet package, Reading Servlet parameter, Reading Initilization parameter, The Javax.servlet.http Package, Handling http
JavaServer pages: JSP Technologies, Understanding the Client Server Model, Understanding the Web Server Software, Configuring the JSP Server, Handling JSP Errors, JSP translation time Errors, JSP Request Time Errors, Creating a JSP Error Page
Remote Method Invokation: RMI Architecture, Designing RMI Aplication, Executing RMI Aplication.
EJB: Types of Enterprise Java Beans, Session Bean & Entity Bean, Features of Session Bean, Life Cycle of Stateful Session Bean, Feature of Entity Bean, Container Managed Transaction, Bean Managed Transactions, Implementing a Container Managed Entity Bean, Cookies, Filtering.
XML: What is XML, XML Syntax Rules, XML Parsing.

Struts: Introduction to Apache Struts, MVC Architecture, Struts Architecture, How Struts Works, Introduction to Struts Controller, Introduction to Struts Action Class, Using Struts Action Form Class, Using Struts HTML Tags, Introduction to Struts validation framework, Client Side Address validation in Struts, Custom Validation Example, Developing Application with Struts tiles
Basic features of Hibernate and Spring Framework.

Recommended Books:

Sl.	Book Name		Author Name
1.	The Complete Reference Java 2	:	P. Naughton and H. Schildt
2.	The Complete Reference, Java-2	:	Patrick Naughton, Herbert Schildt
3.	Programming with Java	:	E. Balagurusamy
4.	Teach Yourself Java-2 in 21 days	:	SAMS publications
5.	Programming with Java.	:	A primer, E Balagurusamy
6.	How to Program Java	:	Deitel & Deitel
7.	The Complete Reference Java 2	:	Naughton Schildt

ICT-2206   Advanced Java and Mobile Application Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-2205.

ICT-2207   Database Management Systems   Credit – 3.00
Contact hr/Week: 3

Introduction: Database, data, database management system, Database system versus file system, Data model, Database language, Database user administration, Database system structure, Storage manager, Overview of Physical storage medium.
Entity-Relationship Model: Entity sets, Relationship sets, Mapping Cardinalities, Keys, Attributes, Entity relationship diagram, Weak entity sets, Specialization, Generalization, Structure of Relational databases, Database Schema.
The Relational Algebra and SQL: Selection, projection, Union, Set difference, Cartesian-product, Rename, Set-intersection, Natural-join, Division, Assignment, projection, Aggregate functions, Deletion, Insertion, Updating, Views, Nested sub-queries, Set membership, Set comparison.
Integrity and Security and Relational Database Design: Domain constraint, Integrity, Assertions, Triggers, Authorization, Authentication, Security, Privileges, Roles, Audit trails, Encryption-Decryption Algorithm, Normalization, Decomposition, Functional Dependencies, Closure of a set of Functional dependencies.
Database Design and E-R model: The Entity Relationship Model, Constraints, Entity Relationship Diagram, Entity Relationship Design Issues, Weak Entity Set, Extended E-R Features.
Storage and File Structure: Physical Storage Media, Magnetic Disk, RAID, Storage Access, File Organization, Organization of Record in Files, Data Dictionary Storage

Recommended Books:

Sl.	Book Name		Author Name
1.	Database System Concept	:	H. F. Korth
2.	SQL,PL/SQL	:	Ivan Bayross
3.	Access 2000 Developers Handbook.	:	Litwin,Paul
4.	SQL Star International Limited	:	Oracle
5.	Database Management Systems	:	BOU
6.	Fundamentals of Database Systems	:	Ramez E. Marsi
7.	Fundamentals of Database	:	Jeffry
8.	Oracle 8i the Complete Reference	:	Kock and Loney
9.	Oracle DBA Handbook	:	Kelvin Loney

ICT-2208   Database Management Systems Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-2207.

ICT-2209   Complex Variables and Fourier Analysis   Credit – 3.00
Contact hr/Week: 3

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; Mapping by elementary functions; Line integral of a complex function; Cauchy's Integral Theorem; Cauchy's Integral Formula; Liouville's Theorem; Taylor's Theorem and Laurent's Theorem. Singular points; Residue; Cauchy's Residue Theorem. Evaluation of residues; Contour integration; Conformal mapping.
Fourier Analysis: Fourier series, Convergence of Fourier Series, Fourier analysis; Fourier Integral; Fourier transforms and their uses in solving boundary value problems of wave equations.
Laplace Transforms: Definition; Laplace transforms of some elementary functions; Sufficient conditions for existence of Laplace transforms; Inverse Laplace transforms; Laplace transforms of derivatives. The unit step function; Periodic function; Some special theorems on Laplace transforms; Partial fraction; Solutions of differential equations by Laplace transforms; Evaluation of improper integrals.

Recommended Books:

Sl.	Book Name		Author Name
1.	Advanced Modern Engineering Mathematics	:	Glyn James
2.	Advanced Engineering Mathematics	:	Michael D. Greenberg
3.	Further Engineering Mathematics	:	K.A.Stroud
4.	Advanced Eng. Mathematics	:	H. K Das
5.	Advanced Calculus	:	M. R Spigel
6.	Complex Variable	:	M. R. Spigel
7.	Lap laces Transformation	:	Schaum Out Line Series
8.	Engineering Mathematics	:	Rajput
9.	Complex Variable	:	M. L. Khanna
10.	Laplace Transform	:	Schaum's Outlines Series
11.	Mathematical Method (Vol-I &Vol-II)	:	Abdur Rahman

ICT – 2211　　　Economics　　　　　　　　　　　　　　　　　Credit – 2.00
Contact hr/Week: 2

Introduction: Definition of economics, Scope and utility of studying economics.
Micro-economics: The theory of demand and supply and their elasticity, Price determination, Nature of an economic theory, applicability of economic theories to the problems of developing countries. Indifference curves technique, Marginal utility analysis,
Production: Production function, types of productivity, The nature of Isoquants and Isocosts, Rational region of production of an engineering firm. Euler's theorem.
Market: Concepts of market and market structure. Cost analysis and cost function. Small scale production and large-scale production, Optimization, Theory of distribution.
Macroeconomics: Savings, investment, employment, National income analysis, Inflation, Monetary policy, Fiscal policy and trade policy with reference to Bangladesh.
Economics of development: Dimensions of development, Relevance of theory, the employment problem, Human resource development
Economics of planning: Planning and market, Policy models, Planning experience

Recommended Books:

Sl.	Book Name		Author Name
1.	The Price System and Resource Allocation	:	Richard Leftwich
2.	Economics	:	P.A. Samuelson
3.	Economics	:	P.A. Samuelson &Nordhaus
4.	The Theory of Price.	:	G.J. Stigler

ICT-2213　　　Financial and Managerial Accounting　　　　　　　Credit – 2.00
Contact hr/Week: 2

Preliminaries: Introduction to Accounting, History and development of accounting thought, types of accounting, Accounting Principles & ethics, Accounting Equation & Transaction Analysis. Introduction to Financial Statements and automation accounting system.

Recording Business Transactions: The Accounts & their types. Double-Entry Book keeping system; Invoice, discount from purchase price, purchase return and allowances, Sale of inventory, sales discount, sales returns and allowances; Journals, ledger & Trial balance. Correcting errors in the trial balance.

The Adjusting & Closing Procedure: The adjusting process, Accrual versus cash basis Accounting, Preparation of Adjusted trial balance and financial statements, Closing entries & Reversing entries. Using accounting information in decision-making.

Accounting in practice: Worksheet. Purchase book, sales book, cashbook, patty cashbook, etc. Control accounts and subsidiary accounts. Bank reconciliation statement.

Cost In General: Cost in general: objectives & classifications; Costing Journals; Job order costing, Process costing & Overhead costing, cost sheet; Cost of goods sold statement.

Marginal & Relevant costing: Marginal costing tools and techniques, cost-volume-profit analysis. Guidelines for decision making.

Budget: Capital budgeting; Planning, evaluation & control of capital expenditures.

Recommended Books:

Sl.	Book Name		Author Name
1.	Accounting	:	Charles T. Horngren & walter T. Harrison
2.	Cost Accounting Planning & Control	:	Adolph Matz & Milton F. Usry
3.	Practice in Accountancy	:	Sankar Prasad Basu & Monilal Das
4.	Accounting Principles	:	Jerry J. Weygandt, Donald E. Kieso
5.	Intermediate Accounting	:	Jay M Smith & K Fred Skousen
6.	Accounting	:	Charles T. Horngren&walter T. Harrison
7.	Cost Accounting	:	Adolph Matz& Milton F. Usry

ICT – 3101   Data Mining   Credit – 3.00
Contact hr/Week: 3

Data Mining :Definitions; KDD(Knowledge Discovery database) versus Data Mining; DBMS versus Data Mining, Data Mining Techniques; Issues and challenges;Applications of Data Warehousing & Data mining in Government.

Association Rules:A priori algorithm, Partition algorithm, Dynamic inset counting algorithm, FP – tree growth algorithm; Generalized association rule.

Clustering Techniques: Clustering paradigm, Partition algorithms, CLARA, CLARANS; Hierarchical clustering, DBSCAN, BIRCH, CURE; Categorical clustering, STIRR, ROCK, CACTUS.

Decision Trees: Tree construction principle, Best split, Splitting indices, Splitting criteria, Decision tree construction with presorting.

Web Mining: Web content Mining, Web structure Mining, Web usage Mining, Text Mining.

Temporal and Spatial Data Mining: Basic concepts of temporal data Mining, The GSP algorithm, SPADE, SPIRIT, WUM.
Recommended Book:

Sl.	Book Name		Author Name
1.	Data Mining	:	Margaret H. Dunham
2.	Introduction to data mining	:	Vipin Kumar
3.	Data Mining Concepts and Techniques	:	J. Han and M. Kamber

ICT – 3103   Analog and Digital Communication   Credit – 3.00
Contact hr/Week: 3

Radio Wave Propagation: Surface and space wave propagation, Sky wave through Ionosphere. Pulse method for measuring height and electron concentration of Ionospheric region; Chapman theory of layer formation, Ionospheric storm.
Modulation and Demodulation: Linear modulation - AM, SSB, DSB, and SSB generation, PLL Circuit to generate linear modulated signals, low and high power modulators, Exponential modulation- FM and PM, demodulation of AM, FM.
Broadcasting Transmitter: Transmitter classification, Elements of transmitter, AM and FM transmitters, SSB transmitter, stabilized master oscillator, Frequency multipliers, Mixer circuits, RF power amplifier, Preemphasis circuits, Transmitter performance-carrier frequency requirements, audio frequency response, distortion, and signal to distortion ratio.
Radio Receiver: Receiver classification, Elements of receiver, AM and FM receivers, SSB receiver, Comparison of AM and FM receivers, Noise in receiver, AGC circuits, AFC circuits, Noise limiters, Receiver sensitivity, Cross modulation, Spurious responses.
Representation of Random Signals and Noise in Communication System: Signal Power and Spectral Representations, White noise, Thermal noise, PSDF of White Signals. Input and Output Relationship for Random Signals and Noise Passed Through a Linear Time Invariant System, Band Limited White Noise, ARC Filtering of White Noise.
Noise performance of Analog Communication Systems: Signal-to-Noise Ratio in Linear Modulation, Synchronous Detection of DSB. Signal-to-Noise Ratio for AM and SSB, FM, Effect of Noise in Envelope and Square Law Detection of AM, Threshold Effects in Nonlinear Detectors.
Elements of Digital Communication Systems: Elements of Digital Communication Systems: Model of Digital Communication Systems, Digital Representation of Analog Signal, Certain issues in Digital Transmission, Advantages of Digital Communication Systems, Bandwidth-S/N tradeoff, Hartley Shannon Law.
Pulse Code Modulation: Pulse Code Modulation: PCM Generation and Reconstruction, Quantization noise, Non uniform Quantization and Companding, DPCM, Adaptive DPCM, DM and Adaptive DM. Noise in PCM and DM.
Digital Modulation Techniques: Digital Modulation Techniques: Introduction, ASK, ASK Modulator, Coherent ASK Detector, Non-Coherent ASK Detector, FSK, Bandwidth and Frequency Spectrum of FSK. Non coherent FSK Detector, Coherent FSK Detector, FSK Detection Using PLL, BPSK, Coherent PSK Detection, QPSK, Differential PSK.
Line Coding: Techniques and Analysis.

Recommended Books:

Sl.	Book Name		Author Name
1.	Electronic communication systems	:	George Kennedy
2.	Principles of communication systems	:	Taub and Schilling
3.	Analog and Digital Communication systems	:	Martin S Roden
4.	Electronic communication	:	Sol Lepatine
5.	Electronic communication	:	Dennis Roody and John Coolen
6.	Telecommunication Engg.	:	J Dunlop & D G Smith
7.	Communication Systems	:	Simon Haykin John
8.	Communication Systems Engineering	:	Proakis & Salehi
9.	Analog & Digital Communication	:	B P Lathi
10.	Communication Systems	:	B P Lathi

ICT – 3104   Analog and Digital Communication Lab   Credit – 1.00
Contact hr/Week: 2

Laboratory based on the course ICT-3103.

ICT-3105   Microprocessor and Assembly Language   **Credit – 3.00**
Contact hr/Week: 3

Introductory Concept: Evaluation of microprocessor, Types of microprocessor, system bus, hardware of a microprocessor, memory-addressing technique.
8086 Microprocessor: properties, architecture, registers, FLAGS register, physical address calculation, addressing modes, Instruction set, Instruction format, Fetch-decode-Execution cycle, interrupt, Types of interrupt, handling interrupt request, interrupt vector and table.
Advanced Microprocessors: Intel 80286 architecture, 80286-memory management, Protection; Intel 80386 functional diagram; 386 programming model; 80386 modes; Multi programming, 80486 and Pentium microprocessor.
I/O operation: Isolated and memory mapped I/O, DMA technique, I/O ports, I/O processor.
Assembly Language: Hardware of Microprocessor, Registers, assembler, Assembly language syntax, variables, Directives, Basic Instructions and their formats, The FLAG register, JMP, LOOP, CMP instructions, Conditional jump instruction, programming with high level structure.
Logic instructions, Shift instructions, Rotate instruction, the stack and stack related instructions, Procedure and procedure related instructions, Multiplication and Division instructions-MUL, IMUL, DIV, IDIV, CBW, CWD, arrays, addressing modes, XLAT instructions. String instructions, Macro definition, Parameters in Macro, Macro directives, Nested macros, Interrupt, Interrupt vector and routine, Bios Interrupt, Dos Interrupt, The IN, OUT, INS and OUTS instructions.

Recommended Books:

Sl.	Book Name		Author Name
1.	Assembly Language Program & Organization of the IBM PC	:	Ytha Yu; Charles Marut
2.	Microprocessors and Interfacing.	:	V. Hall
3.	Assembly Language for the IBM-PC.	:	Kip r. Irvine
4.	IBM PC Assembly Language and Programming.	:	Peter Abel
5.	Microprocessor and Microcomputer Based System Design	:	Mohamed Rafiquzzaman
6.	Microprocessor and microcomputer	:	T. Hanley
7.	Micro Computer architecture and programming	:	John F. wakerly
8.	Compute architecture and organization	:	John P. Hayes
9.	The INTEL Microprocessors 8086/8088	:	Bary B Brey
10.	Microprocessor Interfacing	:	Ramesh Gaonker

ICT-3106   Microprocessor and Assembly Language Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-3105.

ICT-3107   Theory of Computation   **Credit – 3.00**
Contact hr/Week: 3

Finite automata: Deterministic finite automata (DFA). Non-deterministic finite automata (NDFA). Equivalence and conversion of DFA and NDFA. Pushdown automata.

Context free languages: Context free grammars, push down automata; context free languages

Turing machines: Basic machines. Configuration. Computing with Turing machines. Combining , Turing machines.
                        :
Recommended Books:

1. Theory of Computation   : Michael Sipser
2. Introduction to Automata theory, Languages and Computation : Hopcroft and Ullman
3. Automata and Algebras   : Adamek, Kluwer.
4. Automata Theory   : Trembly and Sorensen

ICT – 3109   Operating Systems   **Credit – 3.00**
Contact hr/Week: 3

Principle of operating systems and Operating system structure: Definition of operating system, Different kinds of operating systems (Desktop, Multiprocessor, Distributed, Clustered, Real time, Hand held systems), Operating-System Services, User Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure, Virtual Machines.
Concurrency control, Recovery System and Distribute databases: Lock-Based Protocols, Granting of locks, Two-phase locking protocol, Graph based protocol, Tree protocol, Timestamp based protocols, Deadlock detection and recovery. Failure classification, Storage types, Checkpoints. Distributed data, Replication and Fragmentation.
Multiprocessing and time sharing, Process coordination, Deadlocks: Multiple-Processor Scheduling, Thread Scheduling, Algorithm Evaluation, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock. Control and scheduling of large information processing systems, Resource allocation; Dispatching; Processor access methods; Job control languages
Memory Organization: Introduction, Characteristics of memory systems, Main memory design, Memory hierarchy, Cache memory, Virtual memory and memory management concepts.
Memory management: Background, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Demand Paging, Page Replacement, Thrashing, Demand Paging, Page Replacement.

File systems: File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, File-System Implementation, Directory Implementation, Allocation Methods

Protection and security: Protection, Principles of Protection, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights, The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication, Implementing Security Defenses, Fire walling to Protect Systems and Networks.

Advanced topics: Distributed operating system, distributed file system, synchronization, real time systems, multimedia operating system

Recommended Books:

Sl.	Book Name		Author Name
1.	Operating System Concepts	:	Abraham Silberschatz, Peter Baer Galvin, Greg Gagne
2.	Modern Operating Systems	:	Andrew S. Tanenbaum
3.	Distributed Operating Systems	:	Andrew S. Tanenbaum
4.	Mastering LINUX	:	Denis

ICT – 3110   Operating Systems Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-3109.

ICT – 3112   Software Development Project-II   **Credit – 1.00**
Contact hr/Week: 2

Labrotary based on Java, Database and Java for mobile application.

THIRD YEAR SECOND SEMESTER

ICT – 3201   Microwave Engineering   **Credit – 3.00**
Contact hr/Week: 3

Microstrips: Structures and characteristics.
Rectangular Resonant Cavities: Energy storage, losses. impedance transformer, filters, isolator.
Microwave Devices: Semiconductor Microwave devices, Transit time effect velocity Modulation, Microwave amplifier and oscillator; Klystron (Multicavity and reflex), Magnetron, TWT, other microwave tubes.
Antennas: Small current element, radiation resistance, radiation pattern and properties, Hertzian and half wave dipoles, Mono pole, horn, rhombic and parabolic reflector, array, and Yagi- Uda antenna.
Radar and Electronic Navigation Systems: Radar principles; Civil, military and weather applications, Radar equation, Transmitters and radiators, Factor influencing maximum range; Moving target indicator(MTI), Tracking Radar system and search systems; Electronic navigation systems, LORAN, ILS, SONAR
Modern Trends in Microwaves Engineering: Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication, RFMEMS for microwave components, Microwave Imaging.

Recommended Books:

Sl.	Book Name		Author Name
1.	Microwave Devices & Circuits	:	Samuel Y Liao
2.	Field and Wave Electromagnetics	:	D.K.CHENG
3.	Elements of Engineering Electromagnetics	:	N. RAO
4.	Electromagnetics	:	JOHN D. KRAUS
5.	Foundations for Microwave Engineering	:	R.E.COLLIN
6.	Microwave Engineering.	:	D.M. POZAR
7.	Antennas	:	J D Krauss MGH
8.	Antennas for all applications	:	J D Krauss TMH

ICT-3103   Compiler Design   **Credit – 3.00**
Contact hr/Week: 2

Compiler Design Principles and Techniques: Introduction; A simple syntax-directed translator; Lexical analysis; Syntax analysis; Syntax directed translation; Intermediate code generation; Run-time environments; Code generation; Machine-Independent optimizations; Instruction level parallelism; Optimizing for parallelism and locality; Interprocedural analysis, etc.
Tools for Programming, Parser Generation, Debugging and Testing in Linux: Programming tools: the GNU compiler tool chain, building software with GNU make, building and using libraries, coverage testing with GNU gcov, profiling with GNU gprof, building packages with automake/autoconf, etc.; parser generation with flex and bison; Debugging and Testing: software unit testing frameworks, debugging with GDB, code hardening, etc.

Recommended text:
1. Compilers: Principles, Techniques, and Tools (2nd Edition), PEARSON. Author: Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffery D. Ullman.
2. Compiler Design in C, Prentice Hall of India (PHI) private limited. Author: Allen I. Holub.
3. GNU/LINUX Application Programming, Charles River Media, Inc. Author: M. TIM. JONES.
4. Crafting a Compiler with C, the Benjamin/Cummings Publishing Company. Author: Charles N. Fischer, Richard J. LeBlanc, Jr.
5. Practice and Principles of Compiler Building with C, Prentice-Hall of India (PHI) Private limited. Author: Henk Alblas and Albert Nymeyer.

ICT – 3205   Computer Peripheral and Interfacing   **Credit – 3.00**
Contact hr/Week: 3

Input devices: Keyboard; Key switching mechanism and coding techniques; Static encoder; Lockout and rollover; Scanning encoder; Keyboard without key.
Modern data-entry devices: Scanners overview; Bar code reader; Optical mark reader (OMR); Optical Character Reader (OCR); Digitizer: Reading technique, Capacitive Electrostatic scanning digitizer.
Display devices: CRT; Basic CRT operations; Timing and frequencies; CRT controller ICs; LCDs; LCD technologies; Passive and active matrix; Guest-host techniques; Twisted-pneumatic LCDs; LCD reliability; Electroluminescent display.
Printers: Impact printers; Dot matrix printer, niddle principal; Laser printing; Ink-Jet printing; Color printing; Plotters.
Storage devices: Floppy disk; Floppy disk controller; Position control with stepping actuators; Magnetic hard disk and controller; Compact disk.
Introductory Concept of Interfacing: I/O interface, memory interface, interfacing components and their characteristics.
Serial and parallel Interface: Characteristics of memory and I/O interface, Synchronous and asynchronous communication, Serial I/O interface, RS232, 8251A communication interface, RS-232 interface, 8155A Programmable peripheral Interface, Parallel adapter, parallel port.
Interfacing components: 8284A Programmable timer, Bus architecture, Bus Timing, Bus Controller, analog and digital interface, Interrupt sources, types of interrupt, 8259A priority interrupt controller, Daisy chain.
I/O Controller: 8237A DMA Controller, Floppy and Hard disk Controller.
Embedded System: Introduction to Embedded system, The Embedded Design Life Cycle, Models of Computation, State Charts, General language Characteristics (SDL, Petri nets, Message Sequence Charts, UML, JAVA, HDL), Embedded System Hardware, (Input, Communication, Processing Unit, Memories, output) Embedded operating systems, middleware & Scheduling, Implementing, ASIC, Embedded Systems Hardware/Software co-design.

Recommended Books:

Sl.	Book Name		Author Name
1.	Microcomputer System: The 8086/8088 Family	:	Yu Cheng Liu, Glenn A. Gibson
2.	Computer Peripherals	:	Klilkinm
3.	Microprocessor and Interface	:	Douglas V. Hall
4.	Microprocessor and Microcomputer Based System Design	:	Mohamed Rafiquzzaman
5.	Microprocessor and Interfacing	:	Artwick
6.	Microprocessor Interfacing	:	Ramesh Gaonker
7.	Embedded System Design	:	Peter Marwedel
8.	Computers as Components: Principles of Embedded Computing Systems Design	:	Wayne Wolf

ICT – 3206   Computer Peripheral and Interfacing Lab   **Credit – 1.00**

Contact hr/Week: 2

Laboratory based on the course ICT-3205.

ICT – 3207   Computer Networks   **Credit – 3.00**
Contact hr/Week: 3

Introduction: Computer networks, Types of Computer networks, Network Topology, Circuit Switching and Packet Switching, protocol and protocol hierarchies, The OSI reference model, TCP/IP protocol suit.
Physical Layer and Media: Guided transmission media, wireless transmission, radio waves, microwaves, infrared, Bluetooth; satellites communication etc.
The Network layer: Network layer design issues: IP addressing, IP packet forwarding, Sub-netting, CIDR, Internet Protocol, ICMP, ARP, RARP, DHCP, and IPv6 overview, Address mapping, Error reporting and multicasting; Delivery, Forwarding, and Routing algorithms, Congestion control algorithms.
The Transport layer: The transport service, Elements of transport protocols, simple transport protocols, User datagram protocol (UDP) – UDP operations and UDP package modules, Transmission control protocol (TCP) – TCP features, TCP Connection establishment and termination, TCP Flow control and error control, Congestion control.
The Application layer: The Domain Name System, Electronic Mail, Network Management: SNMP, World Wide Web, HTTP, Multimedia etc.
Multiplexing, Spreading and switching: Multiplexing – FDM, WDM, TDM (Synchronous and statistical) spread spectrum FHSS & DSSS, Circuit Switching, Packet Switching, Message Switching, Routing Algorithms, Virtual Circuit and Datagram, Congestion Control Algorithms, Quality of Service, Internetworking, Internetworking Devices etc.
Error-Recovery and Link-Control: Data link layer and control, Error detection and correction, framing, flow and error control, Stop-and-Wait protocol, Automatic Repeat Request (ARQ), Go-Back-N, Selective Repeat, HDLC, PPP.
Multiple Access: Random Access; ALOHA, CSMA, CSMA/CD, CSMA/CA,Channelized Access; CDMA, TDMA, FDMA, Controlled Access; Rservation, Poling, Token Passing. Ethernet, Wireless LANs, and Bluetooth.
Network Layer Protocols: Address Resolution Protocol, Internet Protocol, Internet Control Message Protocol, IPV6, Routing Information Protocol, Open Shortest Path First, Border Gateway Protocol, User Datagram Protocol, Transmission Control Protocol.

Recommended Books:

Sl.	Book Name		Author Name
1.	Computer Networks	:	Andrew S. Tanenbaum
2.	Communication Networks.	:	SharamHekmat
3.	Data Communications and Networking	:	Behrouz A. Fourouzan
4.	Data and Communication	:	Stallings
5.	An Engineering Approach to Computer Networking	:	S. Keshav
6.	Understanding communication and networks	:	William A Shay

7.	Communication Networks	:	Leon-Garcia and I. Widjaja
8.	Data Networks	:	Bertsekas and Gallagar
9.	Internetworking with TCP/IP	:	Douglas Comer & D. L. Stevens
10.	TCP/IP Utilities - Vol. I, The protocols	:	Richard Stevens
11.	TCP/IP, Architecture, Protocols and implementation	:	SidnieFeit
12	Data & Network Communications	:	Miller

ICT – 3208   Network Planning and Designing Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-3207.

ICT – 3209   Software Engineering   **Credit – 3.00**
Contact hr/Week: 3

Software Engineering Paradigms: Definition of S/W Eng.; The classical life cycle; prototyping fourth generation technique; The product and the process, measurement, matrices.
Software Project Planning: Project planning objectives; S/W slope; Resources; Metrics for S/W productivity and quality; S/W project estimation; Decomposition techniques; Empirical Estimation Models; Automated Estimation tools; S/W project scheduling.
Requirements Analysis Fundamentals: Analysis principle; Software Prototyping Specification; Requirement Analysis Methodologies; Structured and object oriented analysis; Data Flow-oriented Analysis methods.
Software Design Fundamentals: Design process; Design fundamentals: S/W architecture, program structure, Data structure, S/W procedure, Modularity, abstraction; Effective modular design; Procedural design; Data flow-oriented Design; Top-down and bottom-up design; Design Process considerations; Transform analysis; Transaction analysis; Data structure-oriented design: Logical construction of programs and systems, Data structured systems development; object-oriented design; Design concepts; Methods; strategy. Real-time Design; coding style: Code documentation, Data declaration, statement construction, Input/output.
Software reliability and availability models: Software quality factors; software review; software quality metrics; Software reliability; Software quality assurance approach.
Software Testing Techniques: Testing fundamentals; White box testing; Basis path testing; Loop testing; Black Box testing.
Software Testing Strategies: Verification and validation; Organization for software testing; Unit testing; Integration testing; Validation testing; System testing; The art of debugging.
Software Maintenance and configuration management: Definition; Maintenance Characteristics; Maintainability; Maintenance tasks; Software configuration management.

Recommended Books:

Sl.	Book Name		Author Name
1.	Software Engineering	:	Ian Sommerville
2.	Software Engineering	:	Roger S. pressman
3.	Systems Analysis and Design	:	Elias M. Awad
4.	Software Engineering	:	Ian Sommerville
5.	Object Oriented Systems Analysis & Design using UML	:	Simon Binott, Ray Farmer

ICT – 3211   Bio-Informatics   **Credit – 3.00**
Contact hr/Week:3

Introductory Concept
Basics of Biology, Molecular Biology and Bioinformatics, The central Dogma, DNA, transcription, Translation, Genomics, Amino acids, Proteomics and Genomics, Humana Computer Interaction and Bioinformatics.
Genome Analysis and Gene Mapping
Genome analysis, genome mapping, sequence Alignment, pair wise sequence alignment, Multiple sequence alignment, local and global alignment, sequence alignment techniques: dot matrix, dynamic algorithms, Popular algorithms: Needleman and Wunsch, Smith-Waterman, Scoring methods: PAM, BLOSUM, Phylogenetic analysis. Tools for similarity search, BLAST, Phi-BLAST, Psi-BLAST, FASTA.
Classification and Analysis of Protein
Overview of protein structure, protein structure Database, Data Capture, capturing micro array data, protein structure visualization tools, protein structure alignment, protein classification approaches, Alpha and beta structure analysis, structure comparison, protein structure analysis and prediction, motif, profiles, patterns and fingerprint search, protein evolution, Methods of 2D structure prediction, 2-D Gel Electrophoresis, 2-D Gel Electrophoresis image analysis, tools: CAROL, PiKA, Z3, PDQuest.
Multiple sequence alignment, Functional annotation of sequences, Gene Identification and Prediction, Gene Expression and Microarray, Hidden Markov Model, Navigation the NCBI web site. Genbank, EMBL, OMIM, Pubmed, Navigation other genome database sites (Ensembl, Celera).
Bionic Arm
Introduction of bionic devices, working principle of bionic arm, first bionic man and woman, prospect of bionic devices, latest bionic componets.

Recommended Book:

Sl.	Book Name		Author Name
1.	Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery	:	S.C. Rastogi, N. Mendiratta, P. Rastogi; PHI
2.	Fundamental Concepts of Bioinformatics	:	D.E. Krane and M.L. Raymer, Benjamin Cummings
3.	Genetics, a Molecular Approach	:	T.A.Brown, Chapman & Hall
4.	Introduction to Computational Molecular Biology	:	J.Setubal and J.Meidanis
5.	Bioinformatics: The Machine Learning Approach	:	P. Baldi and S. Brunal, MIT Press
6.	Introduction to Computational Biology: Maps, Sequences, Genomes	:	M.S.Waterman, Chapman & Hall

FOURTH YEAR FIRST SEMESTER

ICT – 4000   Research Thesis/Project   **Credit – 3.00**
Contact hr/Week: 2

Students will perform a research project work on Information and Communication Technology. It is a continuing course, that is 2-semester-long, will be evaluated with the courses of 4th year 2nd semester.

ICT – 4101   Telecommunication Engineering   **Credit – 3.00**
Contact hr/Week: 2

Introduction: Evolution of Telecommunications, Simple Telephone Communications, Basics of Switching System, Manual Switching System, Major Telecommunication Networks.

Switching: Circuit Switching, Packet Switching, Message Switching, Crossbar Switching, Routing Algorithms, Virtual Circuit and Datagram, Congestion Control Algorithms, Quality of Service, Quality of Experience, Internetworking, and Internetworking Devices etc.

Telephone and cable Network for data transmission: Telephone network; Subscriber loop systems, Switching hierarchy and routing, Transmission plan, Transmission systems, Numbering plan, Charging plan, Signaling techniques, In channel signaling, Common channel signaling, Dial-up modem, cable telephone Network etc.

Traffic Engineering: Network traffic load and parameters, Grade of services and blocking probability, Modeling switching systems, Incoming traffic and service time characterization, Blocking models and loss estimates, Delay systems

Multimedia Communication: Categories of Audio and Video Services, Digitizing Audio and Video, Audio and Video Compression, Streaming Stored Audio and Video, Streaming Live Audio and Video, Real-Time Interactive Audio and Video, Quality of Service, Quality of Experience, Internet Service Models, Best-Effort Service Model, Real-Time Transport Protocol, Real-Time Transport Control Protocol, Skype, Signaling for Voice over IP, Integrated Service Model, ReSerVation Protocol, differentiated Service Model, Content Distribution Networks.
Satellite Communication: Overview of Satellite System, Satellite communications: Satellite architecture; Satellite network segments; Operational frequency bands and characteristics; Multiple access techniques; VSAT; Emerging Applications and innovations in satellite; Global Positioning System (GPS).

ICT – 4103   Simulation and Modeling   **Credit – 3.00**
Contact hr/Week: 3

Basic Simulation Modeling: The Nature of Simulation Systems, Models, and Simulation Discrete-Event Simulation Simulation of a Single-Server Queueing Alternative Approaches to Modeling and Coding Simulations, Parallel and Distributed Simulation ,Simulation across the Internet and Web-Based Simulation ,Steps in a Sound Simulation Study ,Other Types of Simulation : Continuous Simulation ,Combined Discrete-Continuous Simulation.
Modeling Complex Systems: Introduction, List Processing in Simulation, Approaches to Storing Lists in a Computer Linked Storage Allocation, A Simple Simulation Language: simlib. Single-Server Queueing Simulation with simlib Time-Shared Computer Model Job-Shop Model Efficient Event-List Manipulation.
Simulation Software : Comparison of Simulation Packages with Programming Languages Classification of Simulation Software General-Purpose Simulation Packages
Object-Oriented Simulation, Building Valid, Credible, and Appropriately Detailed Simulation Models Experimental Design, Sensitivity Analysis, and Optimization Simulation of Manufacturing Systems.
Simulation: Partial Differential Equations, Random Signals, Hybrid Simulation, Digital Simulation; Simulation Language-GPSS, SIMSCRIPT, CSMP, etc.

Recommended Books:

Sl.	Book Name		Author Name
1.	Discrete Event System Simulation	:	J. Banks, J. S. Carson
2.	The art of Computer Systems Performance Analysis.	:	Raj Jain
3.	Simulation and Modeling Analysis	:	Averill M. Law, W. D. Kelton
4.	Simulation Modeling and Analysis	:	Law Kelton

ICT – 4105   Cryptography and Cyber Security   **Credit – 3.00**
Contact hr/Week: 3

Introduction to Security: Need for security, Security approaches, Principles of security, Types of attacks.
Crytographic Techniques: Plaintext, Cipher text, Substitution & Transposition techniques, Encryption & Decryption, Types of attacks, Key range & Size.
Symmetric & Assymetric Key Cryptography : Algorithm types & Modes, DES, IDEA, Differential & Linear Cryptanalysis, RSA, Symmetric &Assymetric key together, Digital signature, Knapsack algorithm.
User Authentication Mechanism: Authentication basics, Passwords, Authentication tokens, Certificate based & Biometric authentication, Firewall.
Case Studies of Cryptography: Daniel of service attacks, IP spoofing attacks, Secure inter branch payment transactions.
Cyber law: digital copyrights issues, illegal duplication of software, human rights and data encryption, international cyber law, information sharing, cyber squaterring .
Basic Concepts of Technology and Law: Understanding the Technology of Internet, Scope of Cyber Laws, Cyber Jurisprudence.
Law of Digital Contracts: The Essence of Digital Contracts, The System of Digital Signatures, The Role and Function of Certifying Authorities, The Science of Cryptography,
Intellectual Property Issues in Cyber Space: Domain Names and Related issues, Copyright in the Digital Media, Patents in the Cyber World,

Rights of Netizens and E-Governance: Privacy and Freedom Issues in the Cyber World, E-Governance, Cyber Crimes and Cyber Laws. Information Technology Act, International Scenario in Cyber Laws, Cyber Law Issues for Management, Security Perspective, Internet Security Issues, Digital Signatures for Securing Information Assets, Security Policies.

Recommended Book:

Sl.	Book Name		Author Name
1.	Cryptography and Network Security	:	William Stallings

ICT – 4107   E-Commerce and web Programming   **Credit – 3.00**
Contact hr/Week: 3

Internet Overview: Intra- and Inter-networking, Internet, Internet architecture, Internet service providers (ISP), Tier architecture of the Internet, Internet core, Access networks (DSL, cable, Wireless etc.)
Internet Applications: Voice Over IP (VoIP), Video on Demand (VoD), IPTV, and other multimedia and real time applications.
Web Programming: The web, web 2.0 and Ajax, browser basics, XHTML, cascading style sheets (CSS), JavaScript, dynamic HTML, XML, RSS, building Ajax-enabled web application, Macromedia Flash, Adobe ® Flex ™ , Macromedia ®, Dreamweaver ®, web servers (IIS and Apache), database: SQL, MySQL, DBI and ADO.NET 2.0, web services, PHP, ASP.NET, web forms and web controls, JavaServer Pages web applications, Perl and CGI (Common Gateway Interface), etc.

Recommended Books:

Sl.	Book Name		Author Name
1.	Web Engineering: The Discipline of Systemetic Development of Web Applications	:	Wiley. Author: GertiKappel (Editor), Birgit Prýýll (Editor), Siegfried Reich (Editor).
2.	Internet and World Wide Web How to Program	:	Prentice Hall. Author: Harvey M. Deitel, Paul J. Deitel and Andrew B. Goldberg
3.	Programming the World Wide Web	:	Addison Wesley. Author: Robert W. Sebesta.
4.	Web Engineering: Principles and Techniques	:	Idea Group Publishing ,WoojongSuh (Editor).

ICT – 4108   Internet and Web Programming Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4107.

ICT – 4110   Research Methodology   **Credit – 1.00**
Contact hr/Week: 2

Each student shall be required to undertake a project which is of academic value for a period of 1 semesters. The project involves problem solving using engineering theories and techniques, and the implementation of the project design. The student is expected to design a possible solution to the problem, taking into account various aspects such as professionalism, economy, costing and engineering viability.
At the end of semester, the student is to present his/her progress at a seminar. At the end of the project, it is expected that the student submits a proper written paper and to present his/her work at a seminar.

Option-IV (Select Any One)

ICT – 4111   Digital Image Processing   **Credit – 3.00**
Contact hr/Week: 3

Introduction: Introduction of Digital Image Processing and Pattern Recognition, Application areas, Fundamental steps of Digital Image Processing, Components of Digital Image Processing, Image & Video, Image & Human eyes, Color TV scheme.
Analog and Digital Image: Analog and Digital Image, Image Acquisition and acquisition devices, Spatial and amplitude quantization, Pixels, Resolution, Aspect Ratio, Gray levels, Relationship color and gray levels.
Image Enhancement: Different types of Image Enhancement operations, Spatial domain and frequency domain processing, Different types of filtering.
Image Compression: Fundamental concepts of Image Compression and Data Compression, Data Redundancy, Image Compression models, Error free and Lossy compression, Image Compression Standards.
Morphological processing & Segmentation: Image Segmentation, Different types of Segmentation, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Morphological Image Processing, Dilation, Erosion, Opening, Closing, Hit and Miss etc.
Image Representation: Object representation and description algorithms, Run Code, Chain Code, Signature, Skeleton, Boundary detection, Feature Extraction few case studies.

Pattern Recognition: Fundamental concepts of Pattern Recognition, Pattern, Pattern Classes, Types of Pattern Recognition, Decision Theoretic methods, Structural method, Statistical method, Neural Network, Few case studies like speech recognition, fingerprint recognition, character recognition etc.
Multimedia applications: Tele-Conferencing, Virtual Reality, Authoring Tools, Multimedia Documents, Games.

Recommended Books:

Sl.	Book Name		Author Name
1.	Digital Image Processing	:	R. C. Gonzalez, R. E. Woods
2.	Pattern Recognition and Image Analysis	:	Earl Gose
3.	Image Processing Fundamentals	:	I.T. Young, J.J. Gerbrands, L.J. van Vliet
4.	The Image Processing Handbook	:	Russ, J.C

ICT – 4112   Digital Image Processing Lab   **Credit – 1.00**

Contact hr/Week: 2

Laboratory based on the course ICT-4111.

ICT – 4113   Embedded System Design   **Credit – 3.00**
Contact hr/Week: 3

Embedded Microcontroller: Introduction, Evolution, Architecture, comparison with microprocessor, commercial Microcontroller devices, Applications, selection of a Microcontroller. MCS51 architecture, 8051-pin description, connections, I/O ports and memory organization. Addressing modes, Instructions, I/O port programming, Interrupts, Timer/Counters and serial communication. Real world interfacing such as LCD, ADC, DAC, stepper motor, Key Board, External memory and PPI 8255 Interface.
Design with Atmel Micro controllers 89CXX: Using flash and other memory devices, Flash programming, Applications such as pulse width measurement, Frequencies counter etc. PIC **Micro controllers:** Overview, Features PIC 16C6X / 7X , PIC 16F8XX based systems.
Embedded system: Definitions, Classification, Processors in the system, Other hardware units, Software embedded into a system, Software modules and tools for designing an embedded system. Processor and memory organization: Structural units, features, and Processor selection for an embedded system. Memory devices, organization, Selection and Memory allocation and Maps. Devices and Buses for devices networks: I/O devices, Timer and Counting devices serial communication using I2C, CAN and advanced I/O buses between Networked Multiple devices, Parallel communication using ISA, PCI, PCI –X and Advanced buses. Device drivers and interrupts servicing mechanism, context and the periods for context switching Deadline and Interrupt latency.

Recommended Books:

Sl.	Book Name		Author Name
1.	The 8051 Microcontroller and Embedded systems 3rd Indian reprint Pearson Education	:	M.A. Mazidi & J.G.Mazidi,
2.	Microcontrollers –TMH	:	Ajay Deshmukh,
3.	Embedded system-TMH	:	Rajkamal,
4.	Embedded system design CBS Distributors	:	Frank vahid & Tony giva rgis,
5.	Fundamental of Embedded S/w Pearson	:	D.w.Lewis,
6.	Embedded microcomputers systems first edition Brooks /Colehomson Learning.	:	J.W.Valvano,
7.	8051 Microcontroller 2nd edition, Pengram international	:	Kenneth J Ayala,

ICT – 4114   Embedded System Design Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4113.

ICT-4115   Distributed and Parallel Processing   **Credit – 3.00**
Contact hr/Week: 3

Distributed System Concepts, Communication, Distributed Models, Invocation Semantics, Remote Procedure Calls, Naming, File System, Security, Concurrency control and recovery, local area network, distributed languages and communication primitives, case studies of distributed systems.
Computational demands, advantages of parallel systems. Flynn's classification, controlled parallelism and scalability. Topologies: Mesh, binary tree, Hyper tree, Cube Connected cycles, shuffle-Connected Exchange; Uniform Memory Access (UMA & Non uniform Memory Access (NUMA) Multi processor System.
PARAM Model of Parallel Computation, PARAM Algorithms; Parallel Reductions, Prefix sum, List Ranking, Merging of Two Sorted List.
Parallel Processing: Importance, architecture, Hardware and software issues; Architectures for parallel processing - Classifications.
Comparative Study of Different Architectures: hardware issues in parallel processing, parallel programming;
Distributed Processing: Definition, Impact of distributed processing on organizations, pitfalls in distributed processing.
Distributed Applications: Abstract Syntax Notation One (ASN.1), Network Management - SNMPv2, Electronic mail - SMTP and MIME, Uniform Resource Locator (URL) and Universal Resource Identifier (URI), Hypertext Transfer Protocol (HTTP).
Mapping and Scheduling; mapping of Data from Topology to other (Ring to 2-D Mesh, Binomial trees to 2-D mesh, Rings & mesh into 2-D Mesh, Ring & Mesh into Hypercubes), Load balancing, Static scheduling on UMA multi processor systems.
Applications of parallel computing: Matrix Multiplication, Sorting (bitonic Merge sort, parallel quick sort, hyper quick sort), Searching a Graph (P-depth search, Breadth-Depth Search, Breath first search) , parallel Brach and bound algorithms

Recommended Books:

Sl.	Book Name		Author Name
1.	Parallel Computing: Theory and Practice	:	Michel J. Quinn
2.	Advanced Computer Architecture	:	Kai Hwang
3.	Distributed System, Concept & Design	:	G. Couloris
4.	Distributed Systems	:	Tanenbaum
5.	Distributed Operating Systems	:	P. K. Sinha
6.	Introduction to Parallel Computing	:	A. Grama, A. Gupta, G. Karypis and V. Kumar.
7.	Distributed and Parallel Computing, Manning	:	H. El-Rewini and T.G. Lewis

ICT – 4116   Parallel and Distributed Processing Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4115.

FOURTH YEAR SECOND SEMESTER

ICT – 4000   Research Thesis/Project   **Credit – 3.00**
Contact hr/Week: 2

Students will perform a research project work on Information and Communication Technology. It is a continuing course, that is 2-semester-long, will be evaluated with the courses of 4th year 2nd semester.

ICT – 4201   Wireless and Mobile Communication   **Credit – 3.00**
Contact hr/Week: 3
History and Evolution of Mobile Radio Communication: Principle of Conventional Mobile Radio Systems, Limitations of Conventional Mobile Radio System.
Radio Paging: Introduction, Paging Receiver Types, On Site Paging, Transmitter Specifications, Wide Area Paging, Transmission Specifications, Paging Receivers Architecture.
Cellular Radio Systems: Basic Elements of a Cellular Radio System/Network, Principles of Operations, Frequency Spectrum and its Management, Radio Planning, Overview of Cellular Standard Systems, Digital Cellular Systems, Details of TACS and GDSM Architecture. 1G, 2G, 3G, 4G and the Forthcoming 5G Cellular Mobile Systems.
Mobile Communications by Satellite Service Systems in Operation, INMARSAT, MSAT, LEO and MEO Satellite, GMPCS Mobile Telephone and Data Sensing System using LEO and MEO Satellites (Iridium, Teledesic).
Introduction to wireless networks: wireless access networks – wireless mesh networks, personal area networks (wireless sensor networks, body area networks, LowPan, and Bluetooth), wireless and mobile ad hoc networks, challenged networks (DTNs, VANETs).
Wireless MAC protocols: IEEE 802.11, IEEE 802.11e, IEEE 802.11n, IEEE 802.11s, IEEE 802.15.4, S-MAC, B-MAC, IEEE 802.22/20, IEEE 802.16d/e.
Wireless routing: routing matrix – ETX, ETT, WCETT, AirTime Metric, routing protocols – AODV, DSR, DSDV, HWMP, sensor network routing, VANET routing etc.
Wireless Transport protocols; Wireless TCP and its variants, Hop by Hop Congestion Control, Rate based Congestion Control etc. Quality of Service in Wireless Networks.
Emerging technologies: Bluetooth, Radio Frequency Identification (RFID), Wireless Broadband (WiMAX), Mobile IP, Voice Over Internet Protocol (VOIP), Session Initiation Protocol (SIP).

Recommended Books:

Sl.	Book Name		Author Name
1.	Wireless Communication Principle and Practice	:	T.S. Rappaport
2.	Fundamentals of Wireless Communications	:	David Tse, PramodViswanath
3.	Wireless Communications	:	Andrea
4.	Mobile Communication	:	Jochen Schiller
5.	Wireless and Mobile Network Architectures	:	Yi bing Lin
6.	Mobile Communications Design Fundamentals	:	William C.Y Lee
7.	GSM System Survey	:	ERICSSON
8.	Wireless Telecommunications Networking with ANSI 4	:	Randall A Snyder & Michael

ICT – 4202   Wireless and Mobile Communication Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4201

ICT – 4203   Optical Communication   **Credit – 3.00**
Contact hr/Week: 3

Introduction: Basic Optical communication system, Advantages and application of optical fiber communication systems.
Propagation in Dielectric waveguides: Slab waveguide, Modes in symmetric and asymmetric waveguide, Coupling to the waveguide, Dispersion and distortion in the slab waveguide, integrated optic component.
Attenuation in optical fiber: Introduction, attenuation, absorption, Rayleigh scattering, Pulse distortion and information rate.
Optical fiber and fiber cables: Classification of fiber and fiber cables, step index fiber, graded index fiber, Description of modes and types of modes, Different type of modes, Numerical aperture and multipath dispersion in step-index and graded index fiber, Construction of fiber and fiber optic cable.
Light sources: LED, LD, Optical amplifiers fiber laser, vertical cavity surface-emitting laser diodes.
Light detectors: Photo detection, photomultiplier, semiconductor photodiode, PIN photo diode, Avalanche photodiode, and their comparison.
Coupler and connectors: Connector principle, fiber end preparation, splices, connectors, source coupling, loss mechanism.
Network distribution and fiber components: Direction coupler, star coupler, optical switches, wavelength converters, isolator, Attenuators, circulator, polarization, port configuration of coupler, fiber Bragg grating, Array wave guide gratings, diffraction gratings.
Noise and detection: Thermal and shot noise's, error rates, receiver circuit design, coherent optical fiber detection system, optic heterodyne receivers.
System design: analogue and digital system design, few practical problem and example, application of fiber optic communication in telecommunication.
Optical Communication: Optical Communication system with analog and digital modulation formats; performance and system budgets; Multi channel system, WDM.

Recommended Books:

Sl.	Book Name		Author Name
1.	Optical Fiber Communication	:	John M. Senior
2.	Fiber Optic communication teach	:	D. K. Mynbaev

ICT – 4205   Digital Signal Processing   **Credit – 3.00**
Contact hr/Week: 3

Discrete Fourier Transform: Frequency-domain sampling, Discrete Fourier Transform (DFT), Properties of DFT, Linear filtering and frequency analysis of signals using DFT, Discrete Cosine Transform.

Efficient Computation of DFT: Fast Fourier Transform (FFT) algorithms, Applications of FFT algorithms, Linear filtering approach to the computation of DFT, Quantization effects in the computation of DFT.

Digital Filters: Causality, Symmetric and Antisymmetric Finite Impulse Response (FIR) filters, Linear-phase FIR filters, FIR differentiator, Hilbert transformer, Infinite Impulse Response (IIR) filter design methods, Frequency transformations.

Multirate Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion (SRC), Filter design for SRC: Direct Form FIR Digital Filter Structure, Cascade Form FIR Digital Filter Structure, Polyphase FIR Structure, Multistage Implementation of SRC, SRC of band pass signal, SRC by arbitrary factor, Multirate signal processing applications.

Optimum Filters and Spectrum Estimation: FIR Wiener Filter, IIR Wiener Filter, Discrete Kalman Filter, Nonparametric Methods: The Periodogram method, Bartletts method, Welch's method, Blackman-Turkey method, Parametric Methods: Autocorrelation method, Co-variance method, Modified Co-variance method, Burg method, Frequency Estimations.

Adaptive Filtering: Introduction, FIR Adaptive Filters, Adaptive Recursive Filters, Recursive Least Squares: Exponentially Weighted RLS, Sliding window RLS (WRLS).

Software developments: Software developments: assembly programs, C programs, mixing C and assembly code, software development tools. Hardware issues: hardware selection, configurations, and hardware tools. System considerations. Introduction to code composer studio (CCS).

Recommended Books:

Sl.	Book Name		Author Name
1.	Introduction to Digital Signal Processing	:	Tatsuo Higuchi, Shoukoudou
2.	Digital Signal Processing	:	A.V. Oppenheim and R.W. Schafer
3.	Digital Signal Processing Principles- Algorithms, and Applications	:	J.G. Proakis and D.G. Manolakis
4.	Computer-Based Exercises for Signal Processing Using MatLab	:	C.S. Burrus
5.	Signals and Systems	:	A Anand Kumar
6.	Digital Signal Processing	:	A Anand Kumar

ICT – 4206   Digital Signal Processing Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4205.

Option-IV (Select any one)

ICT – 4207   VLSI Design   **Credit – 3.00**
Contact hr/Week: 3

Introduction: Introduction to MOSFETs; Enhancement and Depletion type NMOSFET, MOSFET Equivalent Circuits, GaAs MOSFETs.

MOSFET Logic Circuits: NMOS Inverter, CMOS inverter, CMOS Processing Technology, Overview of Silicon Semiconductor Technology, Basic CMOS Technology, CMOS Power Dissipation, Packaging, Scaling of MOS Transistor Dimensions Yield and Reliability. Process Enhancement, Layout Design Rules Latch up, CAD Tools for VLSI Design

MOSFET Logic Gates: NMOS, CMOS, Dynamic and Domino Logic Gates, Clocked CMOS Logic, Pass-Transistor Logic, Transmission Gates, CMOS Combinational, Sequential Logic Circuits, Bi-CMOS Logic Circuits, GaAS-MOSFET Logic Circuits, Interfacing CMOS & Bipolar Logic Families. Circuit Characterization and Performance Estimation, Resistance, Capacitance Estimation, Switching Characteristics, Delay Models, Power Dissipation, Packaging, Scaling of MOS Transistor Dimensions Yield and Reliability

CMOS Testing: Fault Models, Design Strategies.

CMOS Subsystem Design: Data-path Operations, Addition, Multiplication, Counters, Shifters, Memory Elements.

Recommended Books:

Sl.	Book Name		Author Name
1.	HDL	:	Perry, Douglas L
2.	Introduction to VLSI Design	:	Fabricius,
3.	Fundamentals of Logic Design	:	Charles H Roth Jr
4.	HDL analysis and modeling of Digital System	:	Navabi, Zainalabedin

ICT – 4208   VLSI Design Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4207

ICT – 4209   Communication Management   **Credit – 3.00**
Contact hr/Week: 3

Network Management: Introduction to Network Management, Network Management Architecture, Concepts, Managers and agents. TMN (Telecommunications Management Network), Network management goals and dimensions.

Network Management System: Configuration management, Fault management Performance management, Security management, Account management. Fault Tolerance.

Network Management Functions Configuration: Configuration Management and Auto-discovery, Configuration Database and Reports, Abstract Syntax Notation One (ASN.1).

Network Management Functions – Security: Security Management, Protecting Sensitive Information, Host and User Authentication, Key Management.

Network Management Functions – Fault: Fault Management, Fault Identification and Isolation, Event Correlation Techniques.

Simple Network Management Protocol - SNMP v1: Structure of Management Information, Std. Management Information Base (MIBs), SNMPv1 Protocol.

Simple Network Management Protocol - SNMP v2: Version 2 Protocol Specification, Version 2 MIB Enhancements, MIB-II, Case Diagrams.

Simple Network Management Protocol - SNMP v3: Version 3 Protocol & MIB, User Based Security Model, View Based Access Model.

Remote Network Monitoring RMON 1: Statistics Collection, Alarms and Filters, Remote Network Monitoring RMON 2, Monitoring Network Protocol Traffic, Application-Layer Visibility, Management Tools, Systems and Applications, Test and Monitoring Tools, Integrating Tools, Development Tools, Web-based Enterprise Management.

Management Component: Role of SNMP, Role of SMI, Role of MIB. SMI, Name, Type, Encoding Method.

Simple Network Management System Protocol (SNMP): Concept, Management Component, Structure of Management Information, Management Information Base (MIB), Lexicographic Ordering, SNMP, Message, UPD port, Security.

ICT – 4210   Communication Management Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4209

ICT – 4211   Artificial Intelligence   **Credit – 3.00**
Contact hr/Week: 3

Concepts of Artificial Intelligence: Introduction, The Foundations of AI, The History of AI, AI technique, The State of the Art;

Problems and Problem Solving: Problems, Example of Problems, Problem Formulation, Problem-solving methods.

Various Searching Techniques: Search Strategies, Uninformed (blind) search strategies like Breadth-First search, Uniform cost search, Depth-First Search etc. and Informed or Heuristic Search Strategies like Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-End Analysis etc.

Propositional and First-Order logic: Knowledge Representation, Reasoning and Logic; Propositional Logic: Syntax, Semantics, Validity and Inference, Rules of Inference for Propositional logic; First-Order Logic: Syntax and Semantics, Using first-order logic.

Inference in first order logic: Inference Rules Involving Quantifiers, Example Proof, Generalized Modus Ponens, Forward and Backward Chaining, Completeness, Resolution.

Game playing: Introduction, Perfect Decisions, Imperfect Decisions, Alpha-Beta Pruning;

Natural language processing: Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing.

Planning: Basic Plan-Generating Systems, Forward Production System, Representation for Plans, Backward Production System, STRIPS, Examples with problem domain;

Learning: Introduction to Learning, Inductive Learning, Learning Decision Trees, Neural Net Learning;

Probabilistic Reasoning: Probability and Bayes' Theorem, Certainty Factors and Rule-Based Systems, Bayesian Networks, Fuzzy Logic;

Expert Systems: Expert system architecture, Representation and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Recommended Books:

Sl.	Book Name		Author Name
1.	Artificial Intelligence	:	Elaine Rich and Kevin Knight
2.	Artificial Intelligence A Modern Approach	:	Stuart Russell and Peter Norvig
3.	Principles of Artificial Intelligence	:	Nils J. Nilsson
4.	Fuzzy and Neural Approches in Engineering.	:	L. H. Tsoukalas and R. E. Uhrig

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ICT – 4212   Artificial Intelligence Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4211.

ICT – 4213   Software Quality Assurance and Testing   **Credit – 3.00**
Contact hr/Week: 3

Introduction/Overview/What is Software Quality, Quality Assurance, Quality Assurance in Context, Quality Engineering, Testing: Concepts, Issues and Techniques, Test Activities, Management, and Automation, Coverage and Usage Testing, Based on Checklists and Partitions, Input Domain Partitioning and Boundary Testing, Coverage and Usage Testing Based on Finite-State Machines and Markov Chains, Control Flow, Data Dependency, and Interaction Testing, Control Flow, Data Dependency, and Interaction Testing, Testing Techniques: Adaptation, Specialization, and Integration, Defect Prevention and Process Improvement, Software Inspection, Formal Verification, Fault Tolerance and Failure Containment, Comparing Quality Assurance Techniques and Activities, Feedback Loop and Activities for Quantifiable Quality Improvement, Quality Models and Measures, Change and Defect Models, Defect Classification and Analysis, Risk Identification for Quantifiable Quality Improvement, Software Reliability Engineering.

ICT – 4214   Software Quality Assurance and Testing Lab   **Credit – 1.00**
Contact hr/Week: 2

Laboratory based on the course ICT-4213