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THE NATIONAL COLLEGE

(Autonomous)

Jayanagar, Bangalore

Affiliated to Bangalore University

Department of Computer Science

REGULATIONS, SCHEME AND SYLLABUS

For the course

I to VI Semesters

BACHELOR OF COMPUTER APPLICATIONS
(BCA - IoT)

2020-2021

(Choice Based Credit System)

Program Outcomes:

PO1: To work effectively both as an individual and a team leader on multi-disciplinary projects.

PO2: Inculcates the ability to analyze, identify, formulate and develop computer applications using modern computing tools and techniques.

PO3: Prepares to create design innovative methodologies for solving complex-real life problems for the betterment of the society.

PO4: To integrate ethics and values in designing computer application.

Regulations Pertaining to Bachelor of Computer Applications (B.C.A)

1. Eligibility: Students who have completed two years Pre-University (10+2) course of Karnataka or equivalent examination are eligible to apply for admission to BCA Degree Programme.
2. Duration of the Course: Three academic year consisting of six semesters.
3. Medium of Instruction: The medium of instruction and examination shall be in English.
4. Evaluation Procedure for courses with practical's:
   a. Continuous Internal Assessment for Theory (CIA): 30 Marks

Two Test average marks	20
Assignment	5
Attendance	5
Total	30

   b. End Semester Examination for theory (ESE): 70 Marks
   c. Continuous Internal Assessment for Practical (CIA): 15 Marks

One Test	10
Attendance	5
Total	15

   d. End Semester Examination for Practical (ESE): 35 Marks
   e. Students should secure a paper minimum of 40% each in end semester theory and in theory total (CIA + ESE), end semester practical examination and in practical total (CIA + ESE)

5. Evaluation Procedure for core Project

IV Semester Project I:

a) Continuous Internal Assessment (CIA): 35 Marks

Demonstration of Project	25
Report	5
Viva	5
Total	35

b) End Semester Examination (70 marks)

c) Students should secure a paper minimum of 40% in the End Semester Examination.

V Semester Project II:

a) Continuous Internal Assessment (CIA): 35 Marks

Demonstration of Project	25
Report	5
Viva	5
Total	35

b) End Semester Examination (70 marks)

c) Students should secure a paper minimum of 40% in the End Semester Examination

VI Semester Project III:

a) Continuous Internal Assessment (CIA): 70 Marks

Demonstration of Project	60
Report	5
Viva	5
Total	70

b) End Semester Examination (100 marks)

c) Students should secure a paper minimum of 40% in the End Semester Examination

SEMESTER I

I SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Part 1	Language1	English	4	30	70	100	2
	Language2	Kan/San/Hin/Japanese	4	30	70	100	2
Part 2	1BIBELET	Basic Electronics-I	4	30	70	100	4
	1BIMATHT	Mathematics I	4	30	70	100	4
	1BICPRGT	Programming in C	4	30	70	100	4
	1BIDEVET	Digital Electronics & Verilog	4	30	70	100	4
	1BIDEVEP	Digital Electronics & Verilog	3	15	35	50	1
	1BICPRGP	C programming	3	15	35	50	1
Part 3		Mandatory Paper	4	30	70	100	2
Total Marks and credits			**34**	**240**	**560**	**800**	**24**

1BIBELET: BASIC ELECTRONICS-I

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 04
Max Marks: 70	Credit: 4
Course Objective:	

After studying this paper the students will be able to

- Analyze the circuits using Kirchhoff's laws and Network theorems.
- Analyze the Series and parallel resonant circuits.
- Analyze the basic working of pn junction diode and its applications
- Analyze the BJT and FET circuits.

UNIT 1: PASSIVE COMPONENTS & AC CIRCUITS — Teaching Hours :10

Resistors: Specification, tolerance, rating, colour code, power dissipation, types of resistors- Fixed and variable.

Capacitors: Specifications, colour code, energy stored in a capacitor, types of capacitors-fixed and variable, electrolytic.

Inductors: Specifications, energy stored in an inductor, types-air core and iron core, chokes.

Transformer: Working, classification, power losses in transformers. Fuses, switches and relays.

AC Circuits: Representation of a.c, sine wave- cycle, time period, frequency, average value, peak value (amplitude), peak to peak, r.m.s value, phase and phase difference, power factor, form factor, phasor diagram, complex number, j operator, reactance and impedance.

RL series and RC series circuits, RLC circuits: series and parallel- impedance curve, selectivity, band width Q factor- comparison between series RLC and parallel RLC circuits.

Series and parallel Resonance circuits- condition for resonance, resonant frequency, half power frequencies, BW, quality factor (loaded and unloaded Q), comparison and applications.

UNIT 2: TRANSIENT ANALYSIS AND NETWORK THEOREM — Teaching Hours :10

Transient analysis of RC and RL circuits, time constant- representation, energy stored in inductors and capacitors.

Network theorems (DC analysis):

Current and Voltage sources: Ideal and real voltage and current sources

D.C resistive circuits: Voltage divider and Current divider theorems open and short circuits. Kirchhoff's laws- mesh analysis and node voltage method. Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem

UNIT 3: BASIC SEMICONDUCTOR THEORY — Teaching Hours 10

Intrinsic Semiconductor, extrinsic semiconductor-N type and P type, forward and reverse bias, energy level diagram of pn-junction.

Diode symbol, the diode curve, forward bias and reverse bias characteristics, the ideal diode, practical diode, Breakdown in diode- zener and avalanche mechanisms, Special purpose diodes.

UNIT 4: RECTIFIERS, FILTERS AND REGULATORS	Teaching Hours 10

Half wave, full wave and bridge rectification efficiency ' η `and ripple factor 'γ' in ease.

Filters: series inductor filter and shunt capacitor filter, LC filter, л section filter performance, comparisons, clippers and clampers.

Voltage regulators- block diagram of regulated power supply- zener as a line and load regulator- design.

UNIT 4: TRANSISTOR AND BIASING	Teaching Hours 12

BJT: Transistor symbol, NPN/PNP- working, CB, CE and CC modes, current Gain, input and output characteristics of CB and CE Configuration, Darlington Pair.

Leakage current, relation between α, β & γ, base spreading resistance. Biasing: Need for biasing, load line, operating point, thermal runaway. Voltage divider bias: design, bias stability factor (no derivation), advantages of voltage divider bias, Problems.

Field Effect Transistor (FET):

Construction and working of JFET, drain characteristics, Transconductance characteristics, FET parameters, FET approximations-Shockley's equation, comparison of FET with BJT, FET-Biasing techniques: types, self biasing design, advantages.

MOSFET - working of Depletion and Enhancement types, CMOS – Construction and working, Problems.

Text Books:

1. Introductory circuit analysis, Robert Boylstead – PHI 5th editon.
2. Basic Electronics and Linear circuits, N.N. Bhargava, D.C Kulshresta and D.C. Gupta-TMH.

Reference Books:

1. Electronic Devices and circuit theory, Robert Boylstead and Louis Nashelsky-PHI
2. Fundamentals of electrical and electronic engineering, B.L Theraja- S.Chand and Co.
3. Basic Electronics, B. Grob-8th Edition
4. Electrical circuits and applications, B. Grob
5. Electronic devices and circuit - Allen Mottershed.
6. Measuring Instruments, W.D Cooper and A.D. Helfrick

1BIMATHT: MATHEMATICS-I

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

On completion of the course, the student will be able to

- ✓ Analyze and understand big and small numbers and their different forms of representation.
- ✓ Comprehend algebraic solutions to simple mathematical and business problems.
- ✓ Solve linear and quadratic equations using multiple methods.
- ✓ Understand information organized in row and column format (matrix), and use algebraic methods to interpret them.
- ✓ Elementary processed in differentiation and integration and appreciate the need for continuous and discrete functions.

UNIT 1: LINEAR ALGEBRA	Teaching Hours 14

Matrices – Nomenclature, Matrix operations – Addition, Subtraction, Multiplication, Inversion. Types of matrices, Characteristics equation of a square matrix, Cayley – Hamilton theorem. Determinants – Evaluation of a determinant, Identical rows and columns, Properties of determinants.

UNIT 2: SOLUTION TO SYSTEMS OF LINEAR EQUATIONS	Teaching Hours 14

System of linear equations and criteria for unique solutions, Solution of linear equations using Cramer's rule, Elementary row operations, Gauss elimination method, Row echelon form, Iteration solutions to linear equations, Matrix method of solutions.

UNIT 3: DIFFERENTIAL AND INTEGRAL CALCULUS	Teaching Hours 16

Limits, Continuity, Derivative, Derivatives of standard functions (results only), Derivatives of a constant, Derivative of exponential and logarithmic functions, Derivatives of sum, product and quotient of two functions, Differentiation of composite functions – Chain rule, Differentiation of parametric functions.

Integration: Standard formulae for integration, Methods of integration – Integration by parts, Integration of substitution.

Partial differentiation: Representation in suffix and differential form, Mixed derivatives, Partial derivatives of higher order. Homogeneous functions, Euler's theorem. Functions of two variables, Parametric representation, Chain rule for partial differentiation.

UNIT 4: FUNCTIONS, VARIABLES, EQUATIONS, AND GRAPHS	Teaching Hours 08

Logarithm, exponential, polynomial functions, rational numbers Basic geometry and theorems, trigonometric identities, Series, sums, inequalities

Graphing and plotting, Cartesian and polar coordinates, conic sections

Text Books:

1. Modern Algebra - Sharma and Vashishta, Krishna Prakashan Mandir, Meerut, U.P
2. Theory of Matrices - B S Vatsa, New Age International Publishers.
3. Differential Calculus - Shanti Narayan, S. Chand & Company, New Delhi.
4. Ordinary and Partial Differential Equations - M D Raisinghania, S. Chand and Co. Pvt. Ltd.

Reference Books:

1. A Textbook of Engineering Mathematics - N. P. Bali, N. Ch. Narayana Iyengar, Laxmi Publications

1BICPRGT: PROGRAMMING IN C

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

On completion of the course, the student will be able to

- ✓ To study about algorithms, flowcharts and programs.
- ✓ To solve problems through logical thinking.
- ✓ To clearly understand the logic of the problem.
- ✓ To analyze the given problem and write the algorithm, flowchart.
- ✓ To write structured C programs, this is the foundation of any programming language.

UNIT 1: INTRODUCTION TO PROGRAMMING CONCEPTS	Teaching Hours 09

Software, Classification of Software, Modular Programming, Structured Programming, Algorithms and Flowcharts with examples. Overview of C Language: History of C, Character set, C tokens, Identifiers, Keywords, Data types, Variables, Constants, Symbolic Constants , Operators in C, Hierarchy of Operators, Expressions, Type Conversions and Library Functions.

UNIT 2: MANAGING INPUT AND OUTPUT OPERATION	Teaching Hours 09

Formatted and Unformatted I/O Functions, Decision making, branching and looping: Decision Making Statements - if Statement, if–else statement, nesting of if-else statements, else–if ladder, switch statement,?: operator, Looping - while, do-while, for loop, Nested loop, break, continue, and goto statements.

UNIT 3: FUNCTIONS	Teaching Hours 08

Function Definition, prototyping, types of functions, passing arguments to functions, Nested Functions, Recursive functions.

UNIT 4 : ARRAYS	Teaching Hours 09

Declaring and Initializing, One Dimensional Arrays, Two Dimensional Arrays, Multi Dimensional Arrays - Passing arrays to functions. Strings: Declaring and Initializing strings, Operations on strings, Arrays of strings, passing strings to functions. Storage Classes - Automatic, External, Static and Register Variables.

UNIT 5: STRUCTURES	Teaching Hours 09

Declaring and Initializing, Nested structure, Array of Structure, Passing Structures to functions, Unions, typedef, enum, Bit fields. Pointers – Declarations, Pointer arithmetic, Pointers and functions, Call by value, Call by reference, Pointers and Arrays, Arrays of Pointers, Pointers and Structures. Meaning of static and dynamic memory allocation, Memory allocation functions.

UNIT 6: FILES	Teaching Hours 08

File modes, File functions, and File operations, Text and Binary files, Command Line arguments. C Preprocessor directives, Macros – Definition, types of Macros, Creating and implementing user defined header files.

Text Books:

1. E. Balaguruswamy, "Programming In ANSI C", 4th edition, TMH Publications, 2007
2. Ashok N. Kamthane, "Programming with ANSI and Turbo C", Pearson Education, 2006

Reference Books:

1. Ashok N. Kamthaneet. al., "Computer Programming and IT", Pearson Education, 2011
2. Mahapatra, " Thinking In C ", PHI Publications, 1998.
3. YashwantKanetkar, "Let Us C", 13th Edition, PHP, 2013.

1BIDEVET: DIGITAL ELECTRONICS & VERILOG

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

After studying this paper the students will be able to

- ✓ Simplify the Boolean functions using Boolean algebra and K-map technique.
- ✓ Learn about basics of Verilog
- ✓ Realize the combinational circuits.
- ✓ Design the Combinational and Sequential logic circuits using Verilog.

UNIT 1: NUMBER SYSTEM	**Teaching Hours 13**

Number System

Decimal, Binary, Octal and Hexadecimal – their inter conversion. BCD numbers (8421), Gray, Excess 3, ASCII and EBCDIC codes Arithmetic operations in Binary, Hexadecimal. BCD addition and Excess 3 addition. Sign magnitude convention, 1's and 2's Complements-2's Complement Subtraction, signed number arithmetic-addition.

Positive and Negative Logic, Basic Logic gates-AND, OR and NOT gates (Logic symbols and Truth tables), Boolean algebra- Laws and Theorems, NAND and NOR gates (Logic symbols and Truth tables), De Morgan's theorems, NAND and NOR as Universal gates. Simplification of Logic Expressions using Boolean algebra, SOP and POS expressions. Karnaugh

maps- K-Map techniques to solve 3 variable.

UNIT 2: BASICS OF VERILOG	**Teaching Hours 11**

Basics of Verilog

Introduction to HDL, Structure of Verilog module, Operators, data types, simulation and synthesis

Types of descriptions: Data flow descriptions, Behavioral Descriptions, Structural Descriptions, Switch–level descriptions, mixed type descriptions

UNIT 3: MODULARITY IN VERILOG	**Teaching Hours 08**

Modularity in Verilog

Procedure, tasks and functions, advanced HDL descriptions.

Synthesis Basics: Highlights of synthesis, Synthesis information from module.

UNIT 4: COMBINATIONAL LOGIC CIRCUITS	**Teaching Hours 10**

Combinational Logic Circuits

Arithmetic Operations: Adders and subtractors, cascading full adders, Look ahead carry, Binary Comparators – 2bit and 4-bit, two bit Multiplier, Multiplexers Realization of 2:1, 4:1 and 8:1 using gates & Applications. Demultiplexer: – Realization of 1:2 1:4 and 1:8 using basic gates & Applications. Encoders: Binary coded

decimal codes, Binary – Gray viceversa, BCD – Excess 3 Encoders: Realization and Priority Encoders, Decoders: BCD – Decimal, BCD – Seven segment, seven segments displays.

Verilog description for the above circuits.

UNIT 5: SEQUENCIAL LOGIC CIRCUITS	**Teaching Hours 10**

Sequential Logic Circuits

Latches and Flip-Flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip- flop Master slave FF, Edge trigger and Pulse trigger FF, Registers and Shift Registers: PISO, PIPO, SISO,SIPO, Right shift and left shift, Universal Shift register. Counters-Binary ripple counters, Synchronous binary counters, Modulo N counters – Synchronous and Asynchronous counters.

Verilog description for the above circuits.

Text Books:

1. Digital Fundamentals: Floyd-UBS publishers
2. Guide to Verilog HDL - A practical primer by J. Bhasker; Addison Wesley Longman Pub.

Reference Books:

1. HDL programming Fundamental: VHDL and Verilog – Botros

SEMESTER II

II SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Part 1	Language1	English	4	30	70	100	2
	Language2	Kan/San/Hin/Japanese	4	30	70	100	2
Part 2	2BIOPSTT	Operating Structures	4	30	70	100	4
	2BIMATHT	Mathematics-II	4	30	70	100	4
	2BIDASTT	Data structure	4	30	70	100	4
	2BIMUCTT	8051 Microcontroller	4	30	70	100	4
	2BIDASTP	Data Structures Lab	3	15	35	50	1
	2BIMUCTP	8051 Microcontroller lab	3	15	35	50	1
Part 3		Mandatory Paper	4	15	35	50	1
Total Marks and credits			**34**	**225**	**525**	**750**	**23**

2BIOPSYT:: OPERATING SYSTEM

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit : 4

Course Objective:

- To understand the services provided by and the design of an operating system.
- To understand the structure and organization of the file system.
- To understand what a process is and how processes are synchronized and scheduled.

Course Outcome:

Upon successful completion of the course the student will be able to:

- To understand the basic working process of Operating System.
- Understand the importance of Process and scheduling.
- Understand the issues in synchronization and Memory management.

UNIT 1: INTRODUCTION	Teaching Hours :10

Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems, Operating System Structures, Components & Services, System calls, System programs, Virtual machines. Process Management: Process Concept, Process Scheduling, Co – Operating process, Threads, Inter process communication, CPU Scheduling Criteria, Scheduling algorithm, Multiple Processor Scheduling, Real time Scheduling, Algorithm evolution

UNIT 2: PROCESS SYNCHRONIZATION AND DEADLOCKS	Teaching Hours :10

The Critical Section Problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, monitors, Dead locks – system model, Characterization, Dead lock prevention, avoidance and detection, Recovery from dead lock, Combined approach to deadlock handling

UNIT 3: MEMORY MANAGEMENT	Teaching Hours 12

Logical and Physical address space, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging in Mastics and Intel 386, Virtual memory-Demand paging and it's performance, Page replacement algorithms, Allocation of frames, thrashing, page size and other considerations. Demand Segmentation.

UNIT 4: FILE MANAGEMENT (SYSTEMS, SECONDARY STORAGE STRUCTURE)	Teaching Hours :12
File Concepts, Access methods, Directory Structure, Protection and consistency, File system structure, Allocation methods, Free space management, Directory Implementation, Efficiency and Performance, Recovery. Disk Management (Structure, Disk Scheduling Methods): Disk Structure & Scheduling methods, Disk management, Swap – Space management.	
UNIT 5: PROTECTION AND SECURITY	Teaching Hours :08
Goals of protection, Domain Protection, Access matrix, Security Problem, Authentication, One time password, program threats, System threads. Case Study of Windows and Linux Operating System	

Text Book:

1. A. Silberschatz, P.B. Galvin and G. Gagne, ***Operating System*** *Concepts*.8th Edition, New Delhi : Wiley India, 2011.

Reference Text Books:

1. Stalling William, ***Operating Systems****: Internals and Design Principles.* 7th Edition, Prentice Hall, 2011.
2. Dietel et al, ***Operating System*.** 3rd Edition. Pearson Education, 2004.
3. A.S. Tanenbaum, ***Modern Operating Systems***. 3rd Ed, Prentice Hall, 2007

2BIMATHT: MATHEMATICS-II

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

On completion of the course, the student will be able to

- ✓ Analyze and understand Laplace and Fourier transforms.
- ✓ Through understanding in set theory.
- ✓ Brief introduction to complex analysis.

UNIT 1: Laplace transforms	**Teaching hours 14**

Definition and basic properties Laplace transform of some common functions and Standard results – Laplace transform of periodic functions- Laplace transforms of derivatives and the integral of function- Laplace transforms, Heaviside function and Dirac-delta function-convolution theorem(no proof)-Inverse Laplace transforms-Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficients.

UNIT 2: Fourier Transforms	**Teaching hours 14**

The Fourier Integral-Complex Fourier transform-Inverse transform-Basic properties-Transforms of the derivative and the derivative of the transform. Fourier sine and cosine transforms and inverse-transforms for first and second order derivatives

UNIT 3: Discrete Mathematical structures	**Teaching hours 12**

Sets, subsets, power sets Counting techniques
Methods of proofs and disproofs, proof by mathematical induction Basic data structures:
stacks, queues, graphs, arrays, hash tables, trees Graph properties:
Recurrence relations and equations Generating functions

UNIT 4: Complex Analysis	**Teaching hours 12**

Complex numbers, the complex plane - conjugate and modulus of a complex number - the modulus-argument form - geometric representation - Equation to circle and line in the complex form.

Text Books:

1. Laplace and Fourier Transforms - M. D. Raisinghania, New Delhi, India: S. Chand and Co. Ltd.
2. Graph theory by F Harary
3. Graph theory by Dr. Chandrashekhar
4. Laplace and Fourier Transforms - M. D. Raisinghania, New Delhi, India: S. Chand and Co. Ltd.
5. Real and Complex Analysis - Walter Rudin, McGraw-Hill Higher Education.
6. Discrete mathematics and its applications by K H Rosen

Reference Books:

1. A Textbook of Engineering Mathematics - N. P. Bali, N. Ch. Narayana Iyengar, Laxmi Publications

2BIDTSTT: DATA STRUCTURES

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit : 4

Course Objective:

- To be able to practically implement the data structures like stack, queue, array etc. To understand and implement different searching and sorting techniques.

UNIT 1: INTRODUCTION — Teaching Hours :12

Introduction and Overview: Definition, Elementary data organization, Data Structures, data Structures operations, Abstract data types, algorithms complexity, time-space trade off. Preliminaries: Mathematical notations and functions, Algorithmic notations, control structures, Complexity of algorithms, asymptotic
notations for complexity of algorithms. Arrays: Definition, Linear arrays, arrays as ADT, Representation of Linear Arrays in Memory, Traversing Linear arrays, Inserting and deleting, Multi-dimensional arrays, Matrices and Sparse matrices.

UNIT 2: Linear Data Structures — Teaching Hours :12

Linked list: Definition, Representation of Singly Linked List in memory,Traversing a Singly linked list, Searching in a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly linked list; Doubly linked list, Header linked list, Circular linked list.
Stacks: Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Conversion of infix expression to postfix expression, Evaluation of Post fix expression, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by
stack.
Queues: Definition, Array representation of queue, Linked list representation of queues. Types of queue: Simple queue, Circular queue, Double-ended queue, Priority queue, Operations on Queues, Applications of queues.

UNIT 3: Non Linear Data Structures — Teaching Hours 12

Binary Trees: Definitions, Tree Search, Traversal of Binary Tree, Tree Sort, Building a Binary Search Tree, Height Balance: AVL Trees, Contiguous Representation of Binary Trees: Heaps, Lexicographic Search Trees: Tries, External Searching: B-Trees, Applications of Trees. Graphs: Mathematical Back ground, Computer Representation, Graph Traversal, Topological Sorting

UNIT 4: Searching and Sorting	Teaching Hours :12

Searching: Introduction and Notation, Sequential Search, Binary Search, Comparison of Methods.

Sorting: Introduction and Notation, Insertion Sort, Selection Sort, Shell Sort, Divide And Conquer, Merge sort for Linked List, Quick sort for Contiguous List. Hashing: Sparse Tables, Choosing a Hash function, Collision Resolution with Open Addressing, Collision Resolution by Chaining.

Text Book:

1. *Seymour Lipschutz, "Data Structures with C", Schaum's outLines, Tata Mc Graw Hill, 2011.*
2. *Robert Kruse, C.L.Tondo, Bruce Leung,Shashi Mogalla,"Data Structures and Program Design using C", Pearson Education, 2009.*

Reference Text Books:

1. *Mark Allen Weiss," Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2013.*
2. *Forouzan,"A Structured Programming Approach using C",2nd Edition, Cengage LearningIndia,2008.*

2BIMUCTT: 8051 MICROCONTROLLER

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit : 4

Course Objective:

This course enables students to understand:

- ✓ Basics of Microprocessor and Microcontroller
- ✓ 8051 Microcontroller architecture and Pin description
- ✓ 8051 Addressing modes and instruction set
- ✓ Design and develop applications using 8051 Assembly language and C program.
- ✓ On-chip peripherals and program using Assembly language and C.

UNIT 1: INTRODUCTION TO MICROCONTROLLERS — Teaching Hours :10

Introduction, Microprocessors and Microcontrollers,. RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture.

The 8051 Architecture:

Introduction, 8051 Microcontroller Hardware, Input/Output Pins, Ports and Circuits External Memory, Counter and Timers, Serial Data Input / Output, Interrupts.

UNIT 2: ADDRESSING MODES AND OPERATIONS — Teaching Hours :12

Introduction, Addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, PUSH and POP Opcodes, Data exchanges, Example Programs;

Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Example Programs. Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Example Programs.

Jump and Call Instructions: The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns, More Detail on Interrupts, Example Problems

UNIT 3: 8051 PROGRAMMING IN C — Teaching Hours 08

Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, accessing code ROM space, data serialization.

UNIT 4: TIMER / COUNTER PROGRAMMING IN 8051	Teaching Hours :10

Programming 8051 Timers, Counter Programming, programming timers 0 and 1 in 8051 assembly level and embedded C.

Interrupts programming:

8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051/52, interrupt programming in assembly level and embedded C

UNIT 5: MEMORIES AND INTERFACING WITH 8051	Teaching Hours :12

Memory Concepts- Types of semiconductor Memories, ROMs-Mask ROM, simple ROM, internal ROM structure, small and large capacity ROM, three state outputs and buses, ROM access time, application of ROM. PROMs and EPROMs- PROMs, PROM programming, EPROMs, EEPROMs IC 2516 (logic diagram and simple explanation of the IC), RAM- Static RAM cell, basic structure of static RAM, IC 74189. Dynamic RAM cell, Basic structure of a dynamic RAM, IC 4164.

Magnetic Bubble Memories, Magnetic surface storage devices, special memories and applications- PLAs, FIFO memories and CCD memories.

Interfacing with 8051: Interfacing 8051 to LCD, Keyboard, ADC, DAC, Stepper motor.

Text Book:

1. Kenneth J. Ayala ; "The 8051 Microcontroller Architecture, Programming & Applications" 2e, Penram International, 1996 / Thomson Learning 2005.

Reference Text Books:

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; "The 8051 Microcontroller and Embedded Systems – using assembly and C"- PHI, 2006 / Pearson, 2006
2. Ajay V Deshmukh; "Microcontrollers- Theory and Applications",TMH,2005.

SEMESTER III

III SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Part 1	Language1	English	4	30	70	100	2
	Language2	Kan/San/Hin/Japanese	4	30	70	100	2
Part 2	3BIAMUCT	ARM Microcontroller	4	30	70	100	4
	3BINTPTT	Network Protocols.	4	30	70	100	4
	3BIDBMST	DBMS	4	30	70	100	4
	3BIAMUCP	ARM microcontroller lab	3	15	35	50	1
	3BIDBMSP	DBMS lab	3	15	35	50	1
	Project	Python Programming	4	30	70	100	4
Part 3		Mandatory Paper	4	15	35	50	1
Total Marks and credits			**34**	**225**	**525**	**750**	**23**

3BIAMUCT: ARM MICROCONTROLLER

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ To understand the Embedded concepts and Embedded system Architecture
- ✓ To learn the architecture and programming of ARM Cortex Microcontroller
- ✓ To select a proper Microcontroller for an application
- ✓ To understand the usage of the development and debugging tools
- ✓ To learn and apply the knowledge of Memory systems and Peripherals

UNIT 1: OVERVIEW OF ARM AND CORTEX-M3	**Teaching Hours 12**

Background of ARM Architecture, Architecture Versions, Processor Naming, Instruction Set Development, Thumb-2 and Instruction Set Architecture. Cortex-M3 Basics: Registers, General Purpose Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Cortex-M3Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.Cortex-M3 Implementation Overview: Pipeline, Block Diagram, Bus. Interfaces on Cortex-M3, I-Code Bus, D-Code Bus, System Bus, External PPB and DAP Bus

UNIT 2: CORTEX EXCEPTION HANDLING AND INTERRUPTS	**Teaching Hours 12**

Exceptions: Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, Supervisor Call and Pendable Service Call. NVIC: Nested Vectored Interrupt Controller Overview, Basic Interrupt Configuration, Software Interrupts and SYSTICK Timer. Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals and Interrupt Latency

UNIT 3: CORTEX-M3/M4 PROGRAMMING	**Teaching Hours 14**

Cortex-M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS (Cortex Microcontroller Software Interface Standard), Using Assembly. Exception Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation. Memory Protection Unit and other Cortex-M3 features: MPU Registers, Setting Up the MPU, Power Management, Multiprocessor Communication.

UNIT 4: CORTEX-M3/M4 DEVELOPMENT AND DEBUGGING TOOLS	Teaching Hours 14

STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development & Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger,
Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.

Text Books:

1. Joseph Yiu," The Definitive Guide to the ARM Cortex-M3", Second Edition, Elsevier Inc. 2010.
2. Andrew N Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", Elsevier Publications,2006
3. Steve Furber, "ARM System-on-Chip Architecture", 2nd Edition, Pearson Education, India ISBN: 9788131708408, 8131708403 , 2015

Reference Books:

1. Dr. K.V.K. Prasad, "Embedded / Real-Time Systems: Concepts, Design and Programming Black Book" , New ed (MISL-DT) Paperback – 12 Nov 2003
2. David Seal "ARM Architecture Reference Manual", Addison Wesley, England; Morgan Kaufmann Publishers,2001
3. Ajay Deshmukh, "Microcontroller - Theory & Applications", Tata McGraw Hill, 2005
4. Arnold. S. Berger, "Embedded Systems Design - An introduction to Processes, Tools and Techniques", Easwer Press, 2001
5. Raj Kamal, "Microcontroller - Architecture Programming Interfacing and System Design" 2nd Edition, Pearson Education, 2011
6. Cortex-M series-ARM Reference Manual
7. Cortex-M3 Technical Reference Manual (TRM)
8. STM32L152xx ARM Cortex M3 Microcontroller Reference Manual 5/97
9. ARM Company Ltd. "ARM Architecture Reference Manual– ARM DDI 0100E"
10. ARM v7-M Architecture Reference Manual (ARM v7-M ARM).

3BINTPTT: NETWORK PROTOCOLS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ To Understand the Architectural Overview of IoT
- ✓ To Understand the IoT Reference Architecture and RealWorld Design Constraints
- ✓ To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

UNIT 1: DATA COMMUNICATIONS AND NETWORKING	**Teaching Hours 10**

Introduction, Data communications network architecture, protocols and standards, standards organization for data communications, layered network architecture, open system interconnection, Serial and parallel data transmission, Data communications networks (network models, network topologies)

UNIT 2: THE HTTP PROTOCOL	**Teaching Hours 10**

Adding HTTP support to the sensor Setting up an HTTP server on the sensor, Setting up an HTTPS server, on the sensor, Adding a root menu, Displaying measured information , in an HTML page, Generating graphics dynamically, Creating sensor data resources, Interpreting the readout request, Testing our data export, User authentication, Adding events for enhanced network performance

Introducing UPnP

Providing a service architecture, Documenting device and service capabilities, Choosing a device type, Being friendly, Providing the device with an identity, Adding icons, Adding references to services, Topping off with a URL to a web presentation page, Adding actions, Adding state variables, Adding a unique device name, Providing a web interface

UNIT 2: THE CoAP PROTOCOL	**Teaching Hours 09**

Defining our first CoAP resources, Manually triggering an event notification, Registering data readout resources, Returning XML, Returning JSON, Returning plain text, Discovering CoAP resources, Testing our CoAP resources, Defining simple control resources, Parsing the URL in CoAP, Controlling the output using CoAP, Monitoring observable
resources, Receiving notifications, Performing control actions

UNIT 4: THE MQTT PROTOCOL	**Teaching Hours 09**

The MQTT Protocol, Publishing and subscribing, Adding MQTT support to the sensorControlling the thread life cycle, Flagging significant events, Connecting to the MQTT server, Publishing the content, Adding MQTT support to the actuator, Initializing the topic content, Subscribing to topics, Receiving the published content, Decoding and parsing content, Adding MQTT support to

the controller, Handling events from the sensor, Decoding and parsing sensor values, Subscribing to sensor events, Controlling the actuator, Controlling the LED output, Controlling the alarm output
UNIT 5: THE XMPP PROTOCOL | **Teaching Hours 09**
XMPP basics, Federating for global scalability, Providing a global identity, Authorizing communication, Sensing online presence, Using XML, Communication patterns, Extending XMPP, Connecting to a server, Provisioning for added security, Adding XMPP support to a thing, Connecting to the XMPP network, Monitoring connection state events, Notifying your friends, Handling HTTP requests over XMPP
Text Books: 1. Learning Internet of Things by Peter Waher 2015 Packt Publishing Internet of Things with Python Publisher: Packt Publishing Limited (20 May 2016)
Reference Books: 1. Designing The Internet Of Things, Wiley, Adrian McEwen.

3BDBMST: DATABASE MANAGEMENT SYSTEM

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 04
Max Marks: 70	Credit: 4
Course Objective:	

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in database.
- Design and build database applications for real world problems
- Illustrate the concepts of NOSQL

UNIT 1: INTRODUCTION — Teaching Hours :10

Data, Database, Database management system, Characteristics of the database approach, Database users, Advantages of Using a DBMS and When not to use a DBMS. Data Models, Categories of data models, Schemas, DBMS Architecture and Data Independence, The Three schema architecture, DBMS Languages and Interfaces, Classifications of DBMS

UNIT 2: E-R MODEL AND FILE ORGANIZATIONS — Teaching Hours :10

Entity types, Entity Sets, Attributes and Keys. Relationships, Relationship types, Roles and Structural constraints. Weak and strong Entity Types and Drawing E- R Diagrams. Naming conventions and design issues, Preparing E-R diagrams for a problem.

Record storage and primary file organization, heap files, Single Level Ordered Indexes, Primary indexes, Clustering indexes and Secondary indexes.

UNIT 3: RELATIONAL MODEL AND NORMALIZATION. — Teaching Hours 10

Relation, Integrity constraints - domain, entity and Referential integrity constraints, Basic Relational Algebra operations, select, project and join operations.

Functional dependencies and Normalization for Relational Databases - Normalization concepts, first, second, third normal forms and Boyce-Codd normal form.

UNIT 4: STUCTURED QUERY LANGAUGE(SQL)	Teaching Hours :10

SQL Basics, SQL data definition and data types, specifying constraints in SQL, Basic queries like INSERT, DELETE ,ALTER and UPDATE statements in SQL, More Complex SQL queries for grouping and built in functions, Joining tables using equi, left, right joins.

UNIT 5: DATABASE SECURITY	Teaching Hours :06

Introduction to database security issues, discretionary access control based Granting/Revoking of privileges, account level and relation level security, Introduction to statistical Database security.

UNIT 6: NOSQL DATABASE	Teaching Hours :06

Why NoSQL? The value of Relational Databases, getting at persistent data, concurrency, integration, A(mostly) standard model, impedance Mismatch, Application and Integration Databases, Attack of the clusters, the emergence of NoSQL, Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-family stores, summarizing Aggregate-Oriented Databases. More Details on Data Models; Relationships, Graph Databases, Schema less Databases, Materialized views, Modeling for Data Access.

Essential Text Book:

1. Fundamentals of Database systems, by Elmasri Ramez and Navathe, 7th Edition, Pearson.
2. Database Management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill.
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Sadalage p. & Fowler, Pearson Addision Wesley, 2012

Reference Text Books:

1. *Database System Concepts*, By Silberschatz, Korth, Sudarshan, 6th Edition, McGraw Hill, 2013.
2. Database principles fundamentals of Design,Implementation and Management, Coronel, Morris and Rob, Cengage Learning 2012.
3. Introduction to database management system by Atul Kahate, 1/e pearson publication.
4. Dan Sullivan, "NoSQL for Mere Mortals", 1st Edition, Pearson education India 2015.
5. Dan McCreary and Anny Kelly, " Making Sense of NoSQL: A guide for Managers and the rest of us", 1st edition, manning publication/ Dreamtech press, 2013.
6. Kristina Chodorow, "Mongodb: The Definitive Guide – powerful and scalable data storage", 2nd Edition, O'Reilly Publications, 2013.

SEMESTER IV

IV SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Part 1	Language1	English	4	30	70	100	2
	Language2	Kan/San/Hin/Japanese	4	30	70	100	2
Part 2	4BISAADT	Sensing and Actuating Devices	4	30	70	100	4
	4BISTATT	Statistics	4	30	70	100	4
	4BIITOTT	Internet of Things	4	30	70	100	4
	4BIITOTP	IoT lab	3	15	35	50	1
	4BISAADP	Sensing and actuating lab	3	15	35	50	1
	Project	Arduino & Raspberry pi Projects	4	30	70	100	4
Part 3		Mandatory Paper	4	15	35	50	1
Total Marks and credits			**34**	**225**	**525**	**750**	**23**

4BISAADT: SENSING AND ACTUATING DEVICES

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 04
Max Marks: 70	Credit: 4
Course Objective:	

- Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
- Market forecast for IoT devices with a focus on sensors

UNIT 1: **TRANSDUCERS** — Teaching Hours :10

Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Capacitive transducer, Piezo-electric Transducers, Inductive transducer, Differential output transducers and LVDT. Piezoelectric transducer, photoelectric transducer, Photovoltaic transducer, Semiconductor photo devices, Temperature transducers-RTD, Thermocouple. Bolometer and RF power measurement using Bolometer

UNIT 2: **SENSORS** — Teaching Hours :12

Introduction to Sensors, Limit Switches, International Limit Switches, BERO Sensors, Proximity Sensors (Inductive, Capacitive, Ultrasonic): Theory of Operation, Sensor Family, Photoelectric Sensors Theory of Operation and its Family, Atmospheric Sensors: Pressure and Density Sensors; Pitot-Static, Angle of Attack and Side-Slip, Outside Air Temperature Sensors, Barometric Sensors: Air Speed Sensor, Altitude Sensor, Vertical Speed Sensor. Electro-Mechanical Sensors: Gyroscope, Synchro, Flux Valve/Gate, Magnetic Compass, Gyromagnetic Compass. Sensors applications.

UNIT 3: **SEVEN GENERATIONS OF IOT SENSORS TO APPEAR** — Teaching Hours 12

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics– Polytronics Systems – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description &
Characteristics–IoT Generation Roadmap

UNIT 4: **TECHNOLOGICAL ANALYSIS**	Teaching Hours :12
Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module	
UNIT 5: **IOT DEVELOPMENT EXAMPLES**	Teaching Hours :06
ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks - Focus on Wearable Electronics	

Essential Text Book:

1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024',Yole Développement Copyrights ,2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015

Reference Text Books:

1. Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

4BISTATT: STATISTICS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 04
Max Marks: 70	Credit: 4
Course Objective:	

- This paper will help students to have a thorough knowledge of descriptive statistics.
- To understand measures of central tendency and use them to analyze data.
- This paper will help students to have a thorough knowledge of descriptive basic probability and samplings.

UNIT 1: **INTRODUCTION** — Teaching Hours :10

Population and sample, Types of data – Qualitative, Quantitative, Univariate, Multivariate, Cross sectional, Time, Series, Discrete, Continuous, Primary, Secondary, Scales of measurement – Nominal, Ordinal, Interval, Ratio, Variables and attributes, Organization and presentation of data, Construction of frequency distributions (univariate and bivariate), Presentation of data through diagrams (bar and pie) and graphs (frequency curve, histogram, cumulative frequency curves), Stem and leaf plot.

UNIT 2: **CORRELATION AND REGRESSION** — Teaching Hours :10

Linear correlation – Scatter diagram, Product moment correlation coefficient – Properties, Spearman's rank correlation coefficient, Simple regression, Prediction.

UNIT 3: **MEASURE OF CENTRAL TENDENCY** — Teaching Hours 04

Measures of location or central tendency – Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean.

UNIT 4: PROBABILITY AND RANDOM VARIABLES — Teaching Hours :18

Introduction to probability, Sample space and events, Axiomatic approach to probability, Addition theorem, Conditional probability.

Random variables: Concept of a random variable, Discrete and continuous random variable and their probability functions, Distribution function and its properties, Expectation of a random variable – Mean Variance, Bivariate probability distribution, Marginal and conditional distributions, Covariance, Independence, Conditional expectation and variance, Mean and variance of linear combination of random variables.

UNIT 5: **SAMPLING METHODS**	Teaching Hours :10

Types of sampling – Purposive, Random and mixed samples, Sampling Methods – Simple, Random, Stratified, Cluster, Relative merits and limitations of the different methods.

Essential Text Book:

1. Freund, Ronald, E. Walpole, Mathematical Statistics, Fourth Edition (1987), Prentice Hall of India, New Delhi.
2. B.L. Agarwal, Basic Statistics (2009), New Age Publishers.
3. J. Medhi, Statistical Methods – An Introductory Text, New Age Publishers.
4. A.M. Goon, M.K. Gupta and B. Das Gupta, Fundamentals of Statistics, Vol. 1, Sixth Edition, World Press, Calcutta.

Reference Text Books:

1. Gupta and Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons
2. G.W. Snedecor, Cochran, Statistical Methods, Eighth Edition, Wiley.
3. Sheldon M. Ross, Introductory Statistics, Second Edition, Acadamic Press.
4. Pal, Sarkar, Statistics Concepts and Applications, Second Edition, PHI.
5. David Freedman, Robert Pisani, Roger Purves, Statistics, Fourth Edition, Viva.
6. Roger. E. Kirk, Statistics, An Introduction, Fourth Edition, Harcourt Brace College Publishers.

4BIITOTT: INTERNET OF THINGS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 04
Max Marks: 70	Credit: 4
Course Objective:	

- Assess the genesis and impact of IoT applications, architectures in real world.
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

UNIT 1: **INTRODUCTION** — Teaching Hours :10

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

UNIT 2: **IOT-AN ARCHITECTURAL OVERVIEW** — Teaching Hours :10

Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

UNIT 3: **REFERENCE ARCHITECTURE** — Teaching Hours 12

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

UNIT 4: **SENSOR CONNECTIVITY** — Teaching Hours :12

Various wired communication protocols recap, IIC (Normal, High speed), SPI (3 wire, 4 wire modes), Single wire, CAN, serial interface.

Various wireless communications: High-level overview with pros and cons of Bluetooth, BLE(Bluetooth low energy), Zigbee, Wifi protocols.

Voltage level translations. Recap of TTL, CMOS levels. Level shifters to cross connect 1.8v, 3.3v and 5v devices

UNIT 5: **DATA MONITORING& VISUALIZATION**	Teaching Hours :08

Data visualization basics. Different options for visualization. Local display using different types of LCD/LED displays, display of charts using web

interfaces etc. Displaying data from serial link in Matlab, processing and other interfaces. Data streaming from things to cloud using API's. Integrate Matlab and Thingspeak.

Essential Text Book:

5. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
6. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017
7. Internet of Things, 2nd edition, Shriram K Vasudevan, Wiley (9 September 2020); Wiley India Pvt Ltd.

Reference Text Books:

7. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014. (ISBN: 978-8173719547)
8. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)
9. Internet of Things, IoT Notes by Parita.

SEMESTER V

V SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Part 2	5BICAACT	Cloud architecture and computing	4	30	70	100	4
	5BIRTOST	Embedded system design &RTOS	4	30	70	100	4
	5BIADSNT	Advanced sensor networks	4	30	70	100	4
	5BIDTANT	Data analytics	4	15	35	50	4
	5BIRTOSP	Embedded systems Lab	3	15	35	50	2
	Project	**(IoT/Embedded)**	4	30	70	100	4
Total Marks and credits			**23**	**150**	**350**	**500**	**22**

5BICAACT: CLOUD ARCHITECTURE AND COMPUTING

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ To understand the differences between traditional deployment and cloud computing
- ✓ To determine whether existing applications to the cloud makes technical and business sense
- ✓ To analyze and compare the long-term costs of cloud services
- ✓ To learn how to build a transactional web application for the cloud or migrate one to it
- ✓ Change your perspective on application scaling in cloud environment for quality metrics

UNIT 1: **CLOUD ARCHITECTURE BASICS**	Teaching Hours :09

The Cloud -Hype cycle-metaphorical interpretation-cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, role of virtualization in enabling the cloud.

UNIT 2: **END TO END DESIGN**	Teaching Hours :10

Requirement analysis: strategic alignment and architecture development cycle-strategic impact-Risk impact-financial impact-Business criteria- technical criteria-cloud opportunities –evaluation criteria and weight-End to end design-content delivery networks-capacity planning-security architecture and design

UNIT 3: **CLOUD APPLICATION ARCHITECTURES**	Teaching Hours :10

Development environments for service development; Amazon, Azure, Google App-cloud platform in industry

UNIT 4: **HOW TO MOVE APPLICATION INTO THE CLOUD**	Teaching Hours :11

Web Application Design- Machine Image Design-privacy design – Database management

UNIT 5: **SPECIALIZED CLOUD ARCHITECTURE**	Teaching Hours :12

Workload distribution architecture-Dynamic scalability-Cloud bursting- hypervisor clustering-service quality metrics&SLA.

Text Books:

1. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).
2. John Rhoton ,Cloud Computing Explained: Handbook for Enterprise Implementation 2013 edition, 2013, recursive press

Reference Books:

1. RajkumarBuyya, Christian Vecchiola, S.ThamaraiSelvi,Mastering Cloud Computing: Foundations and Applications Programming, MorganKaufmann, Elsevier publication, 2013
2. Thomas Erl, ZaighamMahmood, and Ricardo Puttini,Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013

5BIRTOST: EMBEDDED SYSTEMS AND REAL TIME OPERATING SYSTEMS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ To understand the aspects of Real Time Embedded concepts
- ✓ To learn the Essentials of Open Source RTOS and their usage
- ✓ To select the proper technique to design a Real-Time System
- ✓ To understand VxWorks RTOS and real time application programming with it
- ✓ To build the device driver and kernel internal for Embedded OS and RTOSearn and apply the knowledge of Memory systems

UNIT 1: EMBEDDED OS INTERNALS

Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication – Semaphore, Pipes, FIFO, Shared Memory Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB,
Block & Network.

UNIT 2: OPEN SOURCE RTOS

Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards, RTOS Issues – Selecting a Real-Time Operating System, RTOS comparative study.

UNIT 3: REAL TIME KERNEL BASICS

Converting a normal Linux kernel to real time kernel, Xenomai basics. Overview of Open source RTOS for Embedded systems (Free RTOS/ ChibiosRT) and application development. Real Time Operating Systems: Event based, process based and graph based models, Petrinet models. Real time languages, real time kernel, OS tasks, task states, task scheduling, interrupt processing, clocking, communication and Synchronization. Control blocks, memory requirements and control, kernel services, basic design using RTOS.

UNIT 4: VXWORKS / FREE RTOS

VxWorks/ Free RTOS Scheduling and Task Management – Realtime scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems – General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral.

UNIT 5 : CASE STUDY	
Software Development and Tools: Simulators, debuggers, cross compilers, in circuit emulators for the microcontrollers. Interface Issues Related to Embedded Systems: A/D, D/A converters, FPGA, ASIC, diagnostic port. Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board ().Testing a real-time application on the board.	

Text Books:

1. VenkateswaranSreekrishnan," Essential Linux Device Drivers" , Ist Kindle edition, Prentice Hall, 2008
2. Jerry Cooperstein , "Writing Linux Device Drivers: A Guide with Exercises", J.Cooperstein publishers ,2009

Reference Books:

1. Qing Li and CarolynYao,"3Real Time Concepts for Embedded Systems – Qing Li, Elsevier ISBN:1578201241 CMP Books © 2003
3. Raj Kamal," Embedded Systems Architecture Programming and Design":, Tata McGraw Hill, 2011
4. KVK Prasad, "Embedded/Real Time Systems Concepts, Design and Programming Black Book", , Wiley India 2003
5. Seppo J. Ovaska Phillip A. Laplante,"Real-Time Systems Design and Analysis:Tools for the Practitioner", 4ed Paperback – 17 May 2013
6. Ward, Paul T & Mellor, Stephen," Structured Development for Real - Time Systems v1, v2,V3 : Implementation ModelingTechniques " Prentice hall, 2015 David E. Simon, ".Embedded Software Primer": Addison-Wesley Professional , 2000

5BIWSNWT: WIRELESS SENSOR NETWORKS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ Understand the Basics of WSN
- ✓ Gain the knowledge on architecture & sensor networks
- ✓ Understanding on various tools & platforms.

UNIT 1: OVERVIEW OF WIRELESS SENSOR NETWORKS	**Teaching Hours 10**

Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks.

UNIT 2: ARCHITECTURES	**Teaching Hours 12**

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor .Nodes , Operating Systems and Execution Environments, Network Architecture -
Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

UNIT 3: NETWORKING SENSORS	**Teaching Hours 12**

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.

UNIT 4: INFRASTRUCTURE ESTABLISHMENT	**Teaching Hours 10**

Topology Control , Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT 5: SENSOR NETWORK PLATFORMS AND TOOLS	**Teaching Hours 10**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node- level software platforms, Node-level Simulators, State-centric programming

Text Books:

1. Holger Karl & Andreas Willig, " Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks- Technology, Protocols, And Applications”, John Wiley, 2007.

Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

5BIDTANT: DATA ANALYTICS

Total Teaching Hours: 52	No. Of Lecture Hours/Week: 4
Max Marks:70	Credit: 4

Objectives:

- ✓ Introduce students the concept and challenge of big data (3 V's: volume, velocity, and variety). Teach students in applying skills and tools to manage and analyze the big data.

UNIT 1	**Teaching Hours 09**

Preparatory: Data Science landscape, relevance and importance of data analytics, Data sources: Social data - from organizations like WHO and social sites like face book. Government data - like data.gov.in, Data from own organization, Data formats: Structured, Semi-structured, Unstructured, Excel for presentation and simple visualization of structured data. Raw and Processed Data, Components of Tidy Data, Downloading Files, Reading Local Files, Reading Excel Files, Reading XML, Reading JSON, Reading from MySQL, Reading from HDF5, Reading from The Web, Reading From APIs.

UNIT 2	**Teaching Hours 09**

Data preparation / Mugging: Subsetting and Sorting, Summarizing Data, Handling missing values, Creating New Variables, Reshaping Data, Merging Data.

UNIT 3	**Teaching Hours 08**

Data Exploration: Exploratory Graphs

UNIT 4	**Teaching Hours 08**

Data Modelling: Data grouping, frequency, and aggregation, Handling
missing data, Text manipulation and format conversion, Assertions and logical operations

UNIT 5	**Teaching Hours 09**

Analysis: Mathematical functions, Sampling , Relationship between variables, Rank and percentile Time series analysis, Descriptive statistical measures, Confidence level, Analysis of variance, Correlation Covariance, Regression, Moving average

UNIT 6	**Teaching Hours 09**

Visualization Comparison among items, Comparison over time, Relationship - two variables and three variables, Distribution - histogram, line chart, scatter chart, 3D area chart, Composition - static and changing
over time

Text Books:

1. Jake VanderPlas, Python Data Science Handbook: Essential Tools forWorking with Data, O'Reilly, 2017
2. W Mckinney, Python for Data Analysis, O'Reilly, 2013

Reference Books:

1. Murtaza Haider, Getting Started with Data Science, IBM Press, 2015
2. Davy Cielen, Introducing Data Science: Big Data, Machine Learning, andMore, Manning, 2016

SEMESTER VI

VI SEMESTER							
Part	**Paper**		**Hours/week**	**Marks**			**Credit**
	Code	**Title**		**IA**	**Exam**	**Total**	
Project/Internship			23	150	350	500	22
Total Marks and credits			**23**	**150**	**350**	**500**	**22**