Samrat Ashok Technological Institute (Engineering College), VIDISHA (M.P.)
(An Autonomous Institute Affiliated to RGPV, Bhopal)
Syllabus: B.Tech (IoT)
Internet of Things

IoT-2031   Signals & Systems

Course Title	Course Code	Credits - 4		
		L	T	P
Signals & Systems	IoT-2031	3	1	-

COURSE OBJECTIVE

When a student completes this course, s/he should be able to:
- Understand the fundamentals of the Signals and systems,
- Understand linear time invariant systems and able to obtain mathematical modeling of the system.
- Apply the concepts of frequency domain representations to analyze continuous and discrete time signals/systems
- Understand and apply the Z-Transform, to the analysis and description of LTI discrete-time systems.
- Able to apply the knowledge to model a system

PRE-REQUISITES
- Differential equations
- Linear algebra.

COURSE CONTENTS

Unit I: An Introduction to Signals and Systems: Definition of signal and systems, communication and control systems as examples. Classification of signals: continuous time and discrete time signal even and odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals/Functions: exponential, sine, unit impulse, unit step and its properties, ramp, rectangular, triangular, signum. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration, time scaling, time shifting, and time folding. System properties: linearity, additively and homogeneity, causality, stability, reliability. Introduction to different types of systems like causal & non causal systems, static& dynamic, stable &unstable, linear& nonlinear, time variant &time invariant systems.

Unit-II: Linear Time- Invariant Systems: Introduction, Convolution: impulse response representation for LTI systems, properties of the impulse response representation for LTI systems, differential and difference equation for LTI Systems, block diagram representations (direct form-I, direct form-II, transpose, cascade and parallel).

Unit-III: Periodic and semi-periodic inputs to an LSI system, the notion of frequency response and its relation to impulse response, Fourier series representation, the Fourier transform convolution/multiplication and their effect in frequency domain, magnitude and phase response, Fourier domain duality.

Unit-IV: Sampling Theorem, reconstruction of a signal from its samples, aliasing, discrete time processing of continuous time signals, Sampling of band pass signals. Fourier series, Fourier transform (FT), Parseval's theorem.

Mr. Sudesh Morey   Mr. Satish Asnani   Dr. Dhananjay V. Gadre   Dr. N. P. Patidar   Prof. Vipin Patait

Dr. Divya Rishi Sahu   Prof. Shaila Chugh   Prof. C. S. Sharma   Dr. Jyotsna V Ogale   Dr. J. S. Chauhan

Unit-V: The z transform Basic principle of z-transform, definition, region of convergence, system functions, poles and zeros of systems and sequences, properties of ROC, properties of z-transform, inverse z-transform using, contour integration, residue theorem, power series expansion, and partial fraction expansion, relationship between z-transform and Fourier transform.

COURSE OUTCOMES:

This course develop students abilities to

CO 1: Acquire knowledge of basics, fundamentals of signal & systems and identify basic process involved in signal & system interaction.Apply the basic concepts in Modeling and transform domain analysis .

CO 2: Analysis signal & system in time and frequency domain and extract the necessary information Model, analyze and synthesize the systems and performance of systems.

TEXT BOOKS& REFERENCES:

- A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
- B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
- Douglas K. Lindner, "Introduction to Signals and Systems", Mc-Graw Hill International Edition: c1999.
- J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", Tata Mc Graw Hill Publishing Company Ltd., New Delhi
- R.E. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition,
  Prentice Hall, 1998.
- Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
- Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons (SEA) Private Limited, c1995.
- M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", Tata Mc Graw Hill Edition, 2003.
- Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.

END

Mr. Sudesh Morey   Mr. Satish Asnani   Dr. Dhananjay V. Gadre   Dr. N. P. Patidar   Prof. Vipin Patait

Dr. Divya Rishi Sahu   Prof. Shaila Chugh   Prof. C. S. Sharma   Dr. Jyotsna V Ogale   Dr. J. S. Chauhan

IoT-2032   Electronic Devices & Circuits

Course Title	Course Code	Credits - 4		
		L	T	P
Electronic Devices & Circuits	IoT-2032	3	-	2

COURSE OBJECTIVE

The purpose of the course is to teach the fundamental principle of electronics. The material covers a variety of topics including various types of diodes, transistor, amplifiers and application.

PRE-REQUISITES

Basic knowledge of electronic components and laws such as KCL, KVL, etc.

COURSE CONTENTS

Unit I: Semiconductor Diodes: Basics of semiconductor theory, Introduction to PN junction diode, Special function diode, Zener diode, PIN, Varactor, Tunnel & Schottky diode and its applications. Design circuits using diodes. Optoelectronics- LED, LCD, Photo diode, Photo voltaic cell or solar cell. Drift of carrier in electric and magnetic field and Hall effect. Introduction to analog IC's.

Unit II: Bipolar Junction Transistors (BJTs): Physical structure and operation modes, Active region operation of transistor, D.C. and A.C. analysis of transistor circuits, Transistor as an amplifier. Biasing the BJT: fixed bias, emitter feedback bias, collector feedback bias and voltage divider. Basic BJT amplifier configuration: common emitter, common base and common collector amplifiers. Transistor as a switch: cut-off and saturation modes. h and π model of BJT amplifier, Low and high frequency analysis of BJT.

Unit III: Field Effect Transistor (FET): Junction Field-Effect Transistor (JFET) - Construction, Operation and Biasing, Depletion-type MOSFET, Enhancement-type MOSFET: structure and physical operation, current-voltage characteristics, D.C. operation, Biasing, configuration: common source, gate and drain types. High frequency model of MOSFET.

Unit IV: Multistage or Cascade amplifier: classification, coupling and frequency response of cascaded systems, effect of cascading on voltage gain, current gain, phase, input and output impedances and bandwidth of cascaded or multistage amplifiers. Types of coupling, cascade and cascode circuits, Miller theorem, Darlington pair, bootstrap circuit.
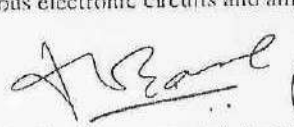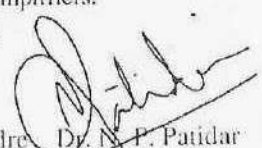
Unit V: Tuned Amplifiers: Tuned amplifier: single tuned, double tuned and stagger tuned amplifiers characteristics and their frequency response, Power amplifier- Class A, B, C, AB, second-harmonic distortion.. Comparison of their efficiencies, types of distortion.

COURSE OUTCOMES:
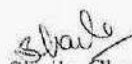
On successful completion of this course student should be able to:

CO1: Identify, understand and demonstrate fundamental principle and working of electronic components and devices.

CO2: Analyze various electronic circuits and amplifiers.

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CO3: Design different electronic circuits and systems by cascading different electronic stages.

TEXT BOOKS& REFERENCES:	• Electronics Circuits and Systems- Owen Bishop • Intuitive Analog Circuit Design- Marc T. Thompson • Electronic Devices & circuits – Boyelstad & Neshelsky – PHI • A Text of electronic" 2nd edition S.Chand-R.S Sedha • Integrated Electronics. – Millman Halkias • Electronic Devices & Circuits – David A. Bell – PHI • Principles of Electronic Devices – Malvino • Starting Electronics (Fourth Edition)-Keith Brindley • Microelectronics & circuit 5th edition - Sandra & Smith.

LABORATORY EXPERIMENTS

1. Familiarize with existing online simulation tools such as Circuit Simulation and Schematics Lab, MultiSim Lab, etc.
2. To design circuits, make wiring diagrams, to test analog and digital simulation, and perform the practical available at simulation lab.
3. Design voltage regulator using Zener diode and verify its characteristics.-CO3
4. To draw the output waveform of Full wave rectifier. Calculate PIV, Ripple Factor, Form Factor and Efficiency.-CO2
5. Analysis of common base PNP bipolar junction transistor and verify input and output characteristics.-CO2
6. Analysis of common emitter NPN bipolar junction transistor and verify input and output characteristics.-CO2
7. To draw the static characteristics of JFET and find out its parameters.-CO2
8. To design the power supply of +5V and -5V using IC regulator.-CO3
9. To design a positive clipper circuit using a 1 kHz square wave with a 10 volt peak-to-peak magnitude as the input signal.-CO3
10. To design a negative clamper circuit using a 1 kHz square wave with a 10-volt peak-to-peak magnitude as the input signal.-CO3
11. To draw the frequency response of two stage RC coupled class A amplifier using transistor.-CO2
12. To draw the frequency response of two stage Direct coupled class A amplifier using transistor.-CO2

END

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IoT – 2033   Analog Electronics

Course Title	Course Code	Credits - 4		
		L	T	P
Analog Electronics	IoT – 2033	3	-	2

COURSE OBJECTIVE

The purpose of this course is to study feedback techniques, oscillator's circuit & basic building blocks of linear integrated circuits; the linear and non-linear applications of operational amplifiers, special integrated circuits & active filters, IC 555 and signl generators circuits using op-amps.

PRE-REQUISITES

Basic Electricals & Electronics Engineering. Network Analysis

COURSE CONTENTS

Unit I: Feedback Amplifier and Oscillators: Concept of feedback and their types, Amplifier with negative feedback and its advantages. Feedback Topologies. Oscillators: Concept of Positive feedback, Classification of Oscillators, Barkhausen criterion, Types of oscillators: RC oscillator, RC Phase Shift, Wien Bridge Oscillators. LC Oscillator: Hartley, Colpitt's, Clapp and Crystal oscillator. Introduction to integrated circuits: Advantages and characteristic parameters of IC's, basic building components, data sheets.

Unit-II: Operational Amplifier: Differential amplifier and analysis, Configurations- Dual input balanced output differential amplifier, Dual input Unbalanced output differential amplifier, Single input balanced output differential amplifier, Single input Unbalanced output differential amplifier Introduction of op-amp, Block diagram, characteristics and equivalent circuits of an ideal opamp, Power supply configurations for OP-AMP. Characteristics of op-amp: Ideal and Practical, Input offset voltage, offset current, Input bias current, Output offset voltage, thermal drift, Effect of variation in power supply voltage, common-mode rejection ratio (CMRR), Slew rate and its Effect, PSRR and gain bandwidth product, frequency limitations and compensations, transient response, analysis of TL082 datasheet.

Unit-III: OP-AMP applications: Inverting and non-inverting amplifier configurations, Summing amplifier, Integrators and differentiators, Instrumentation amplifier, Differential input and differential output amplifier, Voltage-series feedback amplifier, Voltage-shunt feedback amplifier, Log/ Antilog amplifier, Triangular/rectangular wave generator, phase-shift oscillators, Wein bridge oscillator, analog multiplier-MPY634, VCO, Comparator, Zero Crossing Detector. OP-AMP AS FILTERS: Characteristics of filters, Classification of filters, Magnitude and frequency response, Butterworth 1st and 2nd order Low pass, High pass and band pass filters, Chebyshev filter characteristics, Band reject filters, Notch filter; all pass filters, self-tuned filters, AGC,AVC using op-AMP.

UNIT IV: TIMER:IC-555 Timer concept, Block pin configuration of timer. Monostable, Bistable and Astable Multivibrator using timer 555-IC, Schmitt Trigger, Voltage limiters, Clipper and clampers circuits. Absolute value output circuit, Peak detector, Sample and hold Circuit, Precision rectifiers, Voltage-to-current converter, Current-to-voltage converter.

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UNIT V: Voltage Regulator: simple OP-AMP Voltage regulator, Fixed and Adjustable Voltage Regulators, Dual Power supply, Basic Switching Regulator and characteristics of standard regulator ICs such as linear regulator, Switching regulator and low-drop out regulator. Study of LM317, TPS40200 and TPS7250

COURSE OUTCOMES:

On completion of this course students should be able to:

CO 1: Able to understand & demonstrate the fundamentals of operational amplifiers & its applications

CO 2: Able to analyze different OP-Amp Circuits

CO 3: Able to design different applications of OP-Amp

TEXT BOOKS& REFERENCES:

- Ramakant A. Gaikward,"OP- Amp and linear Integrated circuits" Third edition 2006, Pearson.
- B. Visvesvara Rao Linear Integrated Circuits Pearson.

REFERENCES:

- David A. Bell: Operational Amplifiers & Linear ICs, Oxford University Press, 2nd edition,2010.
- D. Roy Choudhury: Linear Integrated Circuits New Age Publication.
- B. Somanathan Nair: Linear Integrated Circuits analysis design and application Wiley India Pvt. Ltd.
- Maheshwary and Anand: Analog Electronics, PHI.
- S Salivahanan,V S KanchanaBhaaskaran: Linear Integrated Circuits",second edition, McGraw Hill.
- Gray Hurst Lewis Meyer Analysis and design of analog Integrated Circuits fifth edition Wiley India.
- RobertF.Coughlin, Frederick,F.Driscoll: Operational Amplifiers and Linear Integrated Circuits, sixth edition, Pearson.
- Millman and Halkias: Integrated electronics, TMH.
- Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
- Sedra and Smith: Microelectronics, Oxford Press.

LABORATORY EXPERIMENTS

1. To measure and compare the op-amp characteristics: offset voltages, bias currents, CMRR, Slew Rate of OPAMP LM741 and TL082.
2. To determine voltage gain and frequency response of inverting and non-inverting amplifiers using TL082.
3. To design an instrumentation amplifier and determine its voltage gain using TL082.
4. To design op-amp integrator (low pass filter) and determine its frequency response.
5. To design op-amp differentiator (high pass filter) and determine its frequency response.
6. Design 2nd order Butterworth filter using universal active filter topology with LM741
7. To design Astable, Monostable and Bistable multivibrator using 555 and analyse its characteristics.
8. Automatic Gain Control (AGC) Automatic Volume Control (AVC) using multiplier.

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IoT – 2034   Introduction to Internet of Things

Course Title	Course Code	Credits - 4		
		L	T	P
Digital Electronics	IoT-2034	3	-	2

COURSE OBJECTIVE

The purpose of this course to student should be able to study and appreciate the functioning of different digital components like logic gates, multiplexers, decoders, flip flops, counters, etc.

PRE-REQUISITES

- Basic knowledge of direct current circuits, concept of voltage, current, resistance, semiconductor, diodes and transistors.

COURSE CONTENTS

UNIT 1: Number Systems and Codes: Digital number systems, base conversion, Binary, Decimal, octal, Hexadecimal, number system with radix r, Gray codes. Alphanumeric codes – ASCII code and BCD codes, concept of parity, complementr's& (r-1)'s, subtraction with complements, signed Binary numbers, Error Detecting & Correcting codes. Basic Theorems & Properties of Boolean algebra: AND, OR, NOT operators, laws of Boolean algebra, Demorgon's theorem, Boolean expression & logic diagram Negative logic, Alternate logic gate representation (concept of bubbled gates) canonical and standard Forms (Minterms&Maxterms), sum of minterms& product of maxterms, conversion between canonical forms. Truth table & maps, 2,3,4,5 and 6 variable maps, solving digital problems using Maps, Don't care conditions, Tabular minimization Sum of product & product of sum reduction, Exclusive OR & Exclusive NOR circuits, Parity generator &checkers.

UNIT 2: Combinational Circuits: Design procedure, Adders (half and Full), subtractor (half and full) code convertors, Analysis of design, Universal building blocks, Implementation of any logic circuit with only NAND gates or with only NOR gates, Binary serial adder, parallel adder, serial/parallel adder, look ahead carry generator, BCD adder, Binary multiplier, Magnitude comparator, Decoder, Demultiplexer, Encoders, priority encoder, Multiplexers & implementation of combinational logic diagram.

UNIT 3: Sequential Logic Circuit : Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table & characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flipflop.

UNIT 4: Registers and Counters : Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre- settable counter, BCD counter, cascading, counter applications, Decoding in counter, Decoding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in serial out, parallel in serial out, serial in parallel out registers, Design at the Register Transfer Level.

UNIT 5: Logic Families: Introduction to different logic families and their characteristics, RTL, DTL, TTL, ECL, IIL,TTL inverter – circuit description and operation, CMOS inverter

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– circuit description and operation, other TTL and CMOS gates.

Memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization Static RAM, Dynamic RAM, Programmable Logic Array (PLA) - Programmable Array Logic (PAL)

COURSE OUTCOMES:

On successful completion of this course student should be able to:

CO 1:The student will be able to represent numerical values in various number systems and perform number conversions between different number systems.

CO 2:The students will be able to design and debug complex combinational and sequential circuits based on an abstract functional specifications

CO 3:The students will be able to list the nomenclature and technology in the area of memory devices: ROM, RAM, PROM, PLD , FPGAs, etc.

CO 4: The students will be able to test and verify digital logic circuits

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(An Autonomous Institute Affiliated to RGPV Bhopal)
Department of Computer Science and Information Technology
Internet of Things

Semester/Year			Program		B.Tech.				
Subject Category	DC	Subject Code:	IOT-2041	Subject Name:	Data Structure and Algorithm				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical							
End Sem	Mid-Sem	Assignment	End Sem	Lab-Work	Quiz	Total Marks	L	T	P	
70	20	10	30	10	10	150	3	0	2	4

Prerequisites:
Programmingand BasicMathematicalknowledge

Course Objective:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Course Outcomes:

Upon completion of this course, the student will be able to:

CO 1: Analyze the algorithms to determine the time and computation complexity and justify the correctness.

CO 2: Implement search technique for a given problem.

CO 3: Write algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.

CO 4: Implement the logic of Stacks, Queues and linked list and analyse the same to determine the time and computation complexity.

CO 5: Implement Graph search and traversal algorithms and determine the time and computation complexity.

UNITs	Descriptions	Hrs.
I	Introduction Data structure, abstract data type, data object. Types of data structure – primitive & non-primitive, linear & non-linear. Operations on data structures – traversing, searching, inserting, deleting. Complexity analysis – worst case, best case, average case. Mathematical preliminaries - Time – space trade off, algorithm efficiency, asymptotic notations – big oh, omega, theta.	8
II	Arrays & Structure Introduction , declaration of arrays , operations on arrays – inserting , deleting , merging of two arrays , 1 dimensional & 2 dimensional arrays, row & column major representation , address calculation in array , storing values in arrays , evaluation of polynomial – addition & representation. Introduction - Searching & sorting, sequential search, binary search, Fibonacci search, indexed sequential search, hashed	8

	search. Types of sorting with general concepts – bubble, heap, insertion, selection, quick, heap, shell, bucket, radix and merge sort.	
III	Stacks & Queues Basic concept of stacks & queues, array representation of stacks, operation on stacks – push, pop, create, get Top, empty, linked representation of stack, multiple stacks. Application of stack – Conversion: infix, prefix, postfix and evaluation of arithmetic expression. Linked representation of queue, operations on queue – insertion & deletion. Types of queue with functions – circular, de-queue, priority queue. Applications of queues – job scheduling, Josephus problem.	8
IV	Linked List Introduction – basic terminology, memory allocation &deallocation for linked list. Linked list variants – head pointer, head node, types linked list – linear & circular linked list. Doubly linked list, creation of doubly list, deletion of node from doubly linked list, insertion of a node from doubly linked list, traversal of doubly linked list. Circular Linked Lists: all operations their algorithms and the complexity analysis. Applications of linked list – polynomial representation & garbage collection.	8
V	Trees and Graphs: Tree: Definition, Terminology Binary tree - definitions and properties, Representation, Binary Tree Traversal In-order, Pre-order, Post order, Insertion and deletion of nodes in binary search tree. Introduction to Binary Search Tree. AVL Tree; Tree operations on each of the trees and their algorithm and analysis. B Tree, B+ Tree: definitions, algorithms and analysis. Graph: Representation of graphs using adjacency matrix, adjacency.	8
Guest Lectures (if any)		--
Total Hours		40

List of Experiments
1. Find a pair with the given sum in an array.
2. Find the maximum product of two integers in an array.
3. Find the largest number possible from a given set of numbers.
4. Print all possible solutions to N–Queens problem.
5. Check if a number is even or odd without using any conditional statement.
6. All-Pairs Shortest Paths – Floyd Warshall Algorithm.
7. Check if a graph is strongly connected or not.
8. Print complete Binary Search Tree (BST) in increasing order.
9. Find the minimum and maximum element in an array using Divide and Conquer.
10. Calculate the height of a binary tree – Iterative and Recursive.
11. Find the maximum occurring word in a given set of strings.
12. Combinations of words formed by replacing given numbers with corresponding alphabets.
13. Find the path between given vertices in a directed graph.
14. Find number of customers who could not get any computer.

Text Books-

- Fundamentals of Data Structures in C -- by Horowitz, Sahni and Anderson-Freed (Silicon Press 2007).
- How to solve it by Computer -- by R G Dromey (PHI 1982, Paperback 2008).
- E. Horowitz, S. Sahni, S.Anderson-freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, ISBN 978-81-7371-605-8
- B. Kernighan, D. Ritchie, ―The C Programming Language‖, Prentice Hall of India, Second Edition, ISBN 81-203-0596-5
- Data Structure Using C and C++ -- by Y. Langsam, M. J. Augenstein and A. N. Tanenbaum (Pearson Education, 2nd Edition, 2015).

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
1. https://nptel.ac.in/courses/106102064

2. https://de-iitr.vlabs.ac.in/

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Department of Computer Science and Information Technology
Internet of Things

Semester/Year			Program			B.Tech.				
Subject Category	DC	Subject Code:	IOT-2042	Subject Name:		Operating System				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical							
End Sem	Mid-Sem	Assignment	End Sem	Lab-Work	Quiz	Total Marks	L	T	P	
70	20	10	30	10	10	150	3	0	2	4

Prerequisites:

- None

Course Objective:

To understand operating system architecture and functioning along with in-depth knowledge of internals and working of OS modules like process management, Storage management, file system, security and protection.

Course Outcomes:

Upon completion of this course, the student will be able to:
CO -1: Understanding of the inherent mechanism involved in functioning of an operating system.
CO -2: Ability to analyze various scheduling and synchronization techniques.
CO -3: Knowledge of file systems its implementation and protection.
CO -4: Analysis of memory and device management methodology.
CO -5: Comprehensive outlook in design principles of operating systems.

UNITs	Descriptions	Hrs.
I	Overview-Introduction to Operating Systems, Evolution of Operating System mainframe, desktop, multiprocessor,Distributed, Network Operating System, and Clustered andHandheld System), Operating System Structure- OperatingSystem Services and System Calls, System Programs. Types ofOperating Systems: Batch Processing, Real Time, Multitaskingand Multiprogramming, time-sharing system and DistributedOperating systems	8
II	Process Management-Concept, Process Control Blocks (PCB), Process Scheduling. Scheduling Criteria, Scheduling Algorithms and theirevaluation. Threads Overview and Multithreading Models Inter Processes Communication and Critical Section Problem andSolution-Semaphores and Monitors, DeadlockCharacterization, Methods for deadlock handling, deadlockprevention, deadlock avoidance, deadlock detection andrecovery from deadlock.	8
III	Storage Management-Memory Hierarchy, Concepts of memory management, MFT and MVT, logical and physical addressspace, swapping, contiguous and non- contiguous allocation,Paging and Segmentation Structure and Implementation ofPage table, Virtual memory, Cache Memory	9

	Organization,Demand paging, Page replacement Algorithms. Thrashing,Demand segmentation.	
IV	File and Disk Management-File concepts, Access methods, Directory Structure, File Sharing and Protection, Free spacemanagement, Efficiency and Performance- Case study on Unix,Linux and Windows, Disk Structure and Scheduling, efficiencycase study of UNIX.I?O system –Hardware ,Application, input-output interface.	7
V	Protection and Security- Protection Goals of Protection, Principles of Protection, Domain of Protections. Access Matrix,Implementation of Access Matrix, Access Control, Revocationof Access Rights Security The Security Problem, Programthreats system and network threats, Cryptography as s securitytool, user authentication, implementation of security defense-Firewall system, Case study - LINUX and Windows.	8
Guest Lectures (if any)		--
Total Hours		40

List of Experiments

1. Basic Linux Commands and Overview
2. Implementation of FCFS (First Come First Serve) CPU Scheduling.
3. Implementation of SJF (Shortest Job First) CPU Scheduling.
4. Implementation of Round Robin (RR) CPU Scheduling.
5. Implementation of Priority CPU Scheduling Algorithm.
6. Implementation of FIFO Replacement Algorithm.
7. Implementation of Optimal Page Replacement Algorithm.
8. Implementation of LRU Page Replacement Algorithm by Stack method.
9. Implement the producer-consumer problem using threads.
10. Write a program to implement Echo service using socket programming

Text Books-
1. Peterson, J.L. &Silberschatz, A.: Operating System Concepts, Addison, Wesley-
Reading.
2. Brinch, Hansen: Operating System Principles, Prentice Hall of India.
3. Haberman, A.N.: Introduction to Operating System Design Galgotia Publication, New
Delhi.
4. Tanenbaum, A.S.: Operating Systems.
5. Hansen, P.B.: Architecture of Concurrent Programs, PHI.
6. Shaw, A.C.: Logic Design of Operating Systems, PHI.

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
https://nptel.ac.in/courses/106105214

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE

(Engineering College), VIDISHA M.P.

(An Autonomous Institute Affiliated to RGPV Bhopal)

Department of Computer Science and Information Technology
Internet of Things

Semester/Year			Program			B.Tech.			
Subject Category	DC	Subject Code:	IOT-2043	Subject Name:		Python Programming			

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical							
End Sem	Mid-Sem	Assignment	End Sem	Lab-Work	Quiz	Total Marks	L	T	P	
70	20	10	30	10	10	150	3	0	2	4

Prerequisites:

Course Objective:
Thiscourse introduces core programming basics- including data types, control   structures, algorithm development, and   programdesign with functions viathe Python   programming   language. The course discuss the fundamental   principles ofObject-Oriented   Programming.

Course Outcomes:
Upon completion of this course, the student will be able to: **CO1:** Ability to install python and its different projects. **CO2:** Implement solution logic of problem and draw it in the form of algorithm.. **CO3:** Design and write a python program for given algorithm. **CO4:** Understand object oriented with reference to python programing

UNITs	Descriptions	Hrs.
I	Introduction to computer science, algorithms, data representation incomputers, hardware, software and operating system. Installation of python-interactive shells, IDIY, saving, editing, and running a script. The concepts or datatypes: variables, immutable variables, numerical types, operators, expressions Indentation and commentsin the program.	8
II	Conditional Statements - Conditions, Boolean Logic. logical operators and Range. Control Statements- Break Continue and Pass. FlowControl-if.If-else Nested if-else, l(loop statements- for loop, whileloop, Nested loops.	8
III	String: subscript operator, Indexing, slicing a string; strings anti number system: Converting strings to numbers and vice versa. Strings and text files, manipulating, files and directories, os and sys modules, text files: reading/writing text and numbers from/to a file, creating and reading a formatted file (csv or tab separated).	9
IV	Lists tuples, and dictionaries. Basic list operators, replacing, inserting, removing an clement, searching and sorting lists, dictionary literals, adding and removing keys, accessing and replacing values, traversing dictionaries.	7

V	Classes and OOP: Classes, objects, attributes and methods, defining classes, design with classes, inheritance, overloading. Overriding, and Data hiding, Exception: Exception handling except clause, Try IiIla II)' ciaUSt.:, User Defined Exceptions.	8

Guest Lectures (if any)	--
Total Hours	40

List of Experiments

1. Write a program in python to check a number whether it is prime or not.
2. Write a program to check a number whether it is palindrome or not.
3. Write a function to swap the values of two variables through a function.
4. Write a python program to Read a file line by line and print it.
5. Write a program to display the number of lines in the file and size of a file in bytes.
6. Write a program to calculate the factorial of an integer using recursion.
7. Write a program to print Fibonacci series using recursion.
8. Write a program for binary search.
9. Python Program for Sum of squares of first n natural numbers.
10. Python Program to find sum of array.
11. Python program to read character by character from a file.
12. Python Program to print with your own font.
13. Python program to print even length words in a string.
14. Python program to check if a string is palindrome or not.
15. Program to print ASCII Value of a character.
16. Python program to find smallest and largest number in a list.
17. Python program to find the size of a Tuple.

Text Books-
- Python Programming, R. NageshwarRao, Wiley India
- Think Python: Allen B. Downey, O'R

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
https://nptel.ac.in/courses/106105214

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
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Semester/Year			Program				B.Tech.			
Subject Category	DC	Subject Code:	IOT-2044	Subject Name:		Foundation of IoT				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical			Total Marks	L	T	P	
End Sem	Mid-Sem	Assignment	End Sem	Lab-Work	Quiz					
70	20	10	-	-	-	100	3	0	0	3

Prerequisites:

- None

Course Objective:

1. Tomake students know the IoT ecosystem.
2. ToprovideanunderstandingofthetechnologiesandthestandardsrelatingtotheInternet ofThings.
3. TodevelopskillsonIoTtechnicalplanning.

Course Outcomes:

Upon completion of this course, the student will be able to:
CO1: TounderstandtheFundamentals of IoT.
CO2: To know about the networking concepts of IoT.
CO3: Toknow about the different connectivity technologies.
CO4: To know about the WSN and UAV network.
CO5: To know about the various applications of IoT.

UNITs	Descriptions	Hrs.
I	Introduction to IoT: Introduction, Characteristics of IoT, Application of IoT, IoT Categories, IoT Enablers and Connectivity Layers, Baseline Technologies, Sensors, Actuators, IoT components and Implementation, Challenges for IoT.	8
II	IoT Networking: Connectivity Technologies, Gateway Prefix Allotment, Impact of Mobility on Addressing, Multihoming, Deviations from Regular Web, IoT identification and Data Protocols(IPv4, IPv6, MQTT, CoAP, XMPP and AMQP)	8
III	Connectivity Technologies: Introduction, IEEE 802.15.4, ZigBee, 6LoWPAN, RFID, HART and Wireless HART, NFC, Bluetooth, Z-Wave, ISA 100.11A.	9
IV	Wireless Sensor Network: Introduction, Components of Sensor Node, Modes of Detection, Challenges in WSN. UAV Network: Introduction, UAV Network(Feature, Challenges and Topology) FANET: Introduction, FANET design consideration.	7

V	Application of IoT: Smart Homes – Introduction, Origin of Smart Homes, Smart Home Technologies. Smart Cities – Characteristics of Smart Cities, Smart City Framework, Challenges in Smart Cities. Connected Vehicles – Introduction, levels of Automation, Vehicle to Everything(V2X) Paradigm, Vehicular Ad-hoc Network (VANETs)	8	
Guest Lectures (if any)		--	
Total Hours		40	

Text Books-
- Dr.JeevaJose,InternetofThings,KhannaPublishingHouse.
- NiteshDhanjani,AbusingtheInternetofThings,ShroffPublisher/O'ReillyPublisher.
- InternetofThings,RMDSundaramShriramKVasudevan,AbhishekSNagarajan,John Wiley and Sons.
- Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram,JohnWiley & Sons.
- CunoPfister,"GettingStartedwiththeInternetofThings",ShroffPublisher/MakerMedia.
- FrancisdaCosta,"RethinkingtheInternetofThings:AScalableApproachtoConnectingEverything", 1 st Edition, Apress Publications.
- MassimoBanzi,MichaelShilohMake:GettingStartedwiththeArduino,ShroffPublisher/MakerMedia Publishers.

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
          https://onlinecourses.nptel.ac.in/noc19_cs65/preview

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Department of Computer Science and Information Technology
Internet of Things

Semester/Year			Program			B.Tech.			
Subject Category	DC	Subject Code:	IOT-2045	Subject Name:	Sensors and Actuators				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical							
End Sem	Mid-Sem	Assignment	End Sem	Lab-Work	Quiz	Total Marks	L	T	P	
70	20	10	-	-	-	100	3	1	0	4

Prerequisites:
• None

Course Objective:

1. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterised, and analysed.
2. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration
3. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
4. To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure.

Course Outcomes:

Upon completion of this course, the student will be able to:

CO1: Use concepts in common methods for converting a physical parameter into an electrical quantity

CO2: Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.

CO3: Design and develop sensors using optical methods with desired properties

CO4: Evaluate performance characteristics of different types of sensors

CO5: Locate different types of sensors used in real life applications and paraphrase their importance.

UNITs	Descriptions	Hrs.
I	Sensor fundamentals and characteristics, Sensor Classification, Performance and Types, Error Analysis characteristics. Optical Sources and Detectors: Electronic and Optical properties of semiconductor as sensors, LED, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.	7

II	Strain, Force, Torque and Pressure sensors: Strain gauges, strain gauge beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors. Design of signal conditioning circuits for strain gauges, piezo, capacitance and optoelectronics sensors.		9
III	Position, Direction, Displacement and Level sensors: Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor. Signal condition circuits for reactive and self-generating sensors. Acceleration sensors: Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.		8
IV	Flow, Temperature and Acoustic sensors: Pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor,. Temperature sensors- RTD, thermpcouple, thermoresistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor. Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.		8
V	Actuators: Concepts of motors: DC motor, stepper motor, servo motor. Electrical actuators, electromechanical actuator, electromagnetic actuator, magneto resistive actuator, Hydraulic and pneumatic actuators, smart material actuators.		9
Guest Lectures (if any)			--
Total Hours			40

List of Experiments

NA

Text Books-
- Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
- GerdKeiser,"Optical Fiber Communications", 2017, 5th edition, McGraw-Hill Science, Delhi.
- John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida.
- Eric Udd and W.B. Spillman, "Fiber optic sensors: An introduction for engineers and scientists", 2013, 2nd edition, Wiley, New Jersey.
- Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:https://nptel.ac.in/courses/108108147

Recommendation by Board of studies on	Dec-2022
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IoT-2051   Microprocessors and Microcontrollers

Course Title	Course Code	Credits - 4		
		L	T	P
Microprocessors and Microcontrollers	IoT-2051	3	-	2

COURSE OBJECTIVE

1. To make students familiar with the basic blocks of 8 bit & 16 bit microprocessor device in general.
2. To provide comprehensive knowledge of the architecture, features and interfacing with peripherals of 8085/8086 microprocessor.
3. To use assembly and high level languages to interface the microprocessor to various applications.

COURSE CONTENTS

Unit-I: Introduction to 16 bit Microprocessor-Introduction to 8086 Microprocessor family Architecture. Pin diagram, Instruction set, Assembler directive, Addressing modes, Maximum and Minimum Mode operation. Elementary 8086 Programming.

Unit-II: Microcontrollers and Embedded processors, overview of 8051 family. 8051 microcontroller hardware, oscillator and clock, CPU registers, Register banks and stack, flags, PSW, SFR's, I/O ports, internal memory, 8051 pin description, 8051 programming model, Assembly, Language programming, Data types, directives. Addressing modes of 8051, memory access using various addressing modes, Bit addresses for I/O and RAM, I/O port programming.

Unit-III: Arithmetic Operations with 8051: Arithmetic instructions, signed number concepts and arithmetic operations, Branch Instructions: Jump Loop and Call Instructions. Time delay calculations. Logical Operations & Bit manipulation instructions: Logic and compare instructions, rotate and swap instructions, data serialization, single bit instructions, operations with carry, reading input pins.
8051 programming in C: Data types and time delay in 8051, Data types and time delay in 8051, Data conversion, Accessing code and data serialization using 8051 C.

Unit-IV: Timers: Programming, Counter programming, Serial communication, RS232, 8051 programming for serial port, Serial Port programming in C. Introduction to I2C. 8051 Interrupts, programming timer interrupts, external hardware interrupts, serial communication interrupts, interrupt priority in 8051. Interrupt programming in C. Interface 8051, LCD Interfacing, memory address decoding, interfacing with external ROM, data memory space, accessing external memory in C, Interfacing 8255, programming 8255, modes of 8255, 8255 connection to stepper motor, LCD,& ADC, 8051 C programming for 8255.

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Prof. Shaila Chugh   Prof. C. S. Sharma   Dr. Ashutosh Datar   Dr. Jyotsna V. Ogale

COURSE CONTENTS:	Unit-V: AVR architecture & assembly language: General purpose registers, data memory, instructions for data memory, status register, data format and directives, introduction to AVR assembly programming, assembling an AVR program, program counter & program ROM, RISC architecture, viewing registers and memory with AVR studio IDE.
COURSE OUTCOMES:	On successful completion of this course student should be able to: CO 1: Acquire and demonstrate fundamental knowledge of microprocessors or interfacing and programming (BL1,BL2) CO 2: Analyze the performance of microprocessor with the help of instruction set(BL3,BL4) CO 3: Define instruction sets and write assembly language programming. (BL3, BL6) CO 4: Evaluate performance of 8086 compare them.(BL3,BL5)
TEXT BOOKS& REFERENCES:	• Ramesh S Goankar, Micro processor Architecture, Programming & Applications with the 8085, Penram International Publishing (India) Pvt. Ltd., Fourth Edition, 2002. • Douglas V. Hall, Microprocessors and interfacing programming and hardware Gregg Division, McGraw-Hill, 1986 • A K Ray & K M Bhurchandi, Advanced Microprocessor and Peripheral, Tata McGraw-Hill Publishing Company Limited.
LABORATORY EXPERIMENTS:	1. WAP to add a data byte located at the offset address 0500H in the segment 2000H to another data byte located at the offset address 0600H in the segment 3000H. 2. WAP to move 0500H to register BX and CX, add 05H to each of them and store the result in 0700H. Segment address: 5000H. 3. WAP to add the contents of 2000H: 0500H to the contents of 3000H: 0600H and store the result in 5000H: 0700H. 4. WAP to find the square of a given number. 5. WAP to find the 2's compliment of a given number. 6. WAP to find the square root of a given number. 7. WAP to arrange the given set of bytes in ascending order. 8. WAP to arrange the given set of bytes in the descending order. 9. WAP to find out the largest number in the given set of 8-bit number stored at memory location 0500H in the segment 2000H. 10. WAP to find out the even and odd numbers from the given set of 10 data bytes stored at memory location 4000H: 0400H.

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IoT-2052   Data Structure

Course Title	Course Code	Credits - 4		
		L	T	P
Data Structure	IoT-2052	3	-	2

COURSE OBJECTIVE	1. To impart the basic concepts of data structures and algorithms.
	2. To understand concepts about searching and sorting techniques
	3. To understand basic concepts about stacks, queues, lists trees and graphs.
	4. To enable them to write algorithms for solving problems with the help of fundamental data structures

COURSE CONTENTS

Unit-I: Introduction Data structure, abstract data type, data object, Types of data structure primitive & non-primitive, linear & non-linear, Operations on data structures traversing, searching, inserting, deleting. Complexity analysis – worst case, best case, average case. Mathematical preliminaries – Time – space trade off, algorithm efficiency, asymptotic notations – big oh, omega, theta.

Unit-II: Arrays & Structure Introduction , declaration of arrays , operations on arrays inserting , deleting , merging of two arrays , 1 dimensional & 2 dimensional arrays, row & column major representation , address calculation in array , storing values in arrays , evaluation of polynomial addition & representation. Introduction – Searching & sorting, sequential search, binary search, Fibonacci search, indexed sequential search, hashed search. Types of sorting with general concepts bubble, heap, insertion, selection, quick, heap, shell, bucket, radix and merge sort.

Unit-III: Stacks & Queues Basic concept of stacks & queues, array representation of stacks, operation on stacks push, pop, create, getTop, empty, linked representation of stack, multiple stacks, Application of stack Conversion: infix, prefix, postfix and evaluation of arithmetic expression. Linked representation of queue, operations on queue insertion & deletion. Types of queue with functions circular, de-queue, priority queue. Applications of queues job scheduling, Josephus problem.

Unit-IV: Linked List Introduction basic terminology, memory allocation & deallocation for linked list. Linked list variants head pointer, head node, types linked list linear & circular linked list. Doubly linked list, creation of doubly list, deletion of node from doubly linked list, insertion of a node from doubly linked list, traversal of doubly linked list. Circular Linked Lists: all operations their algorithms and the complexity analysis. Applications of linked list polynomial representation & garbage collection.

Unit-V: Trees and Graphs: Tree: Definition, Terminology Binary tree - definitions and properties, Representation, Binary Tree Traversal In-order, Pre-order, Post order, Insertion and deletion of nodes in binary search tree. Introduction to Binary Search Tree. AVL Tree: Tree operations on each of the trees and their algorithm and analysis. B Tree, B+ Tree: definitions, algorithms and analysis. Graph: Representation of graphs using adjacency matrix, adjacency.

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LABORATORY EXPERIMENTS:	

11. Write a program to add two hexadecimal no and store it in an accumulator.
12. Write a program to store 50H in R0, R3 register of RB0, RB1, RB2, RB3.
13. Write a program to push the contents of registers on stack (any register).
14. Write a program to push the data of R0&R1 register of register bank 2&3 and store stack pointer with 70H.
15. Write a program to store, push and pop the value stored on R0&R1 of Register bank 3 into Register bank0.
16. Write a program to take 10 byte of data RAM location 45H to 54 H, add 02H to each of them and save the result in the data RAM location 79Hdown to 70H.
17. Write a program to copy the value 55H into RAM memory location 40H to 45H using
18. Direct addressing mode
19. Register indirect addressing mode without a loop, and with loop.
20. Write a program to clear 16 RAM locations starting at RAM address 60H.
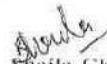
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IoT – 2053   Data Communication and Computer Networks

Course Title	Course Code	Credits - 4		
		L	T	P
Data Communication and Computer Networks	IoT – 2053	3	-	2

COURSE OBJECTIVE	1. To build an understanding of the fundamental concepts of data communication. 2. To familiarize the student with the basic taxonomy, model and terminology of computer networking. 3. To develop an appreciation of the Internet architecture and protocols, as well as a sound understanding of the protocol mechanisms employed at the IP and Transport layers of the Internet. 4. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.
COURSE CONTENTS	**Unit-I:** Introduction: Data Communication, Networks - Physical structures; different topologies, Categories of Networks: LAN, MAN, WAN, Interconnection of networks, The Internet, Transmission Modes, Protocols and Standards, Standards Organizations, The OSI model, different layers in OSI model, TCP/IP protocol suite with different layers. Addressing - physical, logical, port and specific addresses, Digital Data Transmission - Synchronous and asynchronous transmission. **Unit-II:** Physical Layer: Line Coding, Line Coding Scheme, Multiplexing: Frequency Division, Wavelength Division. Synchronous Time Division, Statistical Time Division Multiplexing. Switching-Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks. Structure of Circuit and Packet switches. Dial-up Modems, Digital Subscriber Line - ADSL, HDSL, SDSL, VDSL, Cable TV for Data Transfer- Bandwidth, Sharing, and Data Transmission Schemes. **Unit-III:** Data Link Layer: Introduction - Types of Errors, Redundancy, Detection Vs Correction, Forward Error Correction Vs Retransmission, Modular Arithmetic, Block Coding - Error Detection, Error Correction, Hamming Code, Linear Block Codes, Cyclic Codes - Cyclic Redundancy Check, Hardware Implementation, Polynomials, Checksum, Framin - Fixed and Variable-Size, Flow and Error Control, Simplest ARQ, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ. **Unit-IV:** Medium Access: Random Access - ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access-Reservation, Polling, Token Passing. Channelization- Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA). IEEE Standards, standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless Networks, IEEE 802.11 - Architecture, MAC Sub layer, Addressing Mechanism, Physical Layer, Bluetooth - Architecture, Radio Layer, Baseband Layer, L2CAP

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COURSE OUTCOMES	CO 1: Analyze the algorithms to determine the time and computation complexity and justify the correctness.
	CO 2: Implement search technique for a given problem.
	CO 3: Write algorithm for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
	CO 4: Implement the logic of Stacks, Queues and linked list and analyse the same to determine the time and computation complexity.
	CO 5: Implement Graph search and traversal algorithms and determine the time and computation complexity.
TEXT BOOKS& REFERENCES:	• Fundamentals of Data Structures in C – by Horowitz, Sahni and Anderson-Freed (Silicon Press 2007).
	• How to solve it by Computer -- by R G Dromey (PHI 1982, Paperback 2008).
	• E. Horowitz, S. Sahni, S.Anderson-freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, ISBN 978-81-7371-605-8
	• B. Kernighan, D. Ritchie, ―The C Programming Languagel, Prentice Hall of India, Second Edition, ISBN 81-203-0596-5
	• Data Structure Using C and C++ -- by Y. Langsam, M. J. Augenstein and A. N. Tanenbaum (Pearson Education, 2nd Edition, 2015).
LABORATORY EXPERIMENTS:	1. Find a pair with the given sum in an array.
	2. Find the maximum product of two integers in an array.
	3. Find the largest number possible from a given set of numbers.
	4. Print all possible solutions to N Queens problem.
	5. Check if a number is even or odd without using any conditional statement.
	6. All-Pairs Shortest Paths – Floyd Warshall Algorithm.
	7. Check if a graph is strongly connected or not.
	8. Print complete Binary Search Tree (BST) in increasing order.
	9. Find the minimum and maximum element in an array using Divide and Conquer.
	10. Calculate the height of a binary tree – Iterative and Recursive.
	11. Find the maximum occurring word in a given set of strings.
	12. Combinations of words formed by replacing given numbers with corresponding alphabets.
	13. Find the path between given vertices in a directed graph.
	14. Find number of customers who could not get any computer.

END

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IoT – 2054   Fundamentals of Internet of Things

Course Title		Course Code	Credits - 4		
			L.	T	P
Fundamentals of Internet of Things		IoT – 2054	3	1	-
COURSE OBJECTIVE	1. To make students know the IoT ecosystem. 2. To provide an understanding of the technologies and the standards relating to theInternet of Things. 3. To develop skills on IoT technical planning.				
COURSE CONTENTS	**Unit-I:** IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics. **Unit-II:** M2M to IoT – A Basic Perspective – Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. **Unit-II:** IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Unit-IV:** IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth. **Unit-V:** Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security				

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COURSE CONTENTS	Unit-V: Network Security and Connecting Networks: Encryption Decryption, Digital Signature, Data Encryption Standard (DES), PGP, Access Authorization, Connecting Devices - Hubs, Repeaters, Bridges, Routers and Gateway, Connecting Remote LANs. Virtual LANs - Membership, Configuration, Communication between Switches, IPv4- Address Space, Notation, Classful & Classless Addressing, IPv6 - Structure and Address Space, Advantages, Packet Format, The Integrated Services Digital Network (ISDN)- Narrow band ISDN, Broadband ISDN Service. Digital hierarchies *(SONET/SDH)*.
COURSE OUTCOMES	On successful completion of this course student should be able to: CO 1: Independently understand basic computer network technology CO 2: Understand and explain data communication and its components. CO 3: Enumerate the layers of the OSI model and TCP/IP. Explain the functions of each layer. CO 4: Understand and explain network security and connecting networks.
TEXT BOOKS& REFERENCES	• B. A. Forouzan and Sophia Chung Fegan: Data Communications and Networking, 4th Ed, TMH. • W. Tomasi: Introduction to Data Communications and Networking, Pearson Education. • S. Tanenbaum: Computer Networks, Pearson Education. • W. Stalling: Data and Computer Communication, Pearson Education. • P. C. Gupta: Data Communications and Computer Networks, PHI. • Elahi and M. Elahi: Data Network and Internet-Communications Technology, Cengage Learning. • Duck: Data Communication and Networking, Pearson Education. • The TCP/IP Guide, by Charles M. Kozierok, Free online Resource
LABORATORY EXPERIMENTS:	Study of different types of Network cables and Network devices in detail 1. Study of Network IP 2. Introduction to packet tracer 3. Configure a Network topology using packet tracer 4. Configure LAN and WAN interfaces Configuration of Router using packet tracer. 5. Configure network using Distance Vector Routing protocol 6. Configure network using Link State Vector Routing protocol 7. Creating web server using packet tracer 8. Creating email server using packet tracer 9. Network analysis using wireshark. 10. Discovering hosts and services on a computer using Nmap security scanner.

END

Mr. Satish Asnani   Dr. Dhananjay V. Gadre   Dr. N. P. Patidar   Prof. Vipin Patait   Dr. Divyarishi Sahu

Prof. Shaila Chugh   Prof. C. S. Sharma   Dr. Ashutosh Datar   Dr. Jyotsna V. Ogale

IoT – 2055   Embedded System for IoT

Course Title	Course Code	Credits - 4		
		L	T	P
OC-1(A) Embedded System for IoT	IoT – 2055	3	-	-

COURSE OBJECTIVE	To make students know the basic concept and architecture of embedded systems. 1. Different design platforms used for an embedded system for IoT applications. 2. To have knowledge about the IoT enabled technology.
COURSE CONTENTS	Unit-I: Purpose and requirement specification, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices. Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.
	Unit-II: Design of Power Supply for Embedded Systems, Linear Regulator Topologies, Switching Power Supply Topologies, Power Supply Design Considerations for Embedded Systems. Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform. Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Keyboard and Output devices: LEDs, Seven Segment Displays (SSD).
	Unit-III: Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).
	Unit-IV: IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa. Protocols: HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED. Platforms: IBM Watson IoT – Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE Predix, Xively, macchina.io, Carriots.
	Unit-V: Web of Things and Cloud of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things, IoT Physical Servers, Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API.
COURSE OUTCOMES	After completion of course, students would be able to: CO1: Understand the embedded system concepts and architecture of embedded systems. CO2: Understand the different hardware/software co-design techniques for microcontroller-based embedded systems, apply techniques in IoT applications. CO3: To be able to design web/cloud based IoT applications.

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COURSE OUTCOMES	CO1: To understand the technology and standards relating to IoT.
	CO2: To understand the critical ecosystem required to mainstream IoT.
	CO3: To Acquire skills on developing their own national and enterprise level technicalstrategies.
TEXT BOOKS& REFERENCES	• Dr. Jeeva Jose, Internet of Things, Khanna Publishing House.
	• Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
	• Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan,John Wiley and Sons.
	• Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram,John Wiley & Sons.
	• Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/MakerMedia.
	• Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
	• Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.

END

Mr. Satish Asnani   Dr. Dhananjay V. Gadre   Dr. N. P. Patidar   Prof. Vipin Patait   Dr. Divyarishi Sahu

Prof. Shaila Chugh   Prof. C. S. Sharma   Dr. Ashutosh Datar   Dr. Jyotsna V. Ogale

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
Department of Computer Science and Information Technology
Internet of Things

Semester/Year		VI/III		Program		B.Tech.				
Subject Category	DC	Subject Code:	IOT 2061	Subject Name:		**Operating System**				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical		Total Marks					
End Sem	Mid-Sem	Assign Ment/Quiz	End Sem	Term Work/Lab-Work/Sessional			L	T	P	
70	20	10	-	-	100		3	0	0	3

Prerequisites:

- None

Course Objective:

To understand operating system architecture and functioning along with in-depth knowledge of internals and working of OS modules like process management, Storage management, file system, security and protection

Course Outcomes:

Upon completion of this course, the student will be able to:
CO -1: Understanding of the inherent mechanism involved in functioning of an operating system.
CO -2: Ability to analyze various scheduling and synchronization techniques.
CO -3: Knowledge of file systems its implementation and protection.
CO -4: Analysis of memory and device management methodology.
CO -5: Comprehensive outlook in design principles of operating systems.

UNITs	Descriptions	Hrs.
I	Overview-Introduction to Operating Systems, Evolution of Operating System mainframe, desktop, multiprocessor, Distributed, Network Operating System, and Clustered and Handheld System), Operating System Structure- Operating System Services and System Calls, System Programs. Types of Operating Systems: Batch Processing, Real Time, Multitasking and Multiprogramming, time-sharing system and Distributed Operating systems	8
II	Process Management-Concept, Process Control Blocks (PCB), Process Scheduling. Scheduling Criteria, Scheduling Algorithms and their evaluation. Threads Overview and Multithreading Models Inter Processes Communication and Critical Section Problem and Solution-Semaphores and Monitors, Deadlock Characterization, Methods for deadlock handling, deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock.	8

III	Storage Management-Memory Hierarchy, Concepts of memory management, MFT and MVT, logical and physical address space, swapping, contiguous and non- contiguous allocation, Paging and Segmentation Structure and Implementation of Page table, Virtual memory, Cache Memory Organization, Demand paging, Page replacement Algorithms. Thrashing, Demand segmentation.	9
IV	File and Disk Management-File concepts, Access methods, Directory Structure, File Sharing and Protection, Free space management, Efficiency and Performance- Case study on Unix, Linux and Windows, Disk Structure and Scheduling, efficiency case study of UNIX.I?O system –Hardware ,Application, input-output interface.	7
V	Protection and Security- Protection Goals of Protection, Principles of Protection, Domain of Protections. Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights Security The Security Problem, Program threats system and network threats, Cryptography as s security tool, user authentication, implementation of security defense- Firewall system, Case study - LINUX and Windows.	8
Guest Lectures (if any)		--	
Total Hours		40	

Text Books-
1. Peterson, J.L. &Silberschatz, A.: Operating System Concepts, Addison, Wesley-Reading.
2. Brinch, Hansen: Operating System Principles, Prentice Hall of India.
3. Haberman, A.N.: Introduction to Operating System Design Galgotia Publication, New Delhi.
4. Tanenbaum, A.S.: Operating Systems.
5. Hansen, P.B.: Architecture of Concurrent Programs, PHI.
6. Shaw, A.C.: Logic Design of Operating Systems, PHI.

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
1. https://nptel.ac.in/courses/106105214

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Computer Science and Information Technology
Internet of Things

Semester/Year		VI/III		Program		B.Tech.				
Subject Category	DE-1	Subject Code:	IOT 2062(A)	Subject Name:		**Introduction to IoT Development Board**				

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical							
End Sem	Mid-Sem	Assign Ment/Quiz	End Sem	Term Work/Lab-Work/Sessional	Total Marks		L	T	P	
70	20	10	30	20	150		3	0	2	4

Prerequisites:

- None

Course Objective:

- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.

Course Outcomes:

Upon completion of this course, the student will be able to:
CO 1: To know basics of development boards.
CO2: To know about the Arduino board and its interfacing with various components.
CO 3: To know about the ESP 8266 board and its interfacing with various components.

CO4: To know about the Raspberry Pi architecture. .

CO5: To know about the Raspberry Pi and its interfacing with various components.

UNITs	Descriptions	Hrs.
I	IoT- introduction and its components, IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).	8
II	Arduino Uno – Getting started with the Uno boards, blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module.	8
III	ESP 8266-12E Node MCU – Getting started with the ESP board, Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST APIGET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home 57 Automation for switching lights on/off.	9
IV	Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS, Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts.	7

V	Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.	8
Guest Lectures (if any)		--
Total Hours		40

List of Experiments

1.IR OBSTACLE SENSOR- If object is detected pin 13 will go high (onboard LED ON) and "object detected" message will be displayed in serial monitor
If object is not detected pin 13 will go low (onboard LED OFF) and "object not detected" message will be displayed in serial monitor

2. GAS SENSOR- If Gas is detected pin 13 will go high (onboard LED ON) and "gas detected" message will be displayed in serial monitor
If Gas is not detected pin 13 will go low (onboard LED OFF) and "gas not detected" message will be displayed in serial monitor

3. FIRE SENSOR- If FIRE is detected pin 13 will go high (onboard LED ON) and "FIRE detected" message will bedisplayed in serial monitor
If FIRE is not detected pin 13 will go low (onboard LED OFF) and "FIRE not detected" message will be displayed in serial monitor

4. RELAY SHIELD- Controlling relay shield from serial monitor (Arduino IDE)

5. GSM SHIELD- If GAS is detected pin 7 will go LOW and "GAS detected" message will be sent to destination number.

6. Analog to Digital and PHOTORESISTOR- light-dependent resistor (LDR), the photo resistor adjusts its resistance according to the light received from the environment. It works not only with sunlight, but also with artificial light. Now lets see how we can integrate it to the real world.

7.Introduction to RaspberryPi-Learn how to wire light-emitting diodes (LEDs) and buzzers to GPIO pins. Practice conditionals and loops.

8. Interfacing of DHT11 with Raspberry Pi 3

Text Books-
- Dr.Jeeva Jose, Internet of Things, Khanna Publishing House
- Rao, M. (2018). Internet of Things with Raspery Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd
- Baichtal, J. (2013). Arduino for beginners: essential skills every maker needs. Pearson Education
- Schwartz, M. (2016). Internet of Things with ESP8266. Packt Publishing Ltd.
- Richardson, M., & Wallace, S. (2012). Getting started with raspberry PI. " O'Reilly Publisher Media, Inc."

Modes of Evaluation and Rubric	
The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.	
List/Links of e-learning resource	
List and Links of e-learning resources: 2. https://nptel.ac.in/courses/106105166	
Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Computer Science and Information Technology
Internet of Things

Semester/Year		VI/III		Program		B.Tech.				
Subject Category	DE-2	Subject Code:	IOT 2063(A)	Subject Name:	Data Base Management System					

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assign Ment/Quiz	End Sem	Term Work/Lab-Work/Sessional			L	T	P	
70	20	10	30	20		150	3	0	2	4

Prerequisites:

- Basic Knowledge of Mathematics and Programming.

Course Objective:

At the completion of this course, students should be able to do the following:

1. To understand the different issues involved in the design and implementation of a database system.
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models and database normalization.
3. To understand and use data manipulation language to query, update, and manage a database
4. To develop an understanding of essential DBMS concepts such as: concurrency, recovery, backup.
5. Identifies the file organization methods access methods to store the data.

Course Outcomes:

CO-1: Realize the basic concepts, principles and applications of database system.
CO-2: Discuss the components of DBMS, data models, Relational models.
CO-3: Use knowledge to find the functional dependencies and differentiate between different normal forms.
CO-4: Execute transaction concepts and concurrency protocols
CO-5: Design the databases system

UNITs	Descriptions	Hrs.
I	Database System- concepts and architecture: Data modeling using the Entity Relationship (ER) modeling and Enhanced Entity Relationship (EER) modeling, Specialization and Generalization.	6
II	The Relational Model: Relational database design using ER to relational mapping, Relational algebra and relational calculus, Tuple Relational Calculus, Domain Relational Calculus, SQL.	6
III	Database design theory and methodology: Functional dependencies and normalization of relations, Normal Forms, Properties of relational decomposition, and Algorithms for relational database schema design.	10

IV	Transaction processing concepts: Schedules and serializability, Concurrency control, Two Phase Locking Techniques, Optimistic Concurrency Control, Database recovery concepts and techniques	12
V	Data Storage and indexing: Single level and multi level indexing, Dynamic Multi level indexing using B Trees and B+ Trees, Query processing, Introduction to database security.	6
Guest Lectures (if any)		--
Total Hours		40

List of Experiments

1. Write the queries for Data Manipulation and Data Definition Language.

2. Write SQL queries using logical operations and operators.

3. Write SQL query using group by function.

4. Write SQL queries for group functions.

5. Write SQL queries for sub queries, nested queries.

6. Write program by the use of PL/SQL.

7. Write SQL queries to create views.

8. Write an SQL query to implement JOINS.

9. Write a query for extracting data from more than one table.

10. Write a query to understand the concepts for ROLL BACK, COMMIT & CHECK POINTS.

Text Books -
1. RamezElmasri and Shamkant B. Navathe, Fundamentals of Database Systems (7/e), Pearson Education, 2016
2. Silberschatz, Korth, "Data base System Concepts", 7th ed., McGraw hill, 2019.
3. C. J. Date, "An Introduction to Database Systems", 8th ed., Pearson, 2003.
4. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems (3/e), McGraw Hill, 2014.
5. Peter Rob and Carlos Coronel, Database System- Design, Implementation and Management (7/e), Cengage Learning, 2007.

Modes of Evaluation and Rubric

The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource

List and Links of e-learning resources:
https://archive.nptel.ac.in/courses/106/105/106105175/

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Computer Science and Information Technology
Internet of Things

Semester/Year		VI/III		Program		B.Tech.					
Subject Category	DE-3	Subject Code:	IOT 2064(A)	Subject Name:	**Introduction to Cloud Computing for IoT**						

Maximum Marks Allotted							Contact Hours			Total Credits
Theory			Practical			Total Marks				
End Sem	Mid-Sem	Assign Ment/Quiz	End Sem	Term Work/Lab-Work/Sessional			L	T	P	
70	20	10	30	20		150	3	0	2	4

Prerequisites:
Knowledge of Computer network, Internet Technology and ACA.
Course Objective:
1. To learn how to use Cloud Services. 2. To implement Virtualization 3. To implement Task Scheduling algorithms. 4. Apply Map-Reduce concept to applications. 5. To build Private Cloud. 6. Broadly educate to know the impact of engineering on legal and societal issues involved.
Course Outcomes:
The students would be able to: **CO-1:** Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing. **CO-2:** Describe importance of virtualization along with their technologies and compare various load balancing algorithm. **CO-3:** Describe and analyze the key components of Google and Amazon web service and apply them to solve problems on the cloud. **CO-4:** Describe the key components of Microsoft azure platform and cloud management on azure. **CO-5:** Explain major security and privacy problems in the cloud and how they are addressed with the security mechanisms

UNITs	Descriptions	Hrs.	
I	Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing Architecture ,Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients Services and Applications by Type IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept .	6	

II	Concepts of Abstraction and Virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization ,Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF).Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS.	6
III	Application frameworks Use of Google Web Services ,Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, Google Toolkit (including introduction of Google APIs), major features of Google App Engine service. Use of Amazon Web Services Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store.	10
IV	Windows Azure platform: Microsoft's approach, architecture, and main elements, Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services, Types of services required in implementation – Consulting, Configuration, Customization and Support Cloud Management. An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle) .	12
V	Cloud security concerns, Security boundary, Security service boundary Security of data, Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management.Service Oriented Architecture,message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs, Cloud storage definition – Manned and Unmanned ,Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services.	6
Guest Lectures (if any)		--
Total Hours		40

List of Experiments
1. Creating a Warehouse Application in SalesForce.com. 2. Creating an Application in SalesForce.com using Apex programming Language. 3. Implementation of SOAP Web services in C#/JAVA Applications. 4. Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S. 5. Installation and Configuration of Hadoop. 6. Create an application (Ex: Word Count) using Hadoop Map/Reduce. 7. Case Study: PAAS(Facebook, Google App Engine) 8. Case Study: Amazon Web Services. 9. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8. 10. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs 11. Install Google App Engine. Create hello world app and other simple web applications using python/java. 12. Use GAE launcher to launch the web applications. 13. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim. 14. Find a procedure to transfer the files from one virtual machine to another virtual machine. 15. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version) 16. Install Hadoop single node cluster and run simple applications like wordcount.
Text Books - 1. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India 2.Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013 3. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill Education (India) Private Limited, 2013 4. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill 5. Cloud Computing, Miller, Pearson 6. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson
Modes of Evaluation and Rubric
The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.
List/Links of e-learning resource
List and Links of e-learning resources:

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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Department of Computer Science and Information Technology
Internet of Things

Semester/Year		VI/III		Program		B.Tech.			
Subject Category	OC-1	Subject Code:	IOT 2065(A)	Subject Name:	Introduction to AI and ML for IoT				

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total Marks				
End Sem	Mid-Sem	Assign Ment/Quiz	End Sem	Term Work/Lab-Work/Sessional		L	T	P	
70	20	10	-	-	100	3	0	0	3

Prerequisites:

- **None**

Course Objective:

- To review and strengthen important mathematical concepts required for AI & ML.
- Introduce the concept of learning patterns from data and develop a strong theoretical foundation for understanding state of the art Machine Learning algorithms.

Course Outcomes:

After completion of course, students would be able to:

CO 1. Design and implement machine learning solutions to classification, regression and clustering problems.

CO 2. Evaluate and interpret the results of the different ML techniques.

CO 3. Design and implement various machine learning algorithms in a range of Real-world applications

UNITs	Descriptions	Hrs.
I	Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.	6
II	Idea of Machines learning from data, Classification of problem – Regression and Classification, Supervised and Unsupervised learning.	6
III	Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.	10
IV	Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.	12
V	Discussion on clustering algorithms and use-cases cantered around clustering and classification.	6
Guest Lectures (if any)		--
Total Hours		40

Text Books
1. SarojKaushik, Artificial Intelligence, Cengage Learning, 1st Edition 2011. 2. Anindita Das Bhattacharjee, "Practical Workbook Artificial Intelligence and Soft Computing for beginners, Shroff Publisher-X team Publisher. 3. M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Publishing House, Delhi. 4. Jeeva Jose, Introduction to Machine Learning, Khanna Publishing House, Delhi. 5. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017. 6. Tom Mitchell, Machine Learning, McGraw Hill, 2017. 7. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011. 8. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.

Modes of Evaluation and Rubric
The evaluation modes consist of performance in Two mid-semester Tests, Quiz/ Assignments, term work, end-semester examinations, and end-semester practical examinations.

List/Links of e-learning resource
List and Links of e-learning resources: https://nptel.ac.in/courses/106102220

Recommendation by Board of studies on	Dec-2022
Approval by Academic council on	Dec-2022
Compiled and designed by	CS & IT
Subject handled by department	IOT

DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	DE	Subject Code:	IoT 2071 DE – 4A	Subject Name		Big Data Analytics			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical			L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	1	0	4

Prerequisites:
Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment.

Course Objective:
- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hadoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

UNITs	Descriptions	Hrs.
I	INTRODUCTION TO BIG DATA AND HADOOP Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to InfosphereBigInsights and Big Sheets.	8
II	HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.	8
III	Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	8
IV	Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase :HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction	8
V	Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.	8
Total Hours		40

Course Outcomes:
CO-1 Identify Big Data and its Business Implications.
CO-2 List the components of Hadoop and Hadoop Eco-System.
CO-3 Access and Process Data on Distributed File System.
CO-4 Develop Big Data Solutions using Hadoop Eco System.
CO-5 Apply Machine Learning Techniques using R.

Text Book & Reference Books-

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. SeemaAcharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015. E.Balaguruswamy, "Programming InJava"; TMHPublications.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013).
5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
6. AnandRajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
7. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012.
8. Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007.
9. Pete Warden, "Big Data Glossary", O'Reily, 2011.
10. Michael Mineli, Michele Chambers, AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.

List/Links of e-learning resource

- https://onlinecourses.nptel.ac.in/noc20_cs92/preview

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	1	2	1									1	2
CO-2	2	1	1	1	2								1	2
CO-3	2	1	2	1			1						1	1
CO-4	2	1	2	1										2
CO-5	2	1		1									1	

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	DE	Subject Code:	IoT 2071 DE – 4B	Subject Name		Industrial IoT 4.0			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical			L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	1	0	4

Prerequisites:
Basic Knowledge of Signals and Systems

Course Objective:

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application.
- Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular• applications.

UNITs	Descriptions	Hrs.
I	Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0.	8
II	Implementation systems for IIoT: Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.	8
III	IIoT Data Monitoring & Control: IoT Gate way, IoT Edge Systems and It's Programming, Cloud computing, Real Time Dashboard for Data Monitoring, Data Analytics and Predictive Maintenance with IIoT technology.	8
IV	INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM: Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.	10
V	Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.	6
Total Hours		40

Course Outcomes:

CO1: Knowledge of theory and practice related to Industrial IoT Systems.

CO2: Ability to identify, formulate and solve engineering problems by using Industrial IoT

CO3: Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability.

CO4: Implement the industry 4.0 to solve engineering problems.

Text Book & Reference Books-

1. Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress
2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science..
3. Diego GalarPascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020
4. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.
5. Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs ‖, Academic Press, 2018, Reprint edition , ISBN-13:978-0128100714
6. Hossam A. Gabbar, ―Smart Energy Grid Engineering‖, Academic Press, 2017, ISBN 978- 0-12-805343-0.

List/Links of e-learning resource

- https://onlinecourses.nptel.ac.in/noc20_cs69/preview

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_1	PO_{11}	PO_{12}	PSO1	PSO2
CO-1	1	1	2										1	2
CO-2	2	1	1		1								1	2
CO-3	1	1	2										1	1
CO-4	2	1	2			1				1				2

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things				
Subject Category	DE	Subject Code:	IoT 2072 DE – 5A	Subject Name		Real Time Operating System				

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total Marks				
ES	MS	Assignment/Quiz	ES	LW		L	T	P	
70	20	10	-	-	100	3	1	0	4

Prerequisites:

Course Objective:

- The objective of the course is to introduce the principles shared by many real-time operating systems, and their use in the development of embedded multitasking application software.

UNITs	Descriptions	Hrs.
I	Basics of real-time concepts: Brief history of Real Time Systems, A brief history of Embedded Systems. Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel.	6
II	Process management: Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals.	8
III	I/O Resources: Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture. Memory: Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash filesystems.	8
IV	Embedded System Components: Firmware components, RTOS system software mechanisms, Software application components. Debugging Components: Exceptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self-test and diagnostics, External test equipment, Application-level debugging.	10
V	Performance Tuning: Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency, Fundamental optimizations.	8
Total Hours		40

Course Outcomes:

CO1: To understand the functionality and selection criteria of various operating systems when designing automation systems for technological complexes in real time.

CO2: To know the structure, basic principles of construction and the scope of use of embedded operating systems.

CO3: To be able to program applied tasks for embedded systems and be able to control the processes occurring in real-time systems.

CO4: To have practical skills for solving problems of designing control and monitoring systems for technological complexes in real time based on existing operating systems and programming languages.

CO5: To understand the working of real-time operating systems and real-time database

Text Book & Reference Books-

1. Jane W. S. Liu, "Real-time systems", Prentice Hall, 20002.
2. Philips A. Laplante, "Real-Time System Design and Analysis", 3rd Edition, John Wley& Sons, 2004

List/Links of e-learning resource

- https://nptel.ac.in/courses/117105135

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	1	1										1	2
CO-2	2	1	1										1	2
CO-3	1	1	2							1			1	2
CO-4	2	1	1							1				2
CO-5	1	1	1										1	

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

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SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	DE	Subject Code:	IoT 2072 DE – 5B	Subject Name		Wireless Networks			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical						
ES	MS	Assignment/Quiz	ES	LW		L	T	P	
70	20	10	-	-	100	3	1	0	4

Prerequisites:

Course Objective:
- To provide an overview of Wireless Communication networks and its applications in communication engineering.
- Enable students to understand the contribution of Wireless Communication networks to overall technological growth, make them understand related terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.

UNITs	Descriptions	Hrs.
I	Introduction of Wireless Networks: Different Generations of Wireless Networks. Characteristics of the Wireless Medium: Radio Propagation Mechanisms, Path Loss Modeling and Signal Coverage, Effect of Multipath and Doppler, Channel Measurement and Modeling Techniques.	6
II	Network Planning: Introduction, Wireless Network Topologies, Cellular Topology, Cell Fundamentals Signal to Interferences Radio Calculations, Network Planning for CDMA Systems. Wireless Network Operations: Mobility Management, Radio Resources and Power Management.	9
III	Multiple Division Techniques: FDMA, TDMA, CDMA, OFDM, SDMA. Comparison of Multiple Division Techniques, Modulation Techniques – AM, FM, FSK, PSK, QPSK, QAM, 16QAM Mobile Data Networks: Introduction, Data Oriented CDPD Network, GPRS, EDGE and High Data Rates, SMS in GSM, Mobile Application Protocols.	9
IV	Introduction to Wireless LAN: Evolution of WLAN, Wireless Home Networking, Technologies for Home Area Network (HAN), Overview of IEEE 802.11, Reference Architecture, PHY and MAC Layer, Wireless ATM, HIPERLAN.	7
V	IEEE 802.15 WPAN, HomeRF, Bluetooth, Interference between Bluetooth and 802.11, Adhoc Networks, Introduction to 2G, 3G, LTE (4G), and 5G networks.	8
Total Hours		40

Course Outcomes:

CO1: To understand the functionality and selection criteria of various operating systems when designing automation systems for technological complexes in real time.

CO2: To know the structure, basic principles of construction and the scope of use of embedded operating systems.

CO3: To be able to program applied tasks for embedded systems and be able to control the processes occurring in real-time systems.

CO4: To have practical skills for solving problems of designing control and monitoring systems for

technological complexes in real time based on existing operating systems and programming languages.

CO5: Implement different type of applications for smart phones and mobile devices with latest network strategies

Text Book & Reference Books-

1. KavehPahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks", PHI.
2. Qing- AnZeng, Dharma PrakashAgrawal, "Introduction to Wireless and Mobile Systems", CENGAGE Learning.
3. SumitKasera, NishitNarang, A P Priyanka, "2.5 G Mobile Networks: GPRS and EDGE", TMH
4. Dr.KamiloFeher, "Wireless Digital Communications", PHI.
5. Jochen Schiller, "Mobile Communications", PEARSON.

List/Links of e-learning resource

- https://nptel.ac.in/courses/106105172

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	1	2										1	2
CO-2	2	1	1										1	2
CO-3	1	1	2							1			1	2
CO-4	2	1	2							1				2
CO-5	1	1	2										1	

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things				
Subject Category	DE	Subject Code:	IoT 2073 DE – 6 A	Subject Name		Mobile Application Development				

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total				
ES	MS	Assignment/Quiz	ES	LW	Marks	L	T	P	
70	20	10	-	-	100	3	0	0	3

Prerequisites:

Basic knowledge of programming skills.

Course Objective:

- To facilitate students to understand android SDK.
- To help students to gain a basic understanding of Android application development.
- To inculcate working knowledge of Android Studio development tool

UNITs	Descriptions	Hrs.
I	Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.	6
II	Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.	8
III	Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.	8
IV	Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.	10
V	Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.	8
Total Hours		40

Course Outcomes:

CO1: Identify various concepts of mobile programming that make it unique from Programming for other platforms.

CO2: Critique mobile applications on their design pros and cons.

CO3: Utilize rapid prototyping techniques to design and develop sophisticated mobile Interfaces.

CO4: Program mobile applications for the Android operating system that use basic and Advanced phone features.

CO5: Deploy applications to the Android marketplace for distribution.

Text Book & Reference Books-

1. T1. Lauren Darcey and Shane Conder, "Android Wireless Application Development",
2. Pearson Education, 2nd ed. (2011).
3. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd.
4. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd.

5. Android Application Development All in one for Dummies by Barry Burd, Edition.

List/Links of e-learning resource

- https://archive.nptel.ac.in

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1		2			2							2	1	2
CO-2	2	3		2	1						1	2	3	3
CO-3	2	3	3	2								2	2	2
CO-4	2	2		2								2	3	3
CO-5	2	2	2									2	3	3

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things		
Subject Category	DE	Subject Code:	IoT 2073 DE – 6B	Subject Name		UI/UX		

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total Marks	L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	0	0	3

Prerequisites:
Knowledge of computer programming with any programming language like C/C++, Java.

Course Objective:

- The aim of the UI/UX course is to provide students with the knowledge of user- centered design, user-cantered methods in design, graphic design on screens, simulation and prototyping techniques.
- Also usability testing methods, interface technologies and user centered design in corporate perspective.

UNITs	Descriptions	Hrs.
I	Introduction to the UI: What is User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief Historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content, Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design.	8
II	Introduction to UX: UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience, Visual Design Principles, Functional Layout, Interaction design.	8
III	Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design.	8
IV	UI/ UX Design Tools: User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wire framing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design.	8
V	Information and Data Study: Understanding and collection of data, methods of collecting data, tools for collecting data, analysing data, using data analytics tools like Google analytics for user experience, heat mapping tools.	8
Total Hours		40

Course Outcomes:

CO1: Understand iterative user-centered design of graphical user interfaces.
CO2: Apply the user Interfaces to different devices and requirements.
CO3: Create high quality professional documents and artifacts related to the design process.
CO4: Students are capable of programming using mainstream programming languages, can conduct fine software-engineering practices to implement problem-solving schemes as correct, efficient, and well-structured programs
CO5: Students have the logical, algorithmic, andmathematical capability to model and analyze real-world problems in different application domains

Text Book & Reference Books-
1. A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012..
2. The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011
3. The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007.
4. The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012.

List/Links of e-learning resource

- https://onlinecourses.nptel.ac.in/noc21_ar05/preview

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_1	PO_{11}	PO_{12}	PSO1	PSO2	
CO-1	1	1				1							1	2	
CO-2	1	1	1										1	2	
CO-3	1	1	1							1				1	
CO-4				1	1			1						1	
CO-5	1	1	1										1	1	

Suggestive list of experiments:

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

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DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	OC	Subject Code:	IoT 2074 OC – 3A	Subject Name		Digital Image Processing			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical						
ES	MS	Assignment/Quiz	ES	LW		L	T	P	
70	20	10	-	-	100	3	0	0	3

Prerequisites:
Knowledge of Computer Programming Language and MATLAB

Course Objective:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures
- To study the image compression procedures.

UNITs	Descriptions	Hrs.
I	Digital Image Fundamentals: A simple image model, Sampling and Quantization. Relationship between pixels, Imaging geometry, Image acquisition systems, Different types of digital images.	6
II	Image Transformations Introduction to Fourier transforms, Discrete Fourier transforms, Fast Fourier transform, Walsh transformation, Hadmord transformation, Discrete Cosine Transformation.	8
III	Image Enhancement Filters in spatial and frequency domains, Histogram based processing. Image subtraction, Averaging, Image smoothing, Nedion filtering, Low pass filtering, Image sharpening by High pass filtering.	8
IV	Image Encoding and Segmentation Encoding: Mapping, Quantizer, Coder. Error free compression, Lossy Compression schemes. JPEG Compression standard. Detection of discontinuation by point detection, Line detection, edge detection, Edge linking and boundary detection, Local analysis, Global processing via Hough transforms and graph theoretic techniques.	10
V	Mathematical Morphology Binary, Dilation, crosses, Opening and closing, Simple methods of representation, Signatures, Boundary segments, Skeleton of a region, Polynomial approximation.	8
Total Hours		40

Course Outcomes:

On successful completion of this course student should be able to:
CO1: Ability to apply principles and techniques of digital image processing in applications related to design and analysis of digital imaging systems.
CO2: Ability to analyze and implement image processing algorithms to real problems.
CO3: Gaining of hands-on experience in using software tools for processing digital images.
CO4: Interpret image segmentation and representation techniques.
CO5: Apply Mathematical Morphology using Polynomial approximation.

Text Book & Reference Books-

1. Rafael C Gonzalez, Richard E Woods 3rd Edition, Digital Image Processing Pearson.
2. Sonka, Digital Image Processing & Computer Vision, Cengage Learning.
3. Jayaraman, Digital Image Processing, TMH.
4. Pratt, Digital Image Processing, Wiley India.

5.	Annadurai, Fundamentals of Digital Image Processing,Pearson Education.

List/Links of e-learning resource

- https://nptel.ac.in/courses/117105135

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	1	1										1	2
CO-2	2	1	1										1	2
CO-3	1	1											1	2
CO-4	2	1	1											2
CO-5	1	1	1										1	

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF CS & IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	OC	Subject Code:	IoT 2074 OC – 3B	Subject Name		Embedded System Design			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical			L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	0	0	3

Prerequisites:
Knowledge of microprocessor and controllers.

Course Objective:
• Attain the knowledge of embedded system and its development environment.
• Gain the knowledge of RTOS based embedded system design and its applications.

UNITs	Descriptions	Hrs.
I	Introduction to Embedded Systems: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.	8
II	Embedded System Architecture: Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.	8
III	Input Output and Peripheral Devices Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock. Introduction to communication protocols: basic terminologies, concepts, serial protocol: I2C, CAN, firewire, USB. Parallel protocols: PCI bus, IrDA, bluetooth, IEEE 802.11, wireless protocols.	8
IV	Memory System Architecture Caches, virtual memory, MMU, address translation, memory and interfacing, memory write ability and storage performance. Memory types, composing memory – advance RAM interfacing, microprocessor interfacing I/O addressing, interrupts, direct memory access, arbitration multilevel bus architecture.	8
V	Embedded System Supporting Technologies Difference between normal OS and RTOS, scheduling algorithms. Case study: Tiny OS, Vx Works, QNX. Overview of VLSI technology, introduction to device drivers. Case studies: washing machine, air-conditioning, auto focus camera.	8
Total Hours		40

Course Outcomes:
CO1:Explain the embedded system concepts and architecture of embedded systems
CO2: Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller
CO3:Select elements for an embedded systems tool.
CO4:Understand the memory types used in embedded systems.
CO5: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety,Manufacturability and sustainability.

Text Book & Reference Books-

1. F Vahid, T Giogarvis, Embedded systems: A unified hardware/software approach, Wiley, 1999.
2. Raj Kamal, Embedded Systems Introduction, 2nd Ed., TMH publication, 2015.
3. David E Simons, An Embedded Software Primer, Pearson, 1999.

List/Links of e-learning resource

- https://onlinecourses.nptel.ac.in/noc20_ee98/preview

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	1	3			1							1	2
CO-2	2	1	1	1									1	2
CO-3	2	2	2							1			1	1
CO-4	2	1	2											2
CO-5	1					1	2	1					1	1

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
DEPARTMENT OF IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	OC	Subject Code:	IoT 2075 DE – 4A	Subject Name		AI for IoT			

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total Marks	L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	0	0	3

Prerequisites:
Basic Knowledge of algorithms
Course Objective:

- Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
- Review of classical problem solving: search and forward and backward chaining.
- Formalize a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem etc.

UNITs	Descriptions	Hrs.
I	The AI Problems, The Underlying Assumption, AI Techniques, Level of the Model, Criteria for Success, Some general references, one Final Word. Problems and State Space Search, Defining Problems as a State Space Search, Production Systems, Production Characteristics, Production System Characteristics, and issues in the design of Search Programs, additional problems. Generate-and-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.	8
II	Representations and Mappings, Approaches to Knowledge Representation. Using Predicate Logic, Representation Simple Facts in Logic, Representing instance and is a Relationships, Computable Functions and Predicates, Resolution. Representing Knowledge Using Rules Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning.	8
III	Introduction to Non-monotonic Reasoning, Logics for Non-monotonic Reasoning. Statistical Reasoning, Probability and Bay's Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. Weak Slot-And-Filler Structure, Semantic Nets, Frames. Game Playing: Overview, Example Domain the Blocks World, Components of a Planning System, Goal Stack Planning.	8
IV	Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Natural Language Processing introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing. Connectionist Models introduction: Hopfield Network, Learning in Neural Networks, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI and Symbolic AI.	8
V	Developments Process, knowledge Acquisition. Introduction to Prolog, Syntax and Numeric Function, Basic List Manipulation Functions in Prolog, Functions, Predicates and Conditional, input, output and Local Variables, iteration and Recursion, Property Lists and Arrays, LISP and other AI Programming Languages.	8

Total Hours	40

Course Outcomes:

CO-1: Describe various searching methods and reasoning in AI.
CO-2: Uses of Knowledge Representation Techniques.
CO-3: Analysis the concepts of reasoning and planning.
CO-4: Illustrate the concept of NLP and NN.
CO-5: Applyand evaluate AI Techniques using prolog and lisp.

Text Book & Reference Books-

1. Artificial Intelligence -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
2. Introduction to Prolog Programming By Carl Townsend.
3. "PROLOG Programming For Artificial Intelligence" -By Ivan Bratko(Addison-Wesley)
4. "Programming with PROLOG" —By Klocksin and Mellish.
5. "Artificial Intelligence" (Fifth Edition) -By George F Luger, Pearson Education.
6. "Artificial Intelligence" (Second Edition}-By Stuart Russell and Peter Norvig, Pearson
7. Education.
8. Artificial Intelligence Application Programming, Tim Jones, Wiley India.
9. "Artificial Intelligence And Expert Systems " -By D.W Patterson

List/Links of e-learning resource

- https://nptel.ac.in/courses/106102220

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	2	1	2										1	2
CO-2	2	2	2	1									2	1
CO-3	2	1	2	1									2	1
CO-4	2	1	2	1									2	1
CO-5	2	2	1										1	2

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things				
Subject Category	OC	Subject Code:	IoT 2075 OC – 4B	Subject Name		Cyber Security for IoT				

Maximum Marks Allotted						Contact Hours			Total Credits
Theory			Practical		Total Marks	L	T	P	
ES	MS	Assignment/Quiz	ES	LW					
70	20	10	-	-	100	3	0	0	3

Prerequisites:

Course Objective:
- The course aims at providing students with concepts of computer security, cryptography, digital money, secure protocols, detection and other security techniques.

UNITs	Descriptions	Hrs.
I	Cyber Security Concepts: Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning). Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners.	8
II	Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security, Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.	8
III	Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.	8
IV	Internet Security, Cloud Computing &Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness..	7
V	Security in Evolving Technology: Biometrics, Mobile Computing and Hardening on android and ios, IOT Security, Web server configuration and Security. Introduction, Basic security for HTTP Applications and Services, Basic Security for Web Services like SOAP, REST etc., Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.	9
Total Hours		40

Course Outcomes:

CO1: Understand, appreciate, employ, design and implement appropriate security technologies and policies to protect computers and digital information.
CO2: Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios.

CO3:	Identify common trade-offs and compromises that are made in the design and development process of Information Systems

CO3: Identify common trade-offs and compromises that are made in the design and development process of Information Systems
CO4: Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection.
CO5: Design and develop a security architecture for an organization.

Text Book & Reference Books-

1. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006.
2. V.K. Jain, "Cryptography and Network Security", Khanna Publishing House.
3. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi.
4. AtulKahate, "Cryptography and Network Security", McGraw Hill.
5. V.K. Pachghare, "Cryptography and Information Security", PHI Learning

List/Links of e-learning resource

- https://nptel.ac.in/courses/106106129

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO$_1$	PO$_2$	PO$_3$	PO$_4$	PO$_5$	PO$_6$	PO$_7$	PO$_8$	PO$_9$	PO$_1$	PO$_{11}$	PO$_{12}$	PSO1	PSO2
CO-1	1	3				1							1	2
CO-2	1	1	1										1	2
CO-3	1	2	1			2		2		1				1
CO-4		1	2					1						2
CO-5	1	1	1										1	1

Suggestive list of experiments:

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

Semester/Year		VII/IV		Program		B.Tech – Internet of Things			
Subject Category	DLC	Subject Code:	IoT 2076	Subject Name		Digital Sensor Lab			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical						
ES	MS	Assignment/Quiz	ES	LW		L	T	P	
-	-	-	30	20	50	0	0	2	1

Prerequisites:
Microprocessor and Microcontroller

Course Objective:
- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.

UNITs	List of Experiments	Hrs.
	1.IR OBSTACLE SENSOR- If object is detected pin 13 will go high (onboard LED ON) and "object detected" message will be displayed in serial monitor If object is not detected pin 13 will go low (onboard LED OFF) and "object not detected" message will be displayed in serial monitor. 2. GAS SENSOR- If Gas is detected pin 13 will go high (onboard LED ON) and "gas detected" message will be displayed in serial monitor If Gas is not detected pin 13 will go low (onboard LED OFF) and "gas not detected" message will be displayed in serial monitor. 3. FIRE SENSOR- If FIRE is detected pin 13 will go high (onboard LED ON) and "FIRE detected" message will be displayed in serial monitor If FIRE is not detected pin 13 will go low (onboard LED OFF) and "FIRE not detected" message will be displayed in serial monitor. 4. RELAY SHIELD- Controlling relay shield from serial monitor. 5. GSM SHIELD- If GAS is detected pin 7 will go LOW and "GAS detected" message will be sent to destination number. 6. Analog to Digital and PHOTORESISTOR- light-dependent resistor (LDR), the photo resistor adjusts its resistance according to the light received from the environment. It works not only with sunlight, but also with artificial light. Now let's see how we can integrate it to the real world. 7. Interfacing of DHT11. 8. Iot Based Air Pollution Control System. 9. Tds Sensor Interfacing With Arduino. 10. Actuator Controlling by Mobile Using Arduino.	

Total Hours		40

Course Outcomes:
CO 1: To know basics of development boards.
CO2: To know about the Arduino board and its interfacing with various components.
CO 3: To know about the ESP 8266 board and its interfacing with various components.
CO4: To know about the Raspberry Pi architecture. .
CO5: To know about the Raspberry Pi and its interfacing with various components.

Text Book & Reference Books-

List/Links of e-learning resource

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO₁	PO₂	PO₃	PO₄	PO₅	PO₆	PO₇	PO₈	PO₉	PO₁	PO₁₁	PO₁₂	PSO1	PSO2
CO-1	2	1	2										1	2
CO-2	3	2	2	1									1	2
CO-3	3	2	2	1									2	1
CO-4	3	2	2	1									2	1
CO-5	2	2	1										1	1

Suggestive list of experiments:

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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(An Autonomous Institute Affiliated to RGPV Bhopal)
DEPARTMENT OF CS & IT

Semester/Year		VIII/IV		Program		B.Tech – Internet of Things			
Subject Category	DLC	Subject Code:	IoT 2078	Subject Name		Major Project Prelim			

Maximum Marks Allotted					Total Marks	Contact Hours			Total Credits
Theory			Practical						
ES	MS	Assignment/Quiz	ES	LW		L	T	P	
350	100	50	180	70	750	15	2	10	2

Prerequisites:

Course Objective:

UNITs	Descriptions	Hrs.
Procedure:	a) Each defined project needs to be from Industry/Research organization/Govt.organization/socio-technical issues. b) Project identification should be based on Analysis carried out by the students after completion of B.E Semester 6th Examination but before starting of the 7th Semester. c) Problem definition for the project needs to be submitted by every student in the first week of the 7th Semester to his/her college. d) Each definition will be evaluated based on merit in the beginning of the 7th semester itself by the College. **Facilitation:** You may contact your Major Project In charge co-ordinator/Faculty /Department Head for skilfulAnalysis .	40
Guidliness:	1. The project work will be in-house industry project, where student need to implement project related to any domain of industry like education, legal, manufacturing, design, pharmaceutical, Ecommerce, etc. 2. Students are required to get approval of project definition from the department. 3. After approval of project definition students are required to report their project work weekly to respective internal guide. 4. Maximum 4 students can allow working in particular project group. 5. The students are required to identify their project within two weeks of the commencement of the classes and they are required to follow all the rules and instructions issued by department. 6. Each student or student group would work under the guidance of the Faculty from the College. In case any problem/other issue arises for the smooth progress of Inter Departmental project work discovery/Practical Training, it should be immediately brought to the notice of the major project in charge coordinators/Faculty. 7. The students are required to submit Project synopsis Pre-report to their Head of the Department with the remarks of guide in their College during Eighth week of the semester	
Total Hours		40

Course Outcomes:

On successful completion of theproject student should be able to:

CO1: Identify the problem domain correctly and to represent problem using mathematical structures and logics.

CO2: Analyze possible solution strategies and investigate problem domain and design feasible solutions for it.

CO3: Make use of cutting edge tools and technologies to derive solutions for the problems and carried a detailed studied about the feasibility and societal impact of solutions

CO4: Acknowledges the previous work and support required in the solution. Justify the role of individual in project work. Demonstrate leadership skills in team work.

CO5: Present and communicate the importance of solutions of problem domain. Conduct and accomplish all the subtasks for project completion in time and cost effective manner and conclude the project work with possible scopes.

Text Book & Reference Books-

List/Links of e-learning resource

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO_1	PO_2	PO_3	PO_4	PO_5	PO_6	PO_7	PO_8	PO_9	PO_1	PO_{11}	PO_{12}	PSO1	PSO2
CO-1	3	3	2										2	2
CO-2	2			2		1	2			1			2	
CO-3			3		3	2	3						2	2
CO-4									3				1	
CO-5					2					3	3	3		2

Suggestive list of experiments:

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of CS & IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE VIDISHA (M.P.)
(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV Bhopal)

Scheme of Examination (Semester-VIII)

for Batch Admitted in session - 2020-21

Bachelor of Technology (B. Tech.) – Internet of Things

Subject Code	Subject Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hrs.			Total Credits
			Theory			Practical			L	T	P	
			ES	MS	Assignment/ Quiz	ES	Term Work, Lab Work or Sessional					
IoT 2081	OC	Mooc Course -1/OC - 4	70	20	10			100	3	0	0	3
IoT 2082	OC	Mooc Course -2/OC -5	70	20	10			100	3	0	0	3
IoT 2083	PROJ	Major Project Final				400	150	550	0	0	16	8
Total			140	40	20	400	150	750	6	0	16	14
	NLC	Participation and winning in national level competition										

	SL	MOOCs										
MST: Minimum two mid semester tests to be conducted during Semester,												

ES: End Semester MS: Mid Semester L: Lecture T: Tutorial P: Practical

Mooc Course -1	Mooc Course -2
SWAYAM/NPTEL – COURSE Suggested by Department.	

	Mooc Course -1/OC - 4	Mooc Course -2/OC -5
A	Foundation of Cloud IoT Edge ML	Digital Design with Verilog
B	Foundations of Cyber Physical Systems	Cloud Computing and Distributed Systems

For batch admitted 2020-21

OC - 4	OC -5
A. Foundation of Cloud IoT Edge ML	A. Digital Design with Verilog
B. Foundations of Cyber Physical Systems	B. Cloud Computing and Distributed Systems

Sr. No	Credit Points	Course/subject Name	Equivalent Course in NPTEL	Course Duration (Week)	Link
1.	03	Foundation of Cloud IoT Edge ML	https://onlinecourses.nptel.ac.in/noc23_cs65/preview	08	https://archive.nptel.ac.in/courses/106/104/106104242/
2.	03	Foundations of Cyber Physical Systems	https://onlinecourses.nptel.ac.in/noc23_cs62/preview	12	https://nptel.ac.in/courses/106105241
3.	03	Digital Design with Verilog	https://onlinecourses.nptel.ac.in/noc24_cs61/preview	12	https://nptel.ac.in/courses/108103179
4.	03	Cloud Computing and Distributed Systems	https://onlinecourses.nptel.ac.in/noc21_cs15/preview	08	https://nptel.ac.in/courses/106104182

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year				Program		B.Tech – IOT	
Subject Category	OC-4(A)	Subject Code: IoT 2081	IOT	Subject Name		Foundation of, Cloud, IOT, Edge, ML	

Maximum Marks Allotted							Total Marks	Contact Hours			Total Credits
Theory				Practical							
ES	MS	Assignment	Quiz	ES	LW	Quiz		L	T	P	
70	20	10						3	0	0	3

Prerequisites:

Course Objective:
To enable the students to relate various concepts of Globalization and its impact on Indian Society.

UNITs	Descriptions	Hrs.
I	Introduction to Cloud, Internet of Things (IoT), and Edge Computing Paradigms, Integrating Cloud+ IoT + Edge Infrastructures: System Modelling and Research Challengesin Federating Edge Resources	8
II	Management and Orchestration of Network Slices in 5G, Edge, and Clouds, Introduction to Lightweight Container Middleware for Edge Cloud Architectures	10
III	Data Management and Predictive Analysis to Support Edge Application Deployment, **Edge** Computing Realization for Big Data Analytics	12
IV	Introduction to Machine Learning Services at Public Cloud (AWS Sage Maker), Use Cases for Machine Learning and Deep Learning at the Edge: Smart Surveillance Video Stream Processing, AR/VR, Health Monitoring and Self-driving cars	8
V	.Application of IoT: Smart Homes – Introduction, Origin of Smart Homes, Smart Home Technologies. Smart Cities – Characteristics of Smart Cities, Smart City Framework, Challenges in Smart Cities. Connected Vehicles – Introduction, levels of Automation, Vehicle to Everything(V2X) Paradigm, Vehicular Ad-hoc Network (VANETs)	7

Total Hours		45

Course Outcomes:
CO1: To understand the Fundamentals of IoT.
CO2: To understand the Fundamentals of Edge Computing.
CO3: To understand the Fundamentals of Cloud.
CO4: To understand the Fundamentals of ML.

Text Book
Arshdeep Bagha and Vijay Madisetti, "Internet of Things – A hands-on approach", Orient Blackswan Private Limited - New Delhi.
Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013 .
P. Langley. "Elements of Machine Learning" Morgan Kaufmann Publishers, Inc. 2296.

Reference Books-

List/Links of e-learning resource
- https://archive.nptel.ac.in/courses/106/106/106106131/

Modes of Evaluation and Rubric
The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	TO8	PO9	PO1	PO11	PO12	PSO-1	PSO2

CO-1	3	3	2	3	1							2	3	
CO-2		3	3	2	3									
CO-3	2	3	3	3	2									
CO-4		2	3	3										
CO-5		3	2	3										

1.

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
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DEPARTMENT OF IT

Semester/Year				Program		B.Tech – IOT			
Subject Category	OC 4(B)	**Subject Code: IoT 2081**	IOT	**Subject Name**		Foundation of Cyber Physical system			

Maximum Marks Allotted							Contact Hours			Total Credits
Theory				**Practical**		**Total Marks**				
ES	MS	Assignment		ES	LW	Quiz	Total	L	T	P	Credit
70	20	10					100	3	0	0	3

Prerequisites:

Course Objective: To understand important safety-critical aspects and feel confident designing and analysing system models. It will provide an excellent foundation for students who seek industry positions and for students interested in pursuing research.

To enable the students to relate various concepts of Globalization and its impact on Indian Society.

UNITs	Descriptions	Hrs.
I	Dynamical Systems Modeling: Cyber-Physical Systems (CPS) in the real world, Dynamical Systems: stability and performance, Different notions of stability, Controller Design techniques	8
II	Logic based system specification, Controller Synthesis as a logic problem, Tutorials: System modeling, Control design, stability, Z3 solver, Compute /Communicate/Scheduling, Real time scheduling theory, CAN bus scheduling, Wireless CPS	10
III	Packet drops and their effects on stability/performance, Delay/Deadline-miss aware control design, Tutorials :True time/Jitter time, CAN tools, WSN-CPS simulation with drops, Example of miss aware control	12
IV	Safe-AI based and Secure CPS, Safe Reinforcement learning for CPS, MPC+Gaussian Process learning for CPS, Distributed CPS: Cooperative driving	8
V	Attack detection and mitigation in CPS, Smart Grid Security and Privacy : Automated Generation Control attacks and privacy aware metering, Tutorials : Use of OpenAI-gym, Carla, Matlab for safe-RL/MPC based autonomous driving, Ventos/SUMO for Cooperative driving, Matlab for power system loop modeling	7
Total Hours		45

Course Outcomes:

CO1: Understand the core principles behind CPSs.
CO2: Develop models and controls.
CO3: Identify safety specifications and critical properties of CPSs.
CO4: Understand abstraction and system architectures.
CO5: Learn how to design by invariant.

Text Book

André Platzer. LOGICAL FOUNDATIONS OF CYBER-PHYSICAL SYSTEMS. Springer, Cham, 2018. 659 pages. ISBN 978-3-319-63587-3.

Reference Books-

List/Links of e-learning resource

- https://archive.nptel.ac.in/courses/106/106/106106131/

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO$_{11}$	PO$_{12}$	PSO-1	PSO2
CO-1	3	3	2	3	1							2	3	
CO-2		3	3	2	3									
CO-3	2	3	3	3	2									
CO-4		2	3	3										
CO-5		3	2	3										

1.

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
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DEPARTMENT OF IT

Semester/Year				Program		B.Tech – IOT				
Subject Category	OC 5 (A)	Subject Code: IoT 2082		IOT	Subject Name	Digital Design with Verilog				

Maximum Marks Allotted							Contact Hours			Total Credits

Theory				Practical			Total Marks	L	T	P	Credit
ES	MS	Assignment	Quiz	ES	LW	Quiz					
70	20	10					100	3	0	0	3

Prerequisites:

Switching Theory and Logic Design.

Course Objective:

To learn the concepts of modeling a digital system using Verilog hardware description Language.

UNITs	Descriptions	Hrs.
I	INTRODUCTION TO VERILOG: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches. LANGUAGE CONSTRUCTS AND CONVENTIONS: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.	8
II	UNIT-II GATE LEVEL MODELING: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits. DATA FLOW LEVEL MODELING: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.	10
III	BEHAVIORAL MODELING: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow. if and if-else constructs, assign-deassign construct, repeat construct, for loop, the disable construct, whileloop, forever loop, parallel blocks, force-release construct, Event. SWITCH LEVEL MODELING: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Tri-reg Nets.	12
IV	FUNCTIONS, TASKS, AND U SER-DEFINED PRIMITIVES: Introduction, Function, Tasks, User- Defined Primitives (UDP), FSM Design (Moore and Mealy Machines). SYSTEM TASKS, FUNCTIONS AND COMPILER DIRECTIVES: Introduction, Parameters, Path Delays, Module Parameters, System Tasks and Functions, File-Based Tasks and Functions, Compiler Directives, Hierarchical Access, General Observations. VERILOG MODELS FOR MEMORIES AND BUSES: Static RAM Memory, A simplified 486 Bus Model, UART Design.	8
V	DESIGNING WITH FIELD PROGRAMMABLE GATE ARRAYS AND COMPLEX PROGRAMMABLE LOGIC DEVICES: Xilinx 3000 Series FPGAs, Designing with FPGAs, Using a One-Hot State Assignment, Altera Complex Programmable Logic Devices (CPLDs), Altera FLEX 10K Series CPLDs.	7
Total Hours		45

Course Outcomes:

Students can model digital circuits using Verilog.

Student can represent Function of any digital system using hardware description language

Text Book

1. T.R. Padmanabhan and B. Bala Tripura Sundari, "Design through Verilog HDL'', WSE, IEEE Press 2008.
2. J. Bhaskar, "A Verilog Primer'', BSP, 2nd edition 2003.

Reference Books-

1.Samir Palnitkar, "Verilog HDL", Pearson Education, 2nd Edition,2003.
2. Thomas and Moorby, "The Verilog Hardware Description Language", kluwer academic publishers, 5th edition, 2002.
3. Stephen Brown and Zvonko Vranesic, "Fundamentals of Logic Design with Verilog", TMH publications, 2007.
4. Charles.H.Roth,Jr., Lizy Kurian John "Digital System Design using VHDL" , Thomson, 2nd Edition, 2008

List/Links of e-learning resource

- https://archive.nptel.ac.in/courses/106/106/106106131/

Modes of Evaluation and Rubric

The evaluation modes consist of performance in two mid semester Tests, Quiz/Assignments, term work, end semester practical examination.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO11	PO12	PSO-1	PSO2
CO-1	3	3	2	3	1							2	3	
CO-2		3	3	2	3									
CO-3	2	3	3	3	2									
CO-4		2	3	3										
CO-5		3	2	3										

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

SAMRAT ASHOK TECHNOLOGICAL INSTITUTE
(Engineering College), VIDISHA M.P.
(An Autonomous Institute Affiliated to RGPV Bhopal)
DEPARTMENT OF IT

Semester/Year					Program		B.Tech – IOT				
Subject Category	DE	Subject Code:		IOT		Subject Name	Cloud computing and Distributed System				
Maximum Marks Allotted							Contact Hours			Total Credits	
Theory				Practical			Total Marks				
ES	MS	Assignment	Quiz	ES	LW	Quiz		L	T	P	Credits
60	20	10	10				100	3	0	0	3

Prerequisites:

Course Objective:

A basic grounding in designing and implementing distributed and cloud systems. Developers of cloud services question how those services should be implemented.

UNITs	Descriptions	Hrs.
I	Introduction to distributed systems and cloud computing. Cloud architectures: SaaS, PaaS, IaaS. End-to-end system design. Networks and protocol stacks, Client-server computing. Sockets and remote procedure call, Distributed file systems and cache consistency. NFS, AFS. Storage in the Cloud: Google/ Hadoop file system.	8
II	Web services and REST. Example: Amazon S3. The JAX-RS API. Persistent cloud services. Failure models and failure detectors, Asynchrony: publish-subscribe. Server-side events and REST. Web sockets. Vert.x: Node.js for Java. Distributed snapshots. Distributed debugging. Time and ordering of events. Causal broadcasts.	10
III	Batch cloud computing: map-reduce and Hadoop. Domain-specific languages for cloud data processing: Pig and Hive. Transactions. Serializability and recoverability. Long-lived transactions. Transactions. Atomic commitment protocols: 2PC and 3PC.	12
IV	Highly available services. Replicated services and quorum consensus. The CAP Theorem, NoSQL data stores. Table-based (Google BigTable), key-based (Amazon Dynamo), and Cassandra. The Hector API. Query processing with Map-reduce.	8
V	Consensus and the Paxos algorithm. Applications in the cloud: Google Chubby, Yahoo Zookeeper, Peer-to-peer systems. Distributed hash tables. Applications in multiplayer game-playing.	7

Total Hours	45

Course Outcomes:

1. Describe system models for distributed and cloud computing.
2. Describe the design principles of computer clusters and data centers.
3. Describe and distinguish different virtualization techniques.
4. Explain cloud enabling technologies, cloud mechanisms, and cloud architectures.
5. Use cloud programming (e.g., Google App Engine, Amazon Web Services) to solve real problems.

Text Book

1.Dominic Duggan, Enterprise Software Architecture and Design

Reference Books-

George Coulouris, Jean Dollimore, T. Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, 5th Edition, Addison Wesley, 2012.
Thomas Erl, Ricardo Puttini, and Zaigham Mahmood, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 2013.
Kai Hwang, Jack Dongarra, and Geoffrey C. Fox, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 1st Edition, Morgan Kaufmann, 2011.

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CO-1	3	3	2	3	1							2	3	
CO-2		3	3	2	3									
CO-3	2	3	3	3	2									
CO-4		2	3	3										
CO-5		3	2	3										

Recommendation by Board of studies on	
Approval by Academic council on	
Compiled and designed by	
Subject handled by department	Department of IT

Tentative pool of subjects for Honours & Minor Degree
SWAYAM/NPTEL/ MOOC's Course *

Annexure-I

NPTEL Courses Equivalence for Departmental and Open Electives
For
(Honour's Degree)

ExistingElectives			SimilarNPTELCourse		
Sr. No	Credit Points	Course/subjectName	Equivalent Course inNPTEL	CourseDuration(Week)	Link
1.	2	Cloud Computing and Distributed Systems	https://onlinecourses.nptel.ac.in/noc21_cs15/preview	08	https://nptel.ac.in/courses/106104182
2.	3	Switching Circuits and Logic Design	https://onlinecourses.nptel.ac.in/noc20_cs67/preview	12	https://nptel.ac.in/courses/106105185
3.	3	Advanced Computer Networks	https://onlinecourses.nptel.ac.in/noc23_cs35/preview	12	https://nptel.ac.in/courses/106106243
4.	2	Embedded System Design with ARM	https://onlinecourses.nptel.ac.in/noc22_cs93/preview	08	https://nptel.ac.in/courses/106105193
5.	3	Embedded Sensing, Actuation and Interfacing Systems	https://onlinecourses.nptel.ac.in/noc24_ee68/preview	12	https://nptel.ac.in/courses/108105376
6.	3	Digital System Design	https://onlinecourses.nptel.ac.in/noc21_ee39/preview	12	https://nptel.ac.in/courses/108106177
7.	2	An Introduction to Information Theory	https://onlinecourses.nptel.ac.in/noc22_ee49/preview	08	https://nptel.ac.in/courses/117104129
8.	3	Industrial Automation And Control	https://onlinecourses.nptel.ac.in/noc21_me67/preview	12	https://nptel.ac.in/courses/108105088

Tentative pool of subjects for Honours & Minor Degree
SWAYAM/NPTEL/ MOOC's Course *

NPTEL Courses Equivalence for Departmental and Open Electives
For

(Minor Degree)

ExistingElectives			SimilarNPTELCourse		
Sr.No.	Credit Points	Course/subjectName	Equivalent Course inNPTEL	CourseDuration(Week)	Link
1.		Analog and Digital Electronics	https://nptel.ac.in/courses/108105158		https://nptel.ac.in/courses/108102112
2.	3	Computer Networks And Internet Protocol	https://onlinecourses.nptel.ac.in/noc22_cs19/preview	12	https://nptel.ac.in/courses/106105183
3.	3	Microprocessor and Microcontroller	https://onlinecourses.nptel.ac.in/noc22_ee12/preview	12	https://nptel.ac.in/courses/108105102
4.	2	Foundation of Cloud IoT Edge ML	https://onlinecourses.nptel.ac.in/noc23_cs65/preview	08	https://nptel.ac.in/courses/106104242
5.	3	Foundations of Cyber Physical Systems	https://onlinecourses.nptel.ac.in/noc23_cs62/preview	12	https://nptel.ac.in/courses/106105241
6.	3	Introduction to Embedded System Design	https://onlinecourses.nptel.ac.in/noc20_ee98/preview	12	https://nptel.ac.in/courses/108102169
7.	3	Introduction To Industry 4.0 And Industrial Internet Of Things	https://onlinecourses.nptel.ac.in/noc20_cs69/preview	12	https://nptel.ac.in/courses/106105195
8.	3	Introduction To Internet Of Things	https://onlinecourses.nptel.ac.in/noc22_cs53/preview	12	https://nptel.ac.in/courses/106105166