SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (AUTONOMOUS)
(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)
Accredited by NAAC with 'A+' Grade, Accredited by NBA (UG: Civil, CSE, ECE, EEE, IT & ME)
Recognised as Scientific and Industrial Research Organisation
SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Estd:1980

LIST OF OPEN ELECTIVES
OFFERED BY VARIOUS DEPARTMENTS TO OTHER DEPARTMENTS
IN IV YEAR I SEMESTER OE-IV

Offered by	Course Code	Course Name	Offered to
ARTIFICIAL INTELLIGENCE & DATA SCIENCE	B20ADOE05	Embedded Systems	**CE, EEE & ME**
CIVIL ENGINEERING	B20CEOE06	Green Buildings	**AIDS, CSBS, CSE, ECE, EEE, IT & ME**
COMPUTER SCIENCE & BUSINESS SYSTEMS	B20CBOE05	Bigdata Analytics	**CE, ECE, EEE & ME**
COMPUTER SCIENCE & ENGINEERING	B20CSOE10	Big Data Analytics	**CE, ECE, EEE & ME**
	B20CSOE11	Deep learning	
	B20CSOE12	Internet of Things	**CE, EEE & ME**
ELECTRONICS & COMMUNICATION ENGINEERING	B20ECOE07	Introduction to VLSI Technology	**AIDS, CE, CSBS, CSE, EEE, IT & ME**
	B20ECOE08	Embedded Systems & IOT Applications	**CE, EEE & ME**
ELECTRICAL & ELECTRONICS ENGINEERING	B20EEOE05	Introduction to sensors and transducers	**AIDS, CE, CSBS, CSE, ECE, IT & ME**
INFORMATION TECHNOLOGY	B20ITOE06	Mobile Computing	**CE, ECE, EEE & ME**
MECHANICAL ENGINEERING	B20MEOE10	Project Management	**AIDS, CE, CSBS, CSE, ECE, EEE & IT**
	B20MEOE11	Nano Technology	
	B20MEOE12	Additive manufacturing	
MATHEMATICS AND HUMANITIES	B20BSOE04	Fuzzy sets and fuzzy logic	**AIDS, CE, CSBS, CSE, ECE, EEE, IT & ME**

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ADOE05	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

EMBEDDED SYSTEMS

(Offered by AIDS)

(Offered to CE, EEE & ME)

Course Objectives:

1.	Technology capabilities and limitations of the hardware, software components.
2.	Methods to evaluate design trade-offs between different technology choices.
3.	Design Methodologies.
4.	To motivate students to do programming and experiment with the various cloud computing environments.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Understand the basics of an embedded system.	K2
2.	Program an embedded system.	K3
3.	Design, implement and test an embedded system.	K4
4.	Identify the unique characteristics of real-time systems.	K3
5.	Explain the general structure of a real-time system, and challenges of real-time systems.	K3

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Embedded systems:** What is an embedded system Vs. General computing system, history, classification, major application areas, and purpose of embedded systems. Core of embedded system, memory, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components.
UNIT-II (10 Hrs)	**8-bitmicrocontroller's architecture:** Characteristics, quality attributes application specific, domain specific, embedded systems. Factors to be considered in selecting a controller, 8051 architecture, memory organization, registers, oscillator unit, ports, source current, sinking current, design examples.
UNIT-III (10 Hrs)	**RTOS and Scheduling**, Operating basics, types, RTOS, tasks, process and threads, multiprocessing and multitasking, types of multitasking, non-preemptive, preemptive scheduling.
UNIT-IV (10 Hrs)	**Task communication of RTOS**, Shared memory, pipes, memory mapped objects, message passing, message queue, mailbox, signaling, RPC and sockets, task communication/synchronization issues, racing, deadlock, live lock, the dining philosopher's problem.

UNIT-V (10 Hrs)	**The producer -consumer problem**, Reader writers problem, Priority Inversion, Priority ceiling, Task Synchronization techniques, busy waiting, sleep and wakery, semaphore, mutex, critical section objects, events, device, device drivers, how to clause an RTOS, Integration and testing of embedded hardware and fireware.
Textbooks:	
1.	Introduction to embedded systems Shibu. K.V, TMH,2009.
2.	Embedded Software Primer, David Simon, Pearson.
Reference Books:	
1.	Ayala & Gadre: The 8051 Microcontroller &Embedded Systems using Assembly and C,CENGAGE
2.	Embedded Systems, Rajkamal, TMH,2009.
3.	The 8051 Microcontroller and Embedded Systems, Mazidi, Mazidi, Pearson

Code	Category	L	T	P	C	IM	EM	Exam
B20CEOE06	**OE**	**3**	**---**	**---**	**3**	**30**	**70**	**3 hrs.**

GREEN BUILDINGS

(Offered by CE)

(Offered to AIDS, CSBS, CSE, ECE, EEE, IT & MECH)

Course Objectives:

1	To introduce students to the concept of a 'Green' Building
2	To familiarize students with the 'voluntary environmental building rating systems' (VERS) operating in India.
3	To communicate the logic behind the rating categories in IGBC, GRIHA, LEED, EDGE, and WELL rating systems.

Course Outcomes: After completion of the course, the student will be able to

S. No.	Outcome	Knowledge Level
1	Emphasise the importance of site selection and preparation in sustainability of built environment.	K2
2	Suggest appropriate construction materials and finishes that meet green requirements of various rating systems.	K2
3	Elaborate on the design options available to conserve energy and water in buildings during their operation.	K2
4	Relate the building design to the quality of the indoor environment and specify electro-mechanical interventions for achieving occupant comfort.	K2
5	Paraphrase the requirements of various voluntary green rating systems of buildings for achieving various levels of rating.	K2

SYLLABUS

UNIT- I (8 Hrs)	**Site Selection and Preparation:** Typical features of Green Buildings, benefits of green buildings – Sustainable Site Selection, Preserving the natural resources, maximising comfort, integration of daylight, optimising ventilation; rainwater harvesting, recharge, reuse strategies
UNIT-II (8 Hrs)	**Appropriate Materials and Design:** Renewable Materials, FSC (Forest Stewardship Council) certification – Rapid Renewal, bamboo, eucalyptus, poplar, rubberwood, linoleum – Low energy walling; rammed earth, stabilised mud, Adobe–Post Consumer, Post Industrial Waste recycling – Hollow blocks, lime, pozzolona cements, agri residues – Ferro cement, Ferro concrete – Alternative roofing systems; Vaults, Domes High albedo paints
UNIT-III	**Water & Energy Conservation in Buildings:**

(8 Hrs)	Need for energy conservation in buildings, various forms of energy used in buildings, embodied energy of materials, energy used in transportation and construction processes – Water Conservation systems in Buildings, water harvesting in buildings, waste to energy in residential complexes, Modular wastewater treatment systems
UNIT- IV (8 Hrs)	**Indoor Environment Quality** Weather data collection, temperature, humidity, wind speed, direction–Climate change and Built Environment, how they affect each other – Occupant Comfort, design, codes, thermal comfort, lighting comfort, acoustic comfort - Mechanical Ventilation and Air Conditioning concepts – Energy Efficient Lighting Design – Passive cooling strategies, green roofs – Case studies from actual buildings - Building Automation and BMS
UNIT-V (8 Hrs)	**Measuring Sustainability 'voluntary environmental building rating Systems'** National Building Code of India - LEED Introduction, process, rating system, variants and levels–GRIHA Introduction, process, rating system, variants and levels– IGBC Introduction, process, rating system, variants and levels–

Text Books:	
1	Alternative Building Materials and Technologies, K.S.Jagadish, B.V.Venkatarama Reddy and K.S.Nanjunda Rao, 2nd Edition, New Age International
2	GRIHA Manual and Reference Guides
3	LEED Reference Guides
4	IGBC Reference Guides
Reference Books:	
1	Sun, Wind, and Light: Architectural Design Strategies, Mark DeKay, G.Z.Brown, 3rd Edition, John Wiley & Sons
2	National Building Code of India (2016), Bureau of Indian Standards.
3	https://app.edgebuildings.com/user/welcome

Subject Code	Category	L	T	P	C	I.M	E.M	Exam
B20CBOE05	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

BIG DATA ANALYTICS

(Offered by CSBS)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1	To provide an overview of an exciting growing field of Big Data analytics.
2	To Introduce the tools required to manage and analyze big data like Hadoop Map Reduce, Pig & Hive etc.,

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1	Understand the existing technologies and the need of distributed files systems to analyze the Big Data	K2
2	Explore the features of HDFS and MapReduce to handle the Big Data; and identify the need of interfaces to perform I/O operations in Hadoop	K2
3	Implement and analyze Map-Reduce programming model for better optimization on Big Data.	K3
4	Apply the stream processing techniques to analyze real-time data streams	K3
5	Identify the need of Modern tools, viz., Pig and Hive and its applications on Big Data Analytics	K2

SYLLABUS

UNIT-I (10 Hrs)	**Introduction to Big Data**: Big Data (BD) Definition, Characteristics of Big Data (Volume, Velocity, Verity, Veracity, Validity etc.), Applications of BD, Types of Data: Structured, Un-Structured and Semi-Structured. Hadoop, Data in Hadoop vs Traditional software (RDBMS, Data in Warehouse). **Working with Big Data:** Google File System (GFS), Hadoop Distributed File System (HDFS), Building blocks of Hadoop-v1 and Hadoop-v2.
UNIT-II (10 Hrs)	HDFS Read & Write, Anatomy of mapreduce job run (MRv1& MRv2), Job scheduling, shuffle & Sort, counters. **Java Interfaces for mapreduce:** Mapreduce Types and Formats, Writable Interface, Writable Comparable and comparators, Writable wrappers for Java primitives, Record Readers, Record Writers.
UNIT-III (10 Hrs)	**Map Reduce programing:** Implementation of Mapper, Reducer and Driver, mapreduce wordcount example. Matrix multiplication using mapreduce, Friends of Friends algorithm, Combiner, Partitioner. Joins: Map side join & Reduce side join.

UNIT-IV (8 Hrs)	**Stream Processing:** Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams: Blooms Filter, Counting Distinct Elements in a Stream: FM Algorithm, Estimating Moments, Counting 1's in a Window: DGIM Algorithm, Decaying Window.
UNIT-V (12 Hrs)	**Frameworks and Applications**: Hadoop Echo System, Applications on Big Data Using Pig, Pig Architecture, PigLatin, Data processing operators in Piglatin, Applications on Big Data Using Hive, Hive Architecture, HiveQL, Querying Data in Hive, fundamentals of HBase, HBase architecture and ZooKeeper.
Text Books:	
1.	Hadoop: The Definitive Guide by Tom White, 3rd Edition, O"Reilly
Reference Books:	
1.	Hadoop in Action by Chuck Lam, MANNING Publ
2.	Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown andRafael Coss
e-Resources:	
1.	Hadoop: https://hadoop.apache.org/
2.	Hive: https://cwiki.apache.org/confluence/display/Hive/Home/
3.	Piglatin: https://pig.apache.org/docs/r0.7.0/tutorial.html

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE10	**OE**	**3**	**-**	**--**	**3**	**30**	**70**	**3 Hrs.**

BIG DATA ANALYTICS

(Offered by CSE)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1.	To optimize business decisions and create competitive advantage with Big Data analytics
2.	To learn to analyse the big data using intelligent techniques
3.	To introduce programming tools PIG & HIVE in Hadoop echo system

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Illustrate big data challenges in different domains including social media, transportation, finance and medicine	K3
2.	Design and develop Hadoop	K2
3.	Identify the characteristics of datasets and compare the trivial data and big data for various applications	K2
4.	Design and develop Pig Programming and running pig scripts in different modes	K3
5.	Identify the Hive Data types and HBase storage mechanism	K2

SYLLABUS

UNIT-I (12 Hrs)	Introduction: Big data definition and types of data, Characteristics of big data, Applications of big data, data in warehouse and data in Hadoop. Different Open Source Technologies.
UNIT-II (10 Hrs)	**Hadoop**: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop, Hadoop Commands, Analysing the Data with Hadoop, Hadoop Streaming, Design of HDFS.
UNIT-III (10 Hrs)	**Map Reduce**: How Map Reduce Works, Anatomy of a Map Reduce Job run, Combiner, Failures, Shuffle and Sort, Partitioning, Parallel copying with distributed copying.
UNIT-IV (08 Hrs)	**Pig**: Hadoop Programming made easier, Architecture, Pig Latin application flow, data types and syntax, Local and distributed modes of running pig scripts, how to execute pig program.
UNIT-V (10 Hrs)	**Hive:** Architecture, Data types, Creating and managing tables with hive, Joins, Indexing, Introduction to HBASE and HBase storage mechanism, RDBMS vs HBase, HBase Commands

Text Books:

1.	Tom White, “Hadoop: The Definitive Guide”, Third Edition, O’reilly Media, Fourth Edition, 2015.
Reference Books:	
1.	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons, 2012.
2.	Paul Zikopoulos, DirkdeRoos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, “Harness the Power of Big Data:The IBM Big Data Platform”, Tata McGraw Hill Publications, 2012.
3.	Arshdeep Bahga and Vijay Madisetti, “Big Data Science & Analytics: A Hands On Approach “, VPT, 2016.
4.	Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science nd its Applications (WILEY Big Data Series)”, John Wiley & Sons, 2014.

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE11	**OE**	**3**	**-**	**--**	**3**	**30**	**70**	**3 Hrs.**

DEEP LEARNING

(Offered by CSE)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1	Understand and recollect basic concepts of machine learning
2	Understand concepts of deep feed forward network mechanisms
3	Understand and analyze the concepts of CNN, RNN models
4	Study the concepts of auto encoders and optimization techniques
5	Study and analyze the different DNN architectures

Course Outcomes: After completion of the course, the student will be able to

S. No	OUT COME	Knowledge Level
1	Demonstrate the basic concept of Machine learning	K2
2	Apply the concepts of deep feed forward networks.	K3
3	Apply the concepts of CNN & RNN models	K3
4	Explain and apply optimization techniques and auto encoders.	K3
5	Learn about different DNN models and apply that knowledge to different applications.	K3

SYLLABUS

UNIT-I (12 Hrs)	**Fundamentals Concepts of Machine Learning** **Historical Trends in Deep Learning-Machine Learning Basics**: Learning Algorithms-Supervised and Unsupervised Training, Linear Algebra for machine Learning, Testing, Cross-Validation, Dimensionality reduction, Over/Under-fitting, Hyper parameters and validation sets, Bias, Variance, Regularization
UNIT-II (10 Hrs)	**Deep Feed Forward Networks** **Deep feed forward networks**-Introduction, Various Activation Functions, error functions-Regularization for Deep learning-Early Stopping, Drop out.
UNIT-III (10 Hrs)	**Convolutional Neural Networks And Sequence Modeling Convolutional Networks**: Convolutional operation- Pooling- Normalization, **Sequence Modeling**: Recurrent Neural Networks, The Long Short-Term Memory.
UNIT-IV (08 Hrs)	**Auto Encoders and Optimization Algorithms** **Auto encoders** - Auto encoders: under complete, denoising, optimization for Deep Learning: gradient descent, stochastic gradient descent, mini batch gradient descent,

UNIT-V (10 Hrs)	**More Deep Learning Architectures & Applications** Alexnet, ResNet, Transfer learning, Sentiment Analysis using LSTM, Image Segmentation

TEXTBOOK:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016 (available at http://www.deeplearningbook.org)
2.	Charu C Agarwal, "Neural Networks and Deep Learning", IBM T. J. Watson Research Center, International Business Machines, Springer, 2018

REFERENCE BOOKS:	
1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
2.	Michael Nielsen, "Neural Networks and Deep Learning", Online book, 2016 (http://neuralnetworksanddeeplearning.com/)
3.	Li Deng, Dong Yu, "Deep Learning: Methods and Applications", Foundations and Trends in Signal Processing, 2013.
4.	Christopher and M. Bishop, "Pattern Recognition and Machine Learning", Springer Science Business Media, 2006.
5.	Jason Brownlee , "Deep Learning with Python" , ebook, 2016
6.	N. D. Lewis, "Deep Learning Step by Step with Python: A Very Gentle Introduction to Deep Neural Networks for Practical Data Science, 2016.
7.	Chris Albon, "Machine Learning with Python Cookbook-practical solutions from preprocessing to Deep learning", O'REILLY Publisher,2018
Useful Reference Links:	
1.	https://medium.com/nybles/create-your-first-image-recognition-classifier-using-cnn-keras-and-tensorflow-backend-6eaab98d14dd
2.	https://www.analyticsvidhya.com/blog/2017/08/10-advanced-deep-learning-architectures-data-scientists/
3.	https://www.geeksforgeeks.org/cross-validation-machine-learning/
4.	https://www.geeksforgeeks.org/activation-functions-neural-networks/
5.	https://towardsdatascience.com/sentiment-analysis-using-lstm-step-by-step-50d074f09948
6.	https://medium.com/@lamiae.hana/a-step-by-step-guide-on-sentiment-analysis-with-rnn-and-lstm-3a293817e314
7.	https://towardsdatascience.com/common-loss-functions-in-machine-learning-46af0ffc4d23
8.	https://d2l.ai/chapter_natural-language-processing-applications/sentiment-analysis-rnn.html

Code	Category	L	T	P	C	I.M	E.M	Exam
B20CSOE12	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

INTERNET OF THINGS

(Offered by CSE)

(Offered to CE, EEE & ME)

Course Objectives:

1.	To understand building blocks of IoT and their characteristics
2.	To Know various architectures and protocols in IoT and security issues
3.	To use cloud services for data analytics in IoT applications
4.	To develop IoT applications using Arduino and Raspberry pi

Course Outcomes:

S. No	Outcome	Knowledge Level
1.	Study various Designs of IoT and IoT architectures	K2
2	Illustrate various communication protocols in IoT	K3
3	Use of various sensors and Actuators in IoT applications and Implement IoT applications using Arduino.	K3
4	Analyse data in IoT applications.	K4
5.	Analyse various security issues IoT applications.	K4

SYLLABUS

UNIT-I (9 Hrs)	**Introduction to Internet of Things:** Definition & Characteristics of IoT, Physical design of IoT-Things in IoT, IoT protocols, Logical Design of IoT- IoT Functional Blocks, IoT Communication Models & API's, IoT levels and deployment templates. **IoT Network Architecture and Design:** Comparing IoT Architectures, A Simplified IoT Architecture.
UNIT-II (9 Hrs)	**Communication Technologies:** wired Communication Technologies, wireless Communication Technologies. **Message Communication Protocols for Connected Devices** - CoAP, XMPP, MQTT.
UNIT-III (10 Hrs)	**IOT Physical devices and Endpoints:** Basic building blocks of an IOT device. **Sensors, Participatory sensing, RFIDs:** Sensor Technology, Actuator, Radio Frequency Identification technology. **Programming with Arduino:** Features of Arduino, Components of Arduino board, Arduino IDE, Case Studies: Traffic control system, DHT Sensor with Arduino.
UNIT-IV (9 Hrs)	**Data Acquiring, Organising, Processing and Analytics:** Introduction, Data Acquiring and storage, Organising the Data, Transaction, Business Processes, Analytics, Knowledge

	Acquiring, Managing and Storing Processes.
UNIT-V (9 Hrs)	**IoT Privacy, Security and Vulnerabilities Solutions:** Vulnerabilities, Security Requirements and Threat Analysis, Identity management and establishment, Access control secure message communication. **Case studies illustrating IoT Design:** Home Automation, Environment, Agriculture
Text Books:	
1.	Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Pres 2015.
2.	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things - David Hanes, Gonzalo Salgueiro, Patrick Grossetete Robert Barton, Jerome Henry. 24750 Copyright© 2017 Cisco Systems, Inc. Published by: Cisco Press 800 East 96th Street.
Reference Books:	
1.	Internet of Things: Architecture and Design Principles by Raj Kamal, McGraw Hill Education private limited, 2017.
2.	Internet of Things, Jeeva Jose, Khanna Publishing; First edition (2018).
3.	Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, 1st edition, 2014.
4.	Getting Started with the Internet of Things Cuno Pfister, O'reilly. 2011
5.	Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O' Reilly (SPD), 2014.
e-Resources:	
1.	Introduction to Internet of Things, https://swayam.gov.in/nd1_noc20_cs66/preview
2.	An Introduction to Programming the Internet of Things(IoT) specialization, https://www.coursera.org/specializations/iot

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ECOE07	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

INTRODUCTION TO VLSI TECHNOLOGY

(Offered by ECE)

(Offered to AIDS, CE, CSBS, CSE, EEE, IT & ME)

Course Objectives:

1.	To introduce various fabrication steps of MOS transistors and their electrical properties.
2.	To implement the stick diagrams and layouts using CMOS/Bi-CMOS design rules.
3.	To explain MOS technology interconnection as circuits, scaling models, static and dynamic designs.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Analyze the Electrical properties and Fabrication processes of MOS circuits.	K3
2.	Design the layouts of various MOS circuits by applying the concept of design rules.	K4
3.	Interpret the basic MOS circuit concepts, static and dynamic CMOS logic designs	K2
4.	Interpret various scaling models and their impact on scaling of MOS circuits.	K2

SYLLABUS

UNIT-I (9 Hrs)	**Introduction**: Introduction to IC Technology, Fabrication process: NMOS, PMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Transconductance, Output Conductance and Figure of Merit. NMOS Inverter, Pull-up to Pull down Ratio for NMOS inverter driven by another NMOS Inverter, and through one or more pass transistors, Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Comparison between CMOS and Bi-CMOS technology
UNIT-II (9 Hrs)	**MOS and Bi-CMOS Circuit Design Processes**: MOS Layers, Stick Diagrams, Design Rules and Layout, General observations on the Design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Layout Diagrams of NAND and NOR gates and CMOS inverter.
UNIT-III (10 Hrs)	**Basic Circuit Concepts**: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances, Choice of layers.
UNIT-IV (9 Hrs)	**Scaling of MOS Circuits**: Scaling models, Scaling factors for device parameters, Limitations of Scaling on substrate doping, Miniaturization, Interconnect and contact Resistance, Subthreshold currents and current density

UNIT-V (9 Hrs)	**CMOS Combinational and Sequential logic circuit design:** **Static CMOS Design:** Complementary CMOS and its static properties, Ratioed logic, Pass Transistor logic- Design of logic gates. **Dynamic CMOS Design:** Basic principles, speed and power dissipation of dynamic logic, Issues in dynamic logic- charge leakage, charge sharing, Static latches and registers- Latches versus registers, The bistability principle, SR- Flip flops, Multiplexer based latch .
Text Books:	
1.	Essentials of VLSI Circuits and Systems By Kamran Eshraghian, Douglas and A. Pucknell and SholehEshraghian, Prentice-Hall of India Private Limited,2005 Edition.
2.	Digital Integrated Circuits, Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic,2nd edition, 2016
Reference Books:	
1.	FPGA Based System Design‖- Wayne Wolf, Pearson Education, 2004, Technology and Engineering
2.	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill Education,2003.
e-Resources:	
1.	https://www.engineersgarage.com/vlsi-technology-an-overview/
2.	https://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm
3.	https://www.powershow.com/viewfl/e5a26-ZDc1Z/Lecture_4_Design_Rules_Layout_and_Stick_Diagram_powerpoint_ppt_presentation

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ECOE08	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

Embedded Systems and IoT Applications

(Offered by ECE)

(Offered to CE, EEE & ME)

Course Objectives:

1.	To make students familiar with the basic concepts of embedded system architecture and Communication protocols
2.	Expose the students to the concepts of interconnections between the physical devices and cloud.
3.	Students should be educated to design & develop IoT Devices for addressing real time solutions.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Describe architecture and communication protocols of embedded systems and IoT.	K2
2	Apply the knowledge of embedded systems in understanding the concepts of IoT.	K3
3	Apply the knowledge of different protocols of IoT.	K3
4	Understand the concepts of sensors and communication technologies for communicating data over the sensor network	K2
5	Analyze data from physical devices through the cloud using data analytics.	K4

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Embedded systems** Introduction to Embedded systems, Processor embedded into a system, Embedded software in a system, Examples of embedded systems, Embedded system-on-chip (Soc) and use of VLSI circuit design technology.
UNIT-II (10 Hrs)	**Processor Architectures and Communication Devices** Real world interfacing, Introduction to advanced architectures, I/O types and examples, Serial Bus communication protocols, Parallel bus device protocols, Internet enabled systems.
UNIT-III (10 Hrs)	**Introduction to IoT& M2M** IoT definition, Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Protocols, M2M, Differences and Similarities between M2M and IOT, SDN and NFV for IoT.
UNIT-IV (10 Hrs)	**IoT Physical Devices & Endpoints** Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi and IoT devices,

	Sensors like ultrasonic, IR sensor, temperature & humidity etc., communication modules like Bluetooth, zigbee, Wi-Fi & WSN, Lora WAN 6LoWPAN
UNIT-V (10 Hrs)	**IOT Physical Servers, Cloud Offerings & Data Analytics for IOT.** Web Application Messaging Protocol (WAMP), Cloud based communication, Data Analytics, IoT Design Methodology with a use.
Textbooks:	
1.	Embedded System Architecture Programming and Design, Raj Kamal, 2nd Edition, McGraw Hill
2.	Internet of Things: A Hands-On Approach, ArshdeepBahga, Vijay Madisetti
Reference Books:	
1.	Embedded Software Primer, David Simon, Pearson
2.	Internet of Things: Principles and Paradigms by RajkumarBuyya, Amir VahidDastjerdi.
e-Resources	
1.	https://nptel.ac.in/courses/106/105/106105166/
2.	https://nptel.ac.in/courses/108/102/108102169/

Code	Category	L	T	P	C	I.M	E.M	Exam
B20EEOE05	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs**

INTRODUCTION TO SENSORS AND TRANSDUCERS

(Offered by EEE)

(Offered to AIDS, CE, CSBS, CSE, ECE, IT & ME)

Course Objectives: Students will learn

1.	The basic principles of Sensors & Transducers, classification and their characteristics
2.	About the concepts of Electromechanical and Radiation Sensors
3.	About the basics of thermal sensors
4.	About the basics of Magnetic sensors
5.	The Recent Trends in Sensor Technologies and their applications

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Apply the principles to understand the characteristics & classification of Sensors and Transducers	K3
2.	Explore the concepts and construction of Electromechanical and Radiation Sensors	K3
3.	Explore the concepts and construction of Thermal sensors	K3
4.	Explore the concepts and construction of Magnetic sensors	K3
5.	Illustrate the Recent Trends in Sensor Technologies and applications	K3

SYLLABUS

UNIT-I (10Hrs)	**INTRODUCTION TO SENSORS/TRANSDUCERS** Sensors/Transducers, Principles, Classification, Parameters (Characteristics), Environmental Parameters, Electrical, Mechanical and Thermal Characterizations.
UNIT-II (10 Hrs)	**ELECTROMECHANICAL AND RADIATION SENSORS** Introduction, Inductive Sensors- Sensitivity and Linearity of the Sensor, Ferromagnetic Plunger Type Transducers, Capacitive Sensors- The Parallel Plate Capacitive Sensor, Ultrasonic Sensors. Basic Characteristics of radiation sensors, Types of Photosensistors /Photodetectors, Photoconductive Cell-The LDR.
UNIT-III (10 Hrs)	**THERMAL SENSORS** Introduction-Gas Thermometric Sensors, Acoustic Temperature Sensor, Thermal Radiation Sensors-Detectors, Spectroscopic Thermometry, Noise Thermometry, Heat Flux Sensors.
UNIT-IV (10 Hrs)	**MAGNETIC SENSORS** Introduction - Hall Effect and Sensors, Inductance and Eddy Current Sensors- Variable Inductance Sensors- Variable gap sensor, Angular/Rotary Movement Transducers-

	Synchro's, Electromagnetic Flowmeter, Switching Magnetic Sensors- Pulse Wire Sensor.
UNIT-V (10 Hrs)	**RECENT TRENDS IN SENSOR TECHNOLOGIES & APPLICATIONS** Introduction- Film Sensors-Thick Film Sensors-Thin Film Sensors, Semiconductor IC Technology-Standard Methods. Home Appliance Sensors, Aerospace Sensors, Medical Diagnostic Sensors, Sensors for Environmental Monitoring.
Textbooks:	
1.	SENSORS AND TRANSDUCERS Second Edition by D. Patranabis © 2003 by PHI Learning Private Limited, Delhi. ISBN-978-81-203-2198-4
2.	Sawhney A.K., "A Course in Electrical & Electronic Measurement and Instrumentation," Dhanpat Rai & Company Private Limited, New Delhi, 18th Edition, 2007.
Reference Books:	
1.	SENSORS AND TRANSDUCERS Third Edition by I. Sinclair 2011, by Newes Publications, Delhi. ISBN: 0756049321
2.	Measurement Systems: Application & Design, E.A. Doebelin, Mc Graw Hill

Code	Category	L	T	P	C	I.M	E.M	Exam
B20ITOE06	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

MOBILE COMPUTING

(Offered by IT)

(Offered to CE, ECE, EEE & ME)

Course Objectives:

1.	To understand the fundamentals of mobile communication.
2.	To understand the architecture of various Wireless Communication Networks.
3.	To understand the significance of different layers in mobile system Course Contents.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Develop a strong grounding in the fundamentals of mobile Networks	K3
2.	Apply knowledge in MAC, Network, and Transport Layer protocols of Wireless Network	K3
3.	Familiarize with Ad hoc Networks, IEEE 802.11 WLAN standards and different protocols	K2
4.	Analyse the Mobile Network Layer system working	K3
5.	Familiarize with WAP Model	K2

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Wireless Networks:** Applications, History, Simplified Reference Model, Wireless transmission, Frequencies, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular Systems: Frequency Management and Channel Assignment, types of hand-off and their characteristics.
UNIT-II (10 Hrs)	**MAC** – Motivation, SDMA, FDMA, TDMA, CDMA, Telecommunication Systems, GSM: Architecture Location tracking and call setup, Mobility management, Handover, Security, GSM, SMS, International roaming for GSM, call recording functions, subscriber and service data management, DECT, TETRA, UMTS, IMT-2000.
UNIT-III (10 Hrs)	**Wireless LAN:** Infrared vs. Radio transmission, Infrastructure, Adhoc Network, IEEE 802.11WLAN Standards, Architecture, Services, HIPERLAN, Bluetooth Architecture & protocols.
UNIT-IV (10 Hrs)	**Mobile Network Layer:** Mobile IP, Dynamic Host Configuration Protocol, Mobile Transport Layer, Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/Fast recovery, Transmission/Time-out freezing, Selective retransmission, Transaction Oriented TCP.

UNIT-V (10 Hrs)	**Support for Mobility:** Wireless Application Protocol: Architecture, Wireless Datagram Protocol, Wireless Transport Layer Security, Wireless Transaction Protocol, Wireless Session Protocol, Wireless Application Environment, Wireless Markup Language, WML Scripts, Wireless Telephone Application.

Textbooks:	
1.	Jochen Schiller, "Mobile Communication", Second Edition, Pearson Education, 2008.
2.	Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
Reference Books:	
1.	William Stallings, "Wireless Communications and Networks", Second Edition, Pearson Education, 2004.
2.	C. Siva Ram Murthy, B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Second Edition, Pearson Education, 2008.
e-Resources	
1.	https://nptel.ac.in/courses/106/106/106106147/#
2.	https://www.tutorialspoint.com/android/index.htm

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE10	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

PROJECT MANAGEMENT

(Offered by ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	To make the students understand the importance and necessity of Project Management.
2.	To develop the ability to apply various project planning and scheduling tools and deal with various risks in projects.
3.	To develop the ability to manage various aspects of projects including emotional stress in employees.

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Understand the fundamentals and importance of project management in the context of present-day complex business setting.	K2
2.	Apply various tools and techniques for planning and scheduling the projects like Gantt chart, PERT, and CPM networks.	K3
3.	Understand various techniques to assess and mitigate the risks in project management	K2
4.	Understand the ways of evaluating a project, reporting to the management, and the process of terminating a project.	K2
5.	Understand the role and responsibilities of a project manager, importance of team management, and way to manage the stress.	K2

SYLLABUS

UNIT-I (10 Hrs)	**Overview of Project Management:** Characteristics of projects, Need and Objectives of project management, Project management: the person, the team, the system; The evolution of project management, The Project Life Cycle, Stages and different forms of Project Management.
UNIT-II (10 Hrs)	**Project Planning and Scheduling:** Work breakdown structure, Gantt charts, Network diagrams – activity on node (AON) diagrams, CPM and PERT (Basic Problems)
UNIT-III (10 Hrs)	**Project Risk Management:** Risk concepts, Risk identification: Sources of risks and identification techniques, Risk Assessment, Risk response planning, Principles of risk management.
UNIT-IV (10 Hrs)	**Project Evaluation, Communication, and Termination:** Project formative evaluation and summary evaluation; Project communication management – meetings and reports; Types of

	termination and closeout responsibilities.
UNIT-V (10 Hrs)	**Roles, Authority, and Teams in Project Management:** Project manager's role and responsibility, Authority in project management, Teams in project management and team building approach, Emotional stress and stress management.
Text Books:	
1.	John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall of India, 2002.
2.	Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, PH Inc.
Reference Books:	
1.	S. Choudhury, Project Scheduling and Monitoring in Practice.
2.	P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.
3.	Larson, E.W. and Gray, C.F. (2018), Project management the managerial process, Seventh Edition, McGraw-Hill
4.	Jerome D. Wiest and Ferdiannd K. Levy, A management guide to PERT/CPM, PHI.
e-Resources:	
1.	https://nptel.ac.in/courses/110104073

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE11	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

NANO TECHNOLOGY

(Offered by ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	This course introduces to the fundamentals of nano-scale engineering and manufacturing
2.	This course gives a detailed understanding of various application of nano technology.
3.	Well-established and novel synthesis/fabrication methods nanostructures will be discussed giving a broad overview of nano manufacturing processes.
4.	Standard characterization methods will be elucidated using various examples

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	**Understand** the fundamental principles of nanotechnology and **illustrate** the crystal structures.	K3
2.	**Illustrate** various properties of nano materials.	K3
3.	**Demonstrate** a comprehensive understanding of nano-fabrication methods.	K3
4.	**Practice** state-of-the-art characterization methods for nanomaterials	K3
5.	**Demonstrate** the various aspects of carbon nano tubes and various fields of applications of nano materials.	K3

SYLLABUS

UNIT-I (8Hrs)	**Introduction:** History of nano science, definition of nano meter, nano materials, nano technology. Classification of nano materials. Bragg's equation, Crystal symmetries, crystal directions, crystal planes. Band structure.
UNIT-II (10Hrs)	**Properties of nano materials:** Mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto electronic properties. Effect of size reduction on properties, electronic structure of nano materials.
UNIT-III (12Hrs)	**Synthesis and Fabrication:** Synthesis of bulk polycrystalline samples, growth of single crystals. Synthesis techniques for preparation of nano particle **Bottom-Up Approach** – sol gel synthesis, hydrothermal growth, thin film growth, PVD and CVD; **Top Down Approach** – Ball milling, micro fabrication, lithography. Requirements for realizing semiconductor nano structures, growth techniques for nano structures.
UNIT-IV (12Hrs)	**Imaging/characterization:** Practice state-of-the-art characterization methods for nanomaterials, understanding and critiquing nanomaterial safety and handling methods required during characterization, Imaging/characterization of nanostructures General

	considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM, piezo response microscopy, X-ray photoelectron spectroscopy, XANES and XAFS, angle resolved photoemission spectroscopy, diffuse reflectance spectra, photoluminescence spectra, Raman spectroscopy.
UNIT-V (8Hrs)	**Carbon Nano Technology**: Characterization of carbon allotropes, synthesis of diamond – nucleation of diamond, growth and morphology. Applications of nano crystalling diamond films, grapheme, applications of carbon nano tubes. **Applications of Nano Technology:** Applications in material science, bioengineering, biology and medicine, surface science, sensors, energy, and environment. Applications of nano structured thin fins, applications of quantum dots.
Textbooks:	
1.	Nano science and nano technology by M.S Ramachandra Rao, Shubra Singh, Wiley publishers.
2.	Scanning Electron Microscopy and X-Ray Microanalysis by Joseph Goldstein Lyman, Dale E. Newbury, David C. Joy, Patrick Echlin, Springer.
Reference Books:	
1.	Introduction to Nano Technology by Charles P. Poole, Jr., Frank J.Owens, Wiley publishers.
2	Nanotechnology by Jermy J Ramsden, Elsevier publishers
3	Nano Materials- A.K.Bandyopadhyay/ New Age Introdu.
4	Nano Essentials- T.Pradeep/TMH.
5	Nanotechnology the Science of Small by M.A Shah, K.A Shah, Wiley Publishers.
6	Principles of Nanotechnology by Phani Kumar, Scitech.
e-Resources:	
1.	https://nptel.ac.in/courses/118102003
2.	https://nptel.ac.in/courses/113106093

Code	Category	L	T	P	C	I.M	E.M	Exam
B20MEOE12	**OE**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

ADDITIVE MANUFACTURING

(Offered by ME)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE & IT)

Course Objectives:

1.	The course is designed to develop fundamental knowledge on Additive Manufacturing
2.	Study the Liquid based, solid based, and powder based rapid prototyping techniques
3.	Learn tools used for Additive Manufacturing

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1.	Understand the working principles and process parameters of additive manufacturing processes	**K2**
2.	Illustrate various liquid and solid based additive manufacturing processes	**K3**
3.	Illustrate various powder based additive manufacturing process and post processing Treatment	**K3**
4.	Develop the CAD models for rapid prototyping	**K3**
5.	Use the tools for AM Production	**K3**

SYLLABUS

UNIT-I (10Hrs)	**Introduction to AM:** Principle of AM, AM evolution, Generic AM process, classification, Benefits of AM, Distinction Between AM and CNC Machining, Generalized Additive Manufacturing Process Chain (Eight Steps) **Design for AM :** Preparation of CAD Models – STL File, STL File Format, STL Files from a CAD System, Software for Slicing**,** Part Orientation, Support Structure
UNIT-II (10 Hrs)	**Additive Manufacturing Processes:** **Liquid Based AM:** Stereolithography (SL) – Apparatus, Working Principle, Process Modeling, Process Parameter, advantages, limitations & Applications. **Solid Based AM:** Fused Deposition Modelling (FDM), Laminated object Manufacturing (LOM), Ultrasonic AM- Working Principle, materials, Processes modeling, products, advantages, limitations, and applications
UNIT-III (10 Hrs)	**Powder-Based AM:** Selective Laser Sintering, Direct Metal Laser Sintering, Electron Beam Melting - Working Principle, Processes Modeling, materials, products, advantages, applications, and limitations. **Post Processing Treatment in AM**: Support Material Removal, Improve - surface quality, Dimesnional Deviations, Property Enhancements using Non-thermal and Thermal Techniques

UNIT-IV (10 Hrs)	**Reverse Engineering:** Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements. **Materials for AM:** Polymers, Thermoplastics and Thermosetting Polymers, Metals, Ceramics and Composites
UNIT-V (10 Hrs)	**Rapid Tooling:** Introduction, Conventional v/s RT, Classification – Direct and Indirect, Differentiate, Direct Methods -Laminated Tooling, DMLS, Indirect Methods- RTV Tools,3D Keltool, Applications **Application Areas for AM**: Automotive, Aerospace, Medical Modeling, Reverse Engineering Data, Architectural Modeling,
Textbooks:	
1.	Additive Manufacturing Technologies, Gibson, Ian, David W. Rosen, Brent Stucker, and Mahyar Khorasani, Springer, 2021
2.	Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003.
Reference Books:	
1.	Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003.
2.	Rapid Prototyping and Engineering applications: A tool box for prototype development, LiouW.Liou, Frank W.Liou, CRC Press, 2007.
3.	Rapid Prototyping: Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
4.	Paul F.Jacobs – "Stereo lithography and other RP & M Technologies", SME, NY 2011
5.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.
6.	Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.
e-Resources:	
1.	https://courses.gen3d.com/courses/enrolled/988400
2.	https://all3dp.com/1/design-for-additive-manufacturing-dfam-simply-explained/#where-to-learn-dfam
3	https://markforged.com/resources/blog/design-for-additive-manufacturing-dfam

Code	Category	L	T	P	C	I.M	E.M	Exam
B20BSOE04	**OE**	**3**	**-**	**--**	**3**	**30**	**70**	**3 Hrs.**

FUZZY SETS AND FUZZY LOGIC

(Offered by- EM&H)

(Offered to AIDS, CE, CSBS, CSE, ECE, EEE, IT & ME)

Course Objectives:

1	Crisp sets, Fuzzy sets and Fuzzy Union, Fuzzy Intersection of Fuzzy sets
2	Lamda cut for fuzzy relations, Fuzzy tolerance and equivalence relations
3	Fuzzification for features of membership
4	Defuzzification to scalars by Centroid method, center of sums method, mean and maxima method.
5	Fuzzy logic, Crisp connectives, Fuzzy logic connectivity
6	Applications of Fuzzy systems like washing machine, air conditioner controller

Course Outcomes: After completion of the course, the student will be able to

S.No	Outcome	Knowledge Level
1	Describe Crispsets, Fuzzy sets and operations of Fuzzy sets	K3
2	Describe different types of Fuzzy relations	K3
3	Describe Fuzzification for features of membership	K3
4	Perform Defuzzification to scalars by Centroid method, centre of sums method and mean and maxima method.	K3
5	Describe Fuzzy logic, Crisp connectives, Fuzzy logical connectivity	K3
6	Apply Fuzzy logic to systems like washing machine, air conditioner controller.	K3

SYLLABUS

UNIT-I (10Hrs)	**Crisp Sets Vs Fuzzy Sets:** Crisp sets an overview, Concept of fuzziness, the notion of Fuzzy sets, basic concepts of fuzzy sets. **Operations of Fuzzy Sets: Fuzzy** set operations –fuzzy complement, fuzzy union, fuzzy intersection, combinations of operations.
UNIT-II (10Hrs)	**Fuzzy Relations:** Fuzzy Cartesian product, Fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, Lamda cut for fuzzy relations and composition, Fuzzy tolerance, and equivalence relations.
UNIT-III (10Hrs)	**Fuzzification and Defuzzification:** Features of membership function, fuzzification, defuzzification to crispset, Defuzzification to scalars (centroid method, centre of sums method, mean of maxima method).
UNIT-IV (10Hrs)	**FuzzyLogic:** Introduction to fuzzy logic, Crisp connectives vs Fuzzy, Approximate reasoning.

UNIT-V (10Hrs)	**Applications of Fuzzy Systems:** Fuzzy Control System, Control System Design Problem, Simple Fuzzy Logic Controller, general applications of fuzzy logic (washing machine, air conditioner controller).
Text Books:	
1.	Timothy J.Ross., Fuzzy Logic with Engineering Applications -Second Edition, Wiley Publications,2007,NewDelhi.
2.	S.Rajasekaran, G.A.Vijayalakshmi Pai, Neural networks, Fuzzy logic,and genetic algorithms - synthesis and applications-–Prentice-Hall of India private limited, 2008, NewDelhi.
Reference Books:	
1.	H.J.Zimmerman, Fuzzyset theory and its applications,4thedition,Springer, 2006.NewDelhi.
2	S.Nanda and N.R.Das “Fuzzy Mathematical concepts, Narosa Publishing House, NewDelhi.