M.TECH. (FULL TIME)
INTERNET OF THINGS
CURRICULUM AND SYLLABUS

2017 – 2018

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING AND TECHNOLOGY
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203
## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
### M.Tech – INTERNET OF THINGS
### CURRICULUM – 2017-18

<table>
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<tr>
<th>COURSE CODE</th>
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Total credits to be earned for the award of M.Tech degree – 74 credits
## PROGRAM ELECTIVES

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## SUPPORTIVE COURSES

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Legend:
L - Number of lecture hours per week  
T - Number of tutorial hours per week  
P - Number of practical hours per week  
C - Number of credits for the course
# SEMESTER I

## CS2034 WIRELESS SENSOR PROTOCOLS AND PROGRAMMING

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### PURPOSE

This course provides a broad coverage of challenges and research issues to the design and management of wireless sensor networks.

### INSTRUCTIONAL OBJECTIVES

1. Understand basic sensor network concepts
2. Know physical layer issues, understand and analyze Medium Access Control Protocols
3. Comprehend network and transport layer characteristics and protocols and implement conventional protocols
4. Understand the network management and Middleware services

### UNIT I – FUNDAMENTALS OF SENSOR NETWORKS 15 hours

Introduction to computer and wireless sensor networks and Overview of the syllabus. Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem-communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

### UNIT II- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS 15 hours


### UNIT III- MAC LAYER 15 hours


### UNIT IV- ROUTING IN WIRELESS SENSOR NETWORKS 15 hours

Design Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN - Flooding-Flat Based Routing – SAR, Directed Diffusion, Hierarchical Routing- LEACH, PEGASIS - Query Based Routing- Negotiation Based Routing-
Geographical Based Routing- Transport layer- Transport protocol Design issues-
Performance of Transport Control Protocols. Case study- Implementation and analysis
of Routing protocol or transport layer protocol in Tiny OS

UNIT V - MIDDLEWARE AND SECURITY ISSUES  15 Hours
WSN middleware principles-Middleware architecture-Existing middleware - operating
systems for wireless sensor networks-performance and traffic management -
Fundamentals of network security-challenges and attacks - Protocols and mechanisms
for security. Case study- Handling attacks in Tiny OS

REFERENCES

Networks, Theory and Practice”, Wiley Series on wireless Communication and
Mobile Computing, 2011
University Press, 2005
This course gives an overview of Computer Networks and different aspects of network management and tools.

**INSTRUCTIONAL OBJECTIVES**

1. To study the different kinds of network.
2. Effects of congestion and congestion control in networks
3. Learn the different approaches to support the provision of Quality of service
4. To study about SNMP application and network management tools.

**UNIT I - COMPUTER NETWORKS AND INTERNET**  
12 hours

Internet - The network edge- The network core- Delay , Loss and Throughput in packet switched networks- protocol layers and their service models- TCP/IP protocol architecture- Frame relay networks- ATM networks- protocol architecture- ATM logical connections- ATM cell.

**UNIT II - CONGESTION CONTROL IN DATA NETWORKS AND INTERNET**  
12 hours


**UNIT III - QUALITY OF SERVICE IN IP NETWORKS**  
12 hours

Integrated services architecture - Queuing discipline - Random early detection - Differentiated service - Resource reservation - RSVP- multiprotocol label switching- Real time transport protocol.

**UNIT IV - NETWORK MANAGEMENT**  
12 hours


**UNIT V - NETWORK MANAGEMENT TOOLS, SYSTEMS AND ENGINEERING**  
12 hours

REFERENCES

The purpose of this course is to impart the concepts and architecture of Embedded systems and to make the students capable of designing Embedded systems.

INSTRUCTIONAL OBJECTIVES

1. To understand the Embedded concepts and Embedded system Architecture
2. To learn the architecture and programming of ARM Cortex Microcontroller
3. To select a proper Microcontroller for an application
4. To understand the usage of the development and debugging tools
5. To learn and apply the knowledge of Memory systems and Peripherals

UNIT I – INTRODUCTION TO EMBEDDED CONCEPTS 12 hours
Introduction to embedded systems, Application Areas, Categories of embedded systems, Overview of embedded system architecture, Specialties of embedded systems, recent trends in embedded systems, Architecture of embedded systems, Hardware architecture, Software architecture, Application Software, Communication Software.

UNIT II – OVERVIEW OF ARM AND CORTEX-M3 12 hours

UNIT III – CORTEX EXCEPTION HANDLING AND INTERRUPTS 12 hours
UNIT IV – CORTEX-M3/M4 PROGRAMMING  

UNIT V – CORTEX-M3/M4 DEVELOPMENT AND DEBUGGING TOOLS  12 hours
STM32L15xxx ARM Cortex M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control. STM32L15xxx Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART. Development and Debugging Tools: Software and Hardware tools like Cross Assembler, Compiler, Debugger, Simulator, In-Circuit Emulator (ICE), Logic Analyzer etc.

REFERENCES

### ELECTIVE - I

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Students to choose one Elective course from the list of courses mentioned in the curriculum.

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Students to choose one Elective course from the list of courses mentioned in the curriculum.

### SUPPORTIVE COURSE

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Students to choose one course from the list of supportive courses mentioned in the curriculum either in I, II or III semester.

### INTER DISCIPLINARY ELECTIVE

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Students to choose one Elective course from the list of Post Graduate courses specified under the Faculty of Engineering and Technology other than courses under M.Tech (CSE), M.Tech (IOT), M.Tech (SDN), M.Tech(Mobile and Pervasive Computing) curriculum either in I, II or III semester.
SEMESTER II

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PURPOSE
The purpose of this course is to provide understanding of the techniques essential to the design and implementation of device drivers and kernel internals of embedded operating systems.

INSTRUCTIONAL OBJECTIVES
1. To understand the aspects of Real Time Embedded concepts
2. To learn the Essentials of Open Source RTOS and their usage
3. To select the proper technique to design a Real-Time System
4. To understand VxWorks RTOS and real time application programming with it
5. To build the device driver and kernel internal for Embedded OS and RTOS earn and apply the knowledge of Memory systems

UNIT I - EMBEDDED OS INTERNALS
12 hours

UNIT II - OPEN SOURCE RTOS
12 hours

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

UNIT IV – VXWORKS / FREE RTOS 12 hours

UNIT V – CASE STUDY 12 hours
Software Development and Tools: Simulators, debuggers, cross compilers, in circuit emulators for the microcontrollers. Interface Issues Related to Embedded Systems: A/D, D/A converters, FPGA, ASIC, diagnostic port. Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board ().Testing a real-time application on the board.

REFERENCES

8. David E. Simon, “.Embedded Software Primer”: Addison-Wesley Professional , 2000
The purpose of this course is to impart knowledge on IoT Architecture and various protocols, study their implementations.

INSTRUCTIONAL OBJECTIVES

1. To Understand the Architectural Overview of IoT
2. To Understand the IoT Reference Architecture and Real World Design Constraints
3. To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

UNIT I – OVERVIEW

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

UNIT II – REFERENCE ARCHITECTURE


UNIT III – IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP

UNIT IV – TRANSPORT & SESSION LAYER PROTOCOLS

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

UNIT V – SERVICE LAYER PROTOCOLS & SECURITY

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer
REFERENCES

2. Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
CS2045 CLOUD ARCHITECTURE AND COMPUTING

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Total Contact Hours - 75

Prerequisite
Nil

PURPOSE To learn the advanced software engineering principles and methodologies for effective Software tools and development

INSTRUCTIONAL OBJECTIVES

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

UNIT I – CLOUD ARCHITECTURE BASICS 15 hours
The Cloud -Hype cycle-metaphorical interpretation-cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, role of virtualization in enabling the cloud.

UNIT II – END TO END DESIGN 15 hours
Requirement analysis: strategic alignment and architecture development cycle-strategic impact-Risk impact-financial impact-Business criteria-technical criteria-cloud opportunities –evaluation criteria and weight-End to end design-content delivery networks-capacity planning-security architecture and design

UNIT III – CLOUD APPLICATION ARCHITECTURES 15 hours
Development environments for service development; Amazon, Azure, Google App-cloud platform in industry

UNIT IV – HOW TO MOVE APPLICATION INTO THE CLOUD 15 hours
Web Application Design- Machine Image Design-privacy design –Database management

UNIT V – SPECIALIZED CLOUD ARCHITECTURE 15 hours
Workload distribution architecture-Dynamic scalability-Cloud bursting-hypervisor clustering-service quality metrics & SLA.
REFERENCES


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PURPOSE To train the students in preparing and presenting technical topics.

INSTRUCTIONAL OBJECTIVE

The student shall be capable of identifying topics of interest related to the program of study and prepare and make presentation before an enlightened audience.

The students are expected to give at least two presentations on their topics of interest which will be assessed by a committee constituted for this purpose. This course is mandatory and a student has to pass the course to become eligible for the award of degree. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations.
M.Tech projects should be socially relevant and research oriented ones. Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. The method of assessment for both Phase I and Phase II is shown in the following table:

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Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.
PROGRAMME ELECTIVES

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<th>CS2151</th>
<th>COOPERATIVE COMMUNICATION SYSTEMS</th>
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**PURPOSE**

The purpose of this course is to impart knowledge on the communication in Cooperative networking

**INSTRUCTIONAL OBJECTIVES**

1. To be familiar with the concepts of Cooperative communication in networking
2. To learn the various modes of Cooperative communication in different networking scenarios
3. To study different cooperative routing methodologies
4. To provide an insight on the relaying techniques in Cooperative networking
5. To enhance the knowledge of communication quality in cooperative cross layered networks

**UNIT I - AN OVERVIEW ON COOPERATIVE COMMUNICATIONS**

9 hours


**UNIT II - MODES OF COOPERATIVE COMMUNICATIONS**

9 hours

Cooperation protocols- Hierarchical cooperation- Cooperative communications with single relay- Multi-node cooperative communications- Relay selection: when to cooperate and with whom

**UNIT III - COOPERATIVE NETWORKING**

9 hours

Cognitive multiple access via cooperation- Content-aware cooperative multiple access- Distributed cooperative routing- Broadband cooperative communications

**UNIT IV - COOPERATION RELAYING**

9 hours

Resource Allocation in Pair-Wise Cooperative OFDM - Cooperative OFDM Systems with Multiple Relays- Cooperation with Slotted ALOHA- Cooperation with CSMA/CA- Throughput Optimal Scheduling Protocols for Cooperative Networks
UNIT V- CROSS-LAYER ISSUES IN COOPERATIVE NETWORKS

9 hours

QoS in Cooperative Networks- Routing in Cooperative Networks- Security Issues in Cooperative Networks - Network lifetime maximization via cooperation

REFERENCES

UNIT I - BIG DATA PLATFORMS FOR THE INTERNET OF THINGS  
9 hours

Big Data Platforms for the Internet of Things: network protocol- data dissemination – current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements coming from different Smart City applications

UNIT II - RFID FALSE AUTHENTICATIONS  
9 hours


UNIT III - FOG COMPUTING  
9 hours

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies – role of metadata

UNIT IV - WEB ENHANCED BUILDING  
9 hours

UNIT V - SUSTAINABILITY DATA AND ANALYTICS  9 hours
Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments : lightweight Cyber Physical Social Systems - citizen actuation

REFERENCES

UNIT I – INTRODUCTION: SECURING THE INTERNET OF THINGS


UNIT II- CRYPTOGRAPHIC FUNDAMENTALS FOR IOT

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

UNIT III- IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT

Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control

UNIT IV- PRIVACY PRESERVATION AND TRUST MODELS FOR IOT

Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access.

UNIT V - CLOUD SECURITY FOR IOT

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud
IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

REFERENCES

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. Securing the Internet of Things Elsevier
INTERNET OF THINGS: SENSING AND ACTUATOR DEVICES

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Prerequisite
Nil

PURPOSE
The purpose of this course is to impart knowledge on Internet of Things (IoT), which relates to the study of sensors, actuators, and controllers, among other Things, IoT applications and examples overview (building automation, transportation, healthcare, industry, etc.) with a focus on wearable electronics.

INSTRUCTIONAL OBJECTIVES

1. Understanding of IoT value chain structure (device, data cloud), application areas and technologies involved
2. Understand IoT sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
3. Market forecast for IoT devices with a focus on sensors
4. Explore and learn about Internet of Things with the help of preparing projects designed for Raspberry Pi

UNIT I – INTRODUCTION
Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device

UNIT II - SEVEN GENERATIONS OF IOT SENSORS TO APPEAR

UNIT III - TECHNOLOGICAL ANALYSIS

UNIT IV - IOT DEVELOPMENT EXAMPLES
ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics

UNIT V - PREPARING IOT PROJECTS
Creating the sensor project - Preparing Raspberry Pi - Clayster libraries - Hardware- Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data - Creating the actuator project - Hardware - Interfacing the hardware - Creating a controller - Representing sensor values - Parsing sensor data - Calculating control states - Creating a camera - Hardware - Accessing the serial port on Raspberry Pi - Interfacing the hardware - Creating persistent default settings - Adding configurable properties - Persisting the settings - Working with the current settings - Initializing the camera

REFERENCES
3. Editors Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market
PURPOSE: This course provides the cutting edge technologies using IOT

INSTRUCTIONAL OBJECTIVES:

1. Describe the various technologies used in telecommunications
2. Explain the application of technologies, architectures, and protocols used in the telecommunications industry.

UNIT I – INTRODUCTION TO TELECOMMUNICATIONS AND TRANSMISSION
9 hours

UNIT II - INTRODUCTION TO THE INTERNET AND IP TELEPHONY
9 hours

UNIT III - FIBRE OPTIC NETWORKS, WIRED AND WIRELESS BROADBAND
9 hours
Optical Networking Elements : Switches, Edge, Core - DSL - Cable TV Networks,Packet Cable- Fiber Solutions- Wireless Broadband- HANs PANs, CANs, MANs- Broadband PLT - Antennas- Wireless Bandwidth - Spectrum Utilization-Spread Spectrum

UNIT IV - CELLULAR SERVICES AND STANDARDS
9 hours
UNIT V - WIRELESS NETWORK ARCHITECTURE, WIRELESS AND MOBILITY

9 hours

BFWA- WLANs -IEEE 802.11a,b,g,n - IEEE 802.16, WiMax, WiBro and Mobile-Fi - VoWLAN - Integration of WLANs and Cellular Networks, RFIDMesh Networks - Mobile IP, IP Multimedia Subsystem - Applications, Mobile Video, Mobile TV, and Content

REFERENCES

This course helps to learn RFID's basic technology and 8051 microcontrollers for designing general purpose applications.

UNIT I - BAR CODES AND RFID
Bar codes and RFID basics- Components of an RFID system- Data -Tags-Antennas- Connectors- Cables- Readers- encoder/ printers for smart labels- Controllers- software- RFID advantages over Bar codes.

UNIT II – MICROCONTROLLERS
Intel 8051 - architecture- memory organization- special function registers- timing and control- port operation- memory interfacing - I/O interfacing- Programming the 8051 resources- interrupts- Measurement of frequency, period and pulse width of a signal- power down operation.

UNIT III - INTEL 8051 MICROCONTROLLER- INSTRUCTION SET AND PROGRAMMING
Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions.- 8051 Interfacing and applications.

UNIT IV - RFID APPLICATIONS
Short range RFID applications- access control - personal identification - Transportation ticketing- blood , tissue and organ identification- fleet management-personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping- Clothing Tags.

UNIT V - CASE STUDIES
Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment- smart shipping containers-fleet monitoring and management.
REFERENCES

5. www.circuitstoday.com/interfacing-rfid-module-to-8051
This course gives an overview of Fog Computing and its architecture, challenges and applications in different context.

**INSTRUCTIONAL OBJECTIVES**

1. Become familiar with the concepts of Fog
2. Understand the architecture and its components and working of components and its performance
3. Explore Fog on security, multimedia and smart data
4. Model the fog computing scenario

**UNIT I - INTRODUCTION TO FOG COMPUTING**


**UNIT II - ARCHITECTURE**


**UNIT III - FOG PROTOCOLS**

Fog Protocol - Fog Kit - Proximity Detection Protocols - DDS/RTPS computing protocols -

**UNIT IV - MANAGEMENT OF DATA AND SECURITY ANALYSIS**


**UNIT V - CASE STUDY**

Case Study: Wind Farm - Smart Traffic Light System, Wearable Sensing Devices, Wearable Event Device, Wearable System, Demonstrations, Post Application Example, Event Applications Example

**REFERENCES**

2. Fog Computing: Helping the Internet of Things Realize its Potential  
Amir VahidDastjerdi and RajkumarBuyya, University of Melbourne


10. Security and Privacy Issues of Fog Computing: A Survey, Shanhe Yi, Zhengrui Qin, and Qun Li

11. IEEE INTERNET OF THINGS JOURNAL, VOL. XX, NO. X, JUNE 2017 1 LoDPD: A Location Difference-based Proximity Detection Protocol for Fog Computing Yan Huo*, Member, IEEE, Chunqiang Hu†, ‡, Member, IEEE, Xiaowei Qi*, Tao Jing*

CS2156
WEARABLE COMPUTING, MIXED REALITY AND INTERNET OF EVERYTHING

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Total Contact Hours - 45

Prerequisite

Nil

PURPOSE
This course introduces programming techniques for various day to day devices

INSTRUCTIONAL OBJECTIVES
1. Understand advanced and emerging technologies
2. Obtain skills to do advanced research and programming
3. Learn how to use software programs to perform varying and complex tasks
4. Expand upon the knowledge learned and apply it to solve real world problems

UNIT I - INTRODUCTION
9 hours

UNIT II - SOFTWARE HARDWARE FRAMEWORKS
11 hours
Software: openFrameworks as our IDE (C/C++) - “Arduino” Language (C/C++) - Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem? Representing “reality” with computers. Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) - Digital to Analog Conversion (DAC) - Microcontrollers - Communication – Serial & Parallel - Hardware to Hardware Communication - I2C/IIC (Inter-Integrated Circuit) - SPI (Serial Peripheral Interface) – Serial UART Communication

UNIT III - CYBERNETICS AND HUMANISTIC INTELLIGENCE
11 hours
Wearables - Augmented Reality – Mixed Reality. Case studies, Oculus Rift (2012, 2013), AR versus VR - IoT and Wearables: Smart Cities and Wearable Computing as a form of urban design - Advanced I/O - openFrameworks: Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, SQLite, XML, PHP/Web) - Arduino: Wired/Wireless Networking (hardware vs. USB proxy) - Software serial (RS-232) talking to other devices - Advanced sensor/device communication SPI - Advance IC interfacing / Bitbanging (bitwise operators) - Linux – GPIO
UNIT IV - THE WORLD OF THE FUTURE – INTERNET OF EVERYTHING

8 hours

Humanistic Intelligence, Mann 1998. Wearable Computing and IoT (Internet of Things) The scalespace theory; sur/sousveillance; integrity; VeillanceContract; Humanistic Intelligence; MedialityAxis? Overview of Mobile and Wearable Computing, Augmented Reality, and Internet of Things. The fundamental axes of the Wearables + IoT + AR space - Free-roaming AR: Wearable Computing, Wireless, Sensing, and Metasensing with light bulbs Phenomenal Augmented Reality: Real world physical phenomena as the fundamental basis of mobile and wearable AR.

UNIT V - FUTURE AND PERSPECTIVES

6 hours

Internet of Everything – The Future and perspectives - Challenges

REFERENCES

2. Intel Galileo and Intel Galileo Gen 2 API Features and Arduino Projects for Linux Programmers, Ramon, Manoel 2014 (Open Access)
CS2157 PROGRAMMING AND INTERFACING WITH MICROCONTROLLERS

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Total Contact Hours - 45

Prerequisite
Nil

PURPOSE
This course introduces to programming techniques for various microcontrollers like Arduino, Raspberry Pi and other ARM devices.

INSTRUCTIONAL OBJECTIVES
1. Understand advanced and emerging networking technologies
2. Obtain skills to do advanced networking research and programming
3. Learn how to use software programs to perform varying and complex networking tasks
4. Expand upon the knowledge learned and apply it to solve real world problems

UNIT I- INTRODUCTION 9 hours

UNIT II - SOFTWARE FRAMEWORKS 11 hours
Software: openFrameworks as our IDE (C/C++) - “Arduino” Language (C/C++) - Hardware: Desktop / Laptop / Raspberry Pi - How to approach a programming problem? Representing “reality” with computers. Digital vs. Analog circuits, audio, communication, etc. Analog to Digital Conversion (ADC) - Digital to Analog Conversion (DAC) - Microcontrollers

UNIT III - HARDWARE COMMUNICATION 8 hours

UNIT IV: ADVANCED I/O INTERFACING 11 hours
Advanced I/O - openFrameworks:Live Network feeds (push and pull) - Data persistence (saving data and preferences) - Database interface (MySQL, sqlite, XML, PHP/Web) - Arduino:Wired/Wireless Networking
UNIT V - IoT, FUTURE AND PERSPECTIVES 6 hours
Talking to the cloud: Baby steps to Internet of Things, TCP/IP and UDP - Building peer to peer communication system using Bluetooth &WiFi - Experiments

REFERENCES

CS2158

SDN and NFV FOR IoT

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Prerequisite: Nil

PURPOSE: To understand the underlying principles of Data Center Networking over the conventional network.

INSTRUCTIONAL OBJECTIVES

1. Understand the principles behind the Modern Network approaches such as SDN NFV and IoT
2. Ability to analyze Data Center topologies and virtualized environment
3. Understand the data traversal over virtualized environment for IoT
4. Design algorithms for virtualization over multi-tenant environments
5. Understand the various types of key routing and switching techniques used in modern networks.

UNIT I - MODERN NETWORKING


UNIT II - SOFTWARE DEFINED NETWORKS


UNIT III - VIRTUALIZATION

Background and Motivation for NFV - Virtual Machines - NFV Concepts - NFV Reference Architecture - NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration - NFV Use Cases - SDN and NFV

UNIT IV - THE INTERNET OF THINGS: COMPONENTS


UNIT V - SECURITY

REFERENCES

3. Network Function virtualization with a touch of sdn by Paresh Shah, Syed Farrukh Hassan, RajendraChayapathi
ADVANCED DISTRIBUTED SYSTEMS

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<th>CS2159</th>
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PURPOSE
The purpose of this course is to impart knowledge on design concepts and system level and support required for distributed system.

INSTRUCTIONAL OBJECTIVES
1. To learn of the concepts, principles and technologies of Distributed systems
2. To introduce advanced idea of peer to peer and file system management
3. To understand the issues involved in resource management and process.

UNIT I - DISTRIBUTED SYSTEMS 9 hours

UNIT II - DISTRIBUTED SECURITY AND TRANSACTIONS 9 hours
Introduction - Overview of security techniques - Cryptographic algorithms - Digital signatures - Cryptography pragmatics - Flat and nested distributed transactions - Atomic commit protocols - Concurrency control in distributed transactions - Distributed deadlocks - Transaction recovery

UNIT III - DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS 9 hours
Introduction - Lamport's algorithm - RicartAgrawala algorithms - Singhal's dynamic information structure algorithm - Lodha and Kshemkalyani's fair mutual exclusion algorithms - Quorum based algorithm - Mackaway's algorithms - Token based algorithms - Roymaond's tree based algorithms

UNIT IV - DEADLOCK DETECTION IN DISTRIBUTION SYSTEMS 9 hours
UNIT V - ADVANCED IN DISTRIBUTED SYSTEMS  9 hours

REFERENCES
SOFTWARE ARCHITECTURE AND INTEROPERABILITY

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PURPOSE
To gain the basic principles of software architecture and interoperability

INSTRUCTIONAL OBJECTIVES
1. To learn importance of software architecture
2. To learn about architectural life cycle
3. To learn More Interoperability Challenges to Cope Today
4. To know about various architecture model

UNIT I – INTRODUCTION

UNIT II - QUALITY ATTRIBUTES

UNIT III - ARCHITECTURE IN THE LIFE CYCLE
Architecture in the agile projects – Architecture and requirements – Designing and documentation – Implementation and testing – Architecture reconstruction and conformance.

UNIT IV - INTEROPERABILITY
Physical vs Virtual - The Data Interoperability - The Semantic Interoperability - The Organizational Interoperability - Eternal Interoperability - The Important Economic Dimension - Roadmap for IoT Testing Methodologies

UNIT V - ARCHITECTURE IN ADVANCE

REFERENCES
3. Dr. OvidiuVermesan, Dr. Peter Friess, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, RIVER PUBLISHERS SERIES IN COMMUNICATIONS, 2013.
CS2161

ENERGY HARVESTING TECHNOLOGIES AND POWER MANAGEMENT FOR IoT DEVICES

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PURPOSE
To learn the techniques involved in Energy harvesting

INSTRUCTIONAL OBJECTIVES

1. Understand the various energy sources and energy harvesting based sensor networks
2. Learn about the various Piezoelectric materials and Non-linear techniques
3. Understand the various Power sources for WSN
4. Learn about the applications of Energy harvesting systems.

UNIT I – ENERGY HARVESTING SYSTEMS                          9 hours
Introduction – Energy sources – energy harvesting based sensor networks – photovoltaic cell technologies – generation of electric power in semiconductor PV cells – types

UNIT II - PIEZO-ELECTRIC ENERGY HARVESTING AND ELECTROMECHANICAL MODELING                          9 hours

UNIT III- ELECTROMAGNETIC ENERGY HARVESTING AND NON-LINEAR TECHNIQUES                          9 hours
Basic principles – micro fabricated coils and magnetic materials – scaling – power maximizations – micro and macro scale implementations. Non-linear techniques – vibration control & steady state cases

UNIT IV- ENERGY HARVESTING WIRELESS SENSORS                          9 hours

UNIT V - SELECTED APPLICATIONS OF ENERGY HARVESTING SYSTEMS                          9 hours
Case studies for Implanted medical devices – Bio-MEMS based applications – harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes
REFERENCES

2. Danick Briand, Eric Yeatman, Shad Roundy, “Micro Energy Harvesting”
CS2162

CLOUD STORAGE AND COMPUTING

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Prerequisite
Nil

PURPOSE
To gain the basic principles of cloud storage and computing

INSTRUCTIONAL OBJECTIVES
1. To learn cloud computing basics
2. To learn about cloud storage and security
3. To learn about optimization of cloud storage
4. To know about various cloud service provider

UNIT I - CLOUD COMPUTING 9 hours
Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Exploring virtualization, Load balancing, Hypervisors, Machine imaging, Cloud marketplace overview, Comparison of Cloud providers

UNIT II - INFORMATION STORAGE SECURITY & DESIGN 9 hours
Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM.

UNIT III - STORAGE NETWORK DESIGN 9 hours
Architecture of storage, analysis and planning. Storage network design considerations; NAS and FC SANs, hybrid storage networking technologies (iSCSI, FCIP, FCoE), design for storage virtualization in cloud computing, host system design considerations.

UNIT IV - OPTIMIZATION OF CLOUD STORAGE 9 hours
Global storage management locations, scalability, operational efficiency. Global storage distribution; terabytes to petabytes and greater. Policy based information management; metadata attitudes; file systems or object storage.

UNIT V – CLOUD SERVICE PROVIDER 9 hours
Cloud Service Providers: EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue, Service, Microsoft Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM Cloud Models, IBM Smart Cloud, SAP Labs, SAP HANA Cloud Platform, Virtualization Services Provided by SAP, Sales
force, Sales Cloud, ServiceCloud: Knowledge as a Service, Rack space, VMware, Manjra soft Aneka Platform

REFERENCES
CS2163 KERNEL AND DRIVER PROGRAMMING

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PURPOSE The purpose of this course is to impart knowledge of kernel programming, device driver programming in Linux.

INSTRUCTIONAL OBJECTIVES

1. To learn the fundamental of device driver and write simple device driver programs.
2. To learn the debugging technique and study the concurrency and Trace conditions.
3. To learn memory allocation and write driver programs for communicating with hardware.
4. To learn about the interrupt handling, PCI driver and USB driver.
5. To learn the block driver and network driver.

UNIT I – INTRODUCTION TO DEVICE DRIVER AND CHAR DRIVER 9 hours
Introduction to device driver - The Role of the Device Driver –Splitting the Kernel - Classes of Devices and Modules - Security Issues – Building and running modules – Setting your test system – compiling and loading - Char Drivers - Design of scull - Some Important Data Structures - Char Device Registration - open and release - scull’s Memory Usage - read and write - Playing with the New Devices.

UNIT II – DEBUGGING TECHNIQUE, CONCURRENCY AND TRACE CONDITIONS 9 hours

UNIT III – MEMORY ALLOCATION, COMMUNICATING WITH HARDWARE 9 hours
Time, delays and deferred work – Allocating memory – The Real Story of kmalloc - Lookaside Caches - get_free_page and Friends - vmalloc and Friends - Per-CPU Variables - Obtaining Large Buffers - Communicating with hardware – I/O Ports and I/O Memory - Using I/O Ports - I/O Port Example - Using I/O Memory.
UNIT IV – INTERRUPT HANDLING, DATA TYPES, PCI DRIVER AND USB DRIVER

9 hours

Interrupt handling - Preparing the Parallel Port - Installing an Interrupt Handler - Implementing a Handler - Top and Bottom Halves - Interrupt Sharing - Interrupt-Driven I/O - Data types in kernel – Use of Standard C Types - Assigning an Explicit Size to Data Items - Interface-Specific Types - Other Portability Issues - Linked Lists - PCI drivers - PCI Interface - PC/104 and PC/104+ - Other PC Buses - USB drivers - USB and Sysfs - USB Urbs - Writing a USB Driver - USB Transfers Without Urbs

UNIT V – LINUX DEVICE MODEL, BLOCK DRIVER AND NETWORK DRIVERS

9 hours

Linux device model - Kobjects, Ksets, and Subsystems - Low-Level Sysfs Operations - Hotplug Event Generation - Buses, Devices, and Drivers – Classes – Hotplug - Block Driver – Registration - Block Device Operations - Request Processing - Network Drivers

REFERENCES

CS2164  

DESIGN AND TESTING OF DIGITAL SYSTEMS  

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PURPOSE  
Learning the Design of Combinational and Sequential Circuits, Simulating digital Circuits using Programmable logic devices/ VHDL and learn fault diagnosis and testability algorithms

INSTRUCTIONAL OBJECTIVES
1. To impart knowledge on combinational and sequential circuits  
2. To design digital circuits  
3. To test combinational and sequential circuits using testability algorithms

UNIT I - COMBINATIONAL CIRCUIT DESIGN AND SIMULATION USING GATES  
9 hours  
Review of Combinational Circuit Design-Design of Circuits with limited gate fan-in-Gate delays and timing diagrams-Hazards in Combinational Logic-Simulation and testing of Logic circuits-Multiplexer, three-state buffers and Decoder/Encoders

UNIT II - COMBINATIONAL CIRCUITS DESIGN WITH PROGRAMMABLE LOGIC DEVICES AND VHDL  
9 hours  
Designing with ROMs-Programmable Logic devices-Complex Programmable Logic Devices-Field Programmable gate Arrays-VHDL Description of combinational Circuits-VHDL models for Multiplexers-VHDL Modules and Operators-Signals, constants and Arrays-IEEE Standard Logic

UNIT III - SEQUENTIAL CIRCUITS DESIGN  
9 hours  
Sequential Parity Checker-Analysis by Signal Tracing and Timing charts-State Tables and Graphs-Construction and Interpretation of Timing Charts-General Models-Code converter-design Example-Design of Sequential Circuits using ROMs and PLAs

UNIT IV - FAULT MODELING AND SIMULATION  
9 hours  
Keyboard basics - Keyboard scanning algorithm - Character LCD modules - LCD module display Configuration - Time-of-day clock - Timer manager - Interrupts - Interrupt service routines - Interrupt-driven pulse width modulation. Triangle waves analog vs. digital values - Auto port detect - Capturing analog information in the timer interrupt service routine - Automatic, multiple channel analog to digital data acquisition.
UNIT V - TESTING FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS
9 hours
Basic Issues-ATG for SSFs in Combinational Circuits- Fault oriented ATG-Common Concepts, Algorithms and Selection Criteria-ATG for SSFs in Sequential Circuits

REFERENCES
EM2107  

**EMBEDDED CONTROL SYSTEMS**

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**Total contact Hours - 45**

**Prerequisite**

Nil

**PURPOSE**

To introduce the basic concepts of control systems and its embedded implementation.

**INSTRUCTIONAL OBJECTIVES**

1. To learn the basics of control systems.
2. To learn control theory as used in embedded systems.
3. To learn application of control systems.
4. To learn I/O devices used in control systems.

**UNIT I - CONTROL SYSTEM BASICS**

12 hours

Z-transforms – performance requirements - block diagrams - analysis and design - sampling theory – difference equations.

**UNIT II - CONTROL SYSTEM IMPLEMENTATION**

9 hours


**UNIT III - CONTROL SYSTEM TESTING**

6 hours

Software implications - Controller implementation and testing in embedded systems - Measuring frequency response.

**UNIT IV - INPUT DEVICES**

6 hours

Keyboard basics - Keyboard scanning algorithm - Character LCD modules - LCD module display Configuration - Time-of-day clock - Timer manager - Interrupts - Interrupt service routines - Interrupt-driven pulse width modulation. Triangle waves analog vs. digital values - Auto port detect - Capturing analog information in the timer interrupt service routine - Automatic, multiple channel analog to digital data acquisition.

**UNIT V - OUTPUT DEVICES**

3 hours

H Bridge – relay drives - DC/ Stepper Motor control – optical devices.

**UNIT VI – SENSORS**

7 hours

UNIT VII - CASE STUDY

Examples for sensor, actuator, control circuits with applications.

REFERENCES

SUPPORTIVE COURSES

MATHEMATICAL FOUNDATIONS OF
COMPUTER SCIENCE

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PURPOSE
To impart analytical ability and to solve real life problems pertaining to branches of Computer Science and Engineering.

INSTRUCTIONAL OBJECTIVES

1. To be exposed with logic
2. To be thorough in mathematical induction
3. To understand algebraic systems such as relations
4. To be familiar with the basic concepts of lattices

UNIT I – LOGIC

Logic - Statements - Connectives - Truth tables - Normal forms - Predicate calculus - Inference Theory for Statement calculus and predicate calculus.

UNIT II – COMBINATORICS

Combinatory - Mathematical Induction - Pigeonhole principle - Principle of inclusion and exclusion.

UNIT III - RECURSIVE FUNCTIONS

Recursive Functions- Recurrence relation - Solution of recurrence relation using characteristic polynomial and using generating function - Recursive functions - Primitive recursive functions, Computable and non computable functions.

UNIT IV - ALGEBRAIC STRUCTURES

Algebraic Structures - Groups - Definition and examples only - Cyclic groups
Permutation group (Sn and Dn) - Subgroups - Homomorphism and Isomorphism - Cosets - Lagrange's Theorem - Normal subgroups - Cayley's representation theorem.

UNIT V – LATTICES

Lattices - Partial order relations, Poset - Lattices, Hasse diagram - Boolean algebra.

REFERENCES


**MA2010**

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<th>GRAPH THEORY AND OPTIMIZATION TECHNIQUES</th>
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**PURPOSE**

To develop analytical capability and to impart knowledge in graphs, linear programming problem and statistical methods and their applications in Engineering & Technology and to apply their concepts in engineering problems they would come across.

**INSTRUCTIONAL OBJECTIVES**

1. student should be able to understand graphs ,linear programming problems and statistical concepts.

2. Students should be able to apply the concepts in solving the Engineering problems

**UNIT I - BASICS OF GRAPH THEORY**  
9 hours


**UNIT II - CLASSES OF GRAPHS**  
9 hours

Eulerian graphs and Hamiltonian graphs - Standard theorems - Planar graphs - Euler's formula - Five colour theorem - Coloring of graphs - Chromatic number (vertex and edge) properties and examples - Directed graphs
UNIT III- GRAPH ALGORITHM
Computer Representation of graphs - Basic graph algorithms - Minimal spanning tree algorithm - Kruskal and Prim's algorithm - Shortest path algorithms - Dijkstra's algorithm - DFS and BFS algorithms.

UNIT IV - OPTIMIZATION TECHNIQUES 9 hours
Linear programming – Graphical methods – Simplex method (Artificial variables not included) – Transportation and assignment problems.

UNIT V – STATISTICS 9 hours
Tchebyshev’s inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations.

REFERENCES
1. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, PHI 1974.

<table>
<thead>
<tr>
<th>MA2011</th>
<th>STOCHASTIC PROCESSES AND QUEUEING THEORY</th>
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PURPOSE
To impart knowledge on probability concepts to study their applications in stochastic processes & queueing theory

INSTRUCTIONAL OBJECTIVES
1. Compute the characteristics of the random variable given the probabilities
2. Understand and apply various distribution
3. Solve cases of different Stochastic processes along with their properties.
4. Use discrete time finite state Markov chains
5. Gain sufficient knowledge in principles of queueing theory

UNIT I - RANDOM VARIABLES 9 hours
One dimensional and two dimensional Random Variables – Characteristics of Random Variables : Expectation, Moments.

UNIT II - THEORETICAL DISTRIBUTIONS 9 hours
Discrete : Binomial, Poisson, Negative Binomial, Geometric, Uniform Distributions.
Continuous: Uniform, Exponential, Erlang and Gamma, Weibull Distributions.

UNIT III - STOCHASTIC PROCESSES  
9 hours  
Classification of Stochastic Processes – Bernoulli process – Poisson process – Pure birth process – Birth and Death process.

UNIT IV - MARKOV CHAINS  
9 hours  

UNIT V - QUEUING THEORY  
9 hours  
Introduction – Characteristics of Markovian Single server and Multi server queuing models [(M/M/1) : (∞ / FIFO), (M/M/1) : (N / FIFO), (M/M/s) : (∞ /FIFO)] – M/G/1 Queuing System – Pollaczek Khinchin formula.

REFERENCES  
SEMESTER I

<table>
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<tr>
<th>CAC2001</th>
<th>Career Advancement Course For Engineers - I</th>
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INSTRUCTIONAL OBJECTIVES

1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal and written communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Practice verbal communication by making a technical presentation to the class
6. Develop time management Skills

UNIT I–BASIC NUMERACY
- Types and Properties of Numbers, LCM, GCD, Fractions and decimals, Surds

UNIT II-ARITHMETIC – I
- Percentages, Profit & Loss, Equations

UNIT III-REASONING - I
- Logical Reasoning

UNIT IV-SOFT SKILLS - I
- Presentation skills, E-mail Etiquette

UNIT V-SOFT SKILLS - II
- Goal Setting and Prioritizing
ASSESSMENT

Soft Skills (Internal)
Assessment of presentation and writing skills.

Quantitative Aptitude (External)
Objective Questions- 60 marks
Descriptive case lets- 40 marks*
Duration: 3 hours
*Engineering problems will be given as descriptive case lets.

REFERENCE:

1. Quantitative Aptitude by Dinesh Khattar – Pearson Publications
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. Soft Skills for Everyone by Jeff Butterfield – Cengage Learning India Private Limited
5. Six Thinking Hats is a book by Edward de Bono - Little Brown and Company
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd – Meerut
SEMESTER II

**CAC2002**  
Career Advancement Course For Engineers - II  
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Total Contact Hours - 30
Prerequisite
Nil

**PURPOSE**  
To enhance holistic development of students and improve their employability skills

**INSTRUCTIONAL OBJECTIVES**  
1. To improve aptitude, problem solving skills and reasoning ability of the student.
2. To collectively solve problems in teams & group.
3. Understand the importance of verbal communication in the workplace
4. Understand the significance of oral presentations, and when they may be used.
5. Understand the fundamentals of listening and how one can present in a group discussion
6. Prepare or update resume according to the tips presented in class.

**UNIT I - ARITHMETIC – II**  
② Ratios & Proportions, Mixtures & Solutions

**UNIT II - MODERN MATHEMATICS**  
② Sets & Functions, Data Interpretation, Data Sufficiency

**UNIT III – REASONING - II**  
② Analytical Reasoning

**UNIT IV – COMMUNICATION - I**
Group discussion, Personal interview

UNIT V - COMMUNICATION - II

Verbal Reasoning test papers

ASSESSMENT

Communication (Internal)

Individuals are put through formal GD and personal interviews. Comprehensive assessment of individuals’ performance in GD & PI will be carried out.

Quantitative Aptitude (External)

Objective Questions- 60 marks (30 Verbal +30 Quants)
Descriptive case lets- 40 marks*
Duration: 3 hours
*Engineering problems will be given as descriptive case lets.

REFERENCES

1. Quantitative Aptitude by Dinesh Khattar – Pearsons Publicaitons
2. Quantitative Aptitude and Reasoning by RV Praveen – EEE Publications
3. Quantitative Aptitude by Abijith Guha – TATA Mc GRAW Hill Publications
4. General English for Competitive Examination by A.P. Bharadwaj – Pearson Educaiton
5. English for Competitive Examination by Showick Thorpe - Pearson Educaiton
6. IBPS PO - CWE Success Master by Arihant - Arihant Publications(I) Pvt.Ltd - Meerut
7. Verbal Ability for CAT by Sujith Kumar - Pearson India
8. Verbal Ability & Reading Comprehension by Arun Sharma - Tata McGraw – Hill Education
**SEMMESTER III**

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<tr>
<th>CAC2003</th>
<th>Career Advancement Course For Engineers - III</th>
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**PURPOSE**

To develop professional skills abreast with contemporary teaching learning methodologies

**INSTRUCTIONAL OBJECTIVES**

At the end of the course the student will be able to

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<td>acquire knowledge on planning, preparing and designing a learning program</td>
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<td>prepare effective learning resources for active practice sessions</td>
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<td>facilitate active learning with new methodologies and approaches</td>
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<td>create balanced assessment tools</td>
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<td>hone teaching skills for further enrichment</td>
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**UNIT I- DESIGN**

- Planning & Preparing a learning program.
- Planning & Preparing a learning session

**UNIT II – PRACTICE**

- Facilitating active learning
- Engaging learners

**UNIT III – ASSESSMENT**

- Assessing learner’s progress
- Assessing learner’s achievement

**UNIT IV – HANDS ON TRAINING**

- Group activities – designing learning session
- Designing teaching learning resources
- Designing assessment tools
- Mock teaching session

**UNIT IV**

- (10 hrs)
UNIT V – TEACHING IN ACTION (14 hrs)

- Live teaching sessions
- Assessments

ASSESSMENT (Internal)

Weightage:
Design - 40%
Practice – 40%
Quiz – 10%
Assessment – 10%

REFERENCES

Cambridge International Diploma for Teachers and Trainers Text book by Ian Barker - Foundation books
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