MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Manipal School of Information Sciences (MSIS)

Manipal Academy of Higher Education, Manipal

Outcome Based Education (OBE) Framework

Two Year full time Postgraduate Program

Master of Engineering - ME (Internet of Things)

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NATURE AND EXTENT OF THE PROGRAM

An engineering graduate skillset requirement is changing with invent of the new technologies. The impact of Big data and its transformative technologies like Internet of Things (IoT) provide a high employability in the industry. IoT will become the mainstream phenomenon by 2020. IoT is a large-scale implementation technology which is embodied in a wide spectrum of networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities which was not previously possible.

ME (Internet of Things) Program is a comprehensive two-year postgraduate program, which aims to provide hands-on experience to prepare industry ready IoT professionals. The program ME (Internet of Things) helps engineering graduates to specialize in the field of IoT and enables them to learn how IoT devices can be programmed and networked for the data communication and its analysis. Students will also understand the security issues, IoT protocols and the network stack of IoT. This two-year master's program will cover various domain like communication, sensors and actuators, cloud, data analytics.

ME (Internet of Things) postgraduate degree would welcome graduates from any discipline with 50% mark in qualifying exam. Students after successfully completing the program will get career opportunities as an IoT Architect, IoT Security Analyst, IoT application Developer and IoT Stack developer.

PROGRAM EDUCATION OBJECTICE (PEO)

The overall objectives of the Learning Outcomes-based Curriculum Framework (LOCF) for **ME (Internet of Things) program are as follows.**

PEO No	Education Objective
PEO 1	Enable to draw upon fundamental and advanced knowledge in order to apply analytical and computational approach to solve problems in IoT Eco System.
PEO 2	Introduce state of art technologies in the area of IoT and inculcate ethical practices to make industry ready professional.
PEO 3	Promote scientific and societal advancement through research and entrepreneurship.

GRADUATE ATTRIBUTES

S No.	Attribute	Description
1	**Scholarship of Knowledge**	Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyse and synthesise existing and new knowledge, and integration of the same for enhancement of knowledge.
2	**Critical Thinking**	Analyse complex engineering problems critically, apply independent judgement for synthesising information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3	**Problem Solving**	Think laterally and originally, conceptualise and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyse and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

6	**Collaborative and Multidisciplinary work**	Possess knowledge and understanding of group dynamics, recognise opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economic and financial factors.
8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9	**Life-long Learning**	Recognise the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

QUALIFICATIONS DESCRIPTORS

1. Demonstrate

   (i) A systematic, extensive and coherent knowledge and understanding of an academic field of study as a whole and its applications, and links to related disciplinary areas/subjects of study; including a critical understanding of the established theories, principles and concepts, and of a number of advanced and emerging issues in the field of Internet of Things.

   (ii) Procedural knowledge that creates different types of professionals related to the Internet of Things, including research and development, teaching, government and public service.

   (iii) Professional skills in the domain of internet of things, Wireless sensor networks , microcontrollers, Cloud computing, Big data analytics, Communication protocols, embedded systems, data structures, web-services, Security protocols and architectures, sensors, data analytics, actuators including a critical understanding of the latest developments, and an ability to use established techniques in the domain of Internet of Things.

2. Demonstrate comprehensive knowledge about Communication protocols, embedded systems, Wireless sensor networks , microcontrollers, Cloud computing, Big data analytics including current research, scholarly, and/or professional literature, relating to essential and advanced learning areas pertaining to the Internet of Things techniques and skills required for identifying problems and issues related.

3. Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, analysis and interpretation of data.

4. Methodologies as appropriate to the subject(s) for formulating evidence based solutions and arguments.

5. Use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.

6. Communicate the results of studies undertaken in an academic field accurately in a range of different contexts using the main concepts, constructs and techniques of the Internet of Things studies.

7. Address one's own learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge.

8. Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts, to identify, analyse problems, issues, and seek solutions to real-life problems.

PROGRAM OUTCOMES

After successful completion of Master of Engineering - ME (Internet of Things), Students will be able to:

PO No	Attribute	Competency
PO 1	**Scholarship of Knowledge**	Acquire in-depth knowledge of IoT domain, with an ability to discriminate, evaluate, analyze, synthesize the existing and new knowledge, and integration of the same for enhancement of knowledge.
PO 2	**Critical Thinking**	Analyze complex IoT Eco System critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
PO 3	**Problem Solving**	Think laterally and originally, conceptualize and solve IoT problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
PO 4	**Research Skill**	Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
PO 5	**Usage of modern tools**	Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

PO 6	**Collaborative and Multidisciplinary work**	Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
PO 7	**Project Management and Finance**	Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economic and financial factors
PO 8	**Communication**	Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
PO 9	**Life-long Learning**	Recognize the need for and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
PO 10	**Ethical Practices and Social Responsibility**	Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
PO 11	**Independent and Reflective Learning**	Observe and examine critically the outcomes of one's actions and make corrective measures subsequently and learn from mistakes without depending on external feedback.

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COURSE STRUCTURE, COURSEWISE LEARNING OBJECTIVE, AND COURSE OUTCOMES (COS)

FIRST YEAR: ME (Internet of Things)

Semester: 1 **Semester: 2**

Subject Code	Subject Title	L	T	P	C	Subject Code	Subject Title	L	T	P	C
CSE 601	Data Structures and Algorithms	3	-	-	3	BDA 614	Big Data and Data Visualization	3	-	-	3
IOT 601	Operating Systems for IoT	3	-	-	3	ESD 605	Embedded Systems	3	-	-	3
IOT 602	IoT Networks and Protocols	3	-	-	3	IOT 604	Embedded Sensing Systems and Networks	3	-	-	3
IOT 603	IoT Security	3	-	-	3	IOT 605	Responsive Web Application Development	3	-	-	3
	Elective - 1	3	-	-	3		Elective - 2	3	-	-	3
CSE 601L	Data Structures and Algorithms Lab	-	-	3	1	BDA 614L	Big Data and Data Visualization Lab	-	-	3	1
IOT 601L	Operating Systems for IoT Lab	-	-	3	1	ESD 605L	Embedded Systems Lab	-	-	3	1
IOT 602L	IoT Networks and Protocols Lab	-	-	3	1	IOT 604L	Embedded Sensing Systems and Networks Lab	-	-	3	1
IOT 603L	IoT Security Lab	-	-	3	1	IOT 605L	Responsive Web Application Development Lab	-	-	3	1
	Elective - 1 Lab	-	-	3	1		Elective - 2 Lab	-	-	3	1
IOT 695	Mini Project - 1	-	-	4	-	IOT 696	Mini Project - 2	-	-	-	4
IOT 697	Seminar - 1	-	-	1	-	IOT 698	Seminar - 2	-	-	-	1
Total		**15**	**-**	**15**	**25**	**Total**		**15**	**-**	**15**	**25**

SECOND YEAR (FINAL YEAR): ME (Internet of Things)

III and IV Semester		
IOT 799	Project Work	25
Total Number of Credits to Award Degree		75

List of Electives(Theory)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
BDA-601	Fundamentals of Machine Learning	BDA-605	Machine Learning for Big Data
CDC-603	Cloud Application Development with JAVA	CSE-605	Mobile Application Development using Android
ESD-603	Digital Signal Processing	ENP-601	Entrepreneurship
IOT-606	IoT Application Development	ESD-604	Device Drivers
		CSE-631	IT Project Management

List of Electives(Lab)

Elective - 1		Elective - 2	
Code	**Subject**	**Code**	**Subject**
BDA-601L	Fundamentals of Machine Learning Lab	BDA-605L	Machine Learning for Big Data Lab
CDC-603L	Cloud Application Development with JAVA Lab	CSE-605L	Mobile Application Development using Android Lab
ESD-603L	Digital Signal Processing Lab	ENP-601L	Entrepreneurship Lab
IOT-606L	IoT Application Development Lab	ESD-604L	Device Drivers Lab
		CSE-631L	IT Project Management Lab

Name of the Institution / Department: Manipal School of Information Sciences (MSIS)

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Data Structures and Algorithms
Course Code: CSE 601	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Programming – preferably C

Synopsis:	This Course provides insight on 1. This course introduces students to elementary data structures and design of algorithms. 2. Students learn how to design optimal algorithms with respect to time and space 3. Students learn how to implement link list, stack, queues, searching and sorting techniques, sets, trees and graphs. 4. Students learn the design of divide and conquer technique, dynamic programming, greedy technique and back tracking.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Specify and analyse algorithms.
CO 2:	Learn and design programs for implementation of linear and non linear data structure.
CO 3:	Learn and design programs for sorting and searching.
CO 4:	Illustrate application of divide and conquer technique, dynamic programming, greedy technique and back tracking.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*			*							
CO 2	*	*				*					
CO 3	*					*					
CO 4	*	*				*					

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction	
Algorithm Specification, Performance Analysis	At the end of the topic student should be able to: 1. Define algorithms (C1) 2. Analyse algorithms. (C6)
Unit 2: Algorithm Analysis Techniques	
Analysis of Recursive Programs, Solving Recurrence Equations, General Solution for a large class of Recurrences.	1. Define recursive programs (C2) 2. Design simple recursive programs (C6) 3. Solve recurrence relations (C6)
Unit 3: Elementary data structures	
Implementation of Lists, Stacks, Queues	1. Design singly linked list (C6) 2. Design doubly linked list(C6) 3. Explain the concepts of array-based stacks (C2) 4. Explain the concepts of pointer-based stacks (C2) 5. Design and implement Queues. (C6)
Unit 4: Sorting & Searching Techniques	
Quick sort, Heap sort, Merge sort, Binary search, linear search, Fibonacci search	1. Develop algorithm for insertion sort, bubble sort and selection sort. (C6) 2. Develop and analyse algorithm for quick sort (C6) 3. Develop and analyse algorithm for heap sort (C6) 4. Develop and analyse algorithm for merge sort (C6)

	5. Design and analyse algorithms for binary, linear and Fibonacci search (C6)
Unit 5: Operations on Sets	
Introduction to Sets, A Linked- List implementation of Set, The Dictionary, The Hash Table Data Structure	1. Develop data structures for sets (C6) 2. Design a linked list-based implementation of sets (C6) 3. Design a Dictionary (C6) 4. Design Data structure for hash table (C6)
Unit 6: Trees	
Basic Terminology, Implementation of Trees, Binary Trees, Binary Search Trees	1. Examine the concepts of trees. (C3) 2. Design and implement general trees (C6) 3. Design and implement binary trees (C6) 4. Design and implement binary search trees (C6)
Unit 7: Graphs	
Basic definitions, Representation of Graphs, Minimum Cost Spanning Tree, Single Source Shortest Paths, All-Pairs Shortest Path	1. Define graphs (c6) 2. Design data structure for graphs (c6) 3. Formulate an algorithm to solve minimum cost spanning tree(c6) 4. Formulate an algorithm to solve Single source shortest path (c6) 5. Formulate an algorithm to solve All- pair shortest path(c6)
Unit 8: Algorithm Design Techniques	

Divide-and-Conquer Algorithms, Dynamic Programming, Greedy Algorithms, Backtracking	1. Design of divide and conquer algorithms (C6) 2. Solve max min, Strassen's matrix multiplication, multiplication of long integers problem. (C6) 3. Design of dynamic programming techniques (C6) 4. Solve matrix chain order problem (C6) 5. Design of greedy algorithms(C6) 6. Solve Knap-sack, job scheduling with deadlines and optimal storage on tapes problems. (C6) 7. Design of Back tracking algorithms (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Seminar	-	-
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Clinic	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**

Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2		*	*	*
Assignment/Presentation	*	*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Introduction to Algorithms" Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest. 2. "Data Structures& Algorithms" Aho, Hopcroft and Ulmann 3. "Data structures and algorithm analysis in C" Mark Allen Weiss 4. "Computer Algorithms" : Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Operating Systems for IoT
Course Code: IOT 601	**Course Instructor:**
Academic Year: 2020 -2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Programming skills

Synopsis:	This Course provides insight on 1. Basics of operating systems and real time operating systems. 2. Understand the concepts of process management, scheduling, synchronization and dead locks. 3. Concept of memory management. 4. The salient features of real time operating systems with case study of RTx 5. To understand the concepts of event driven programming with case study of tiny OS and Contiki
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Experiment process creation, process hierarchies and multi-thread concepts.
CO 2:	Apply process-scheduling algorithms and process synchronization concepts on various scenarios.
CO 3:	Analyse the requirement for process synchronization and coordination handled by operating system.
CO 4:	Identify the salient features of real time operating systems with programming on RTx
CO 5:	Understand the concept of event driven programming on tiny OS and Contiki

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*	*								
CO 3	*		*								
CO 4		*			*						
CO 5	*				*						

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to Operating Systems	
OS vs RTOS, Functions of Operating Systems, Introduction to Kernel, Types of Kernel, User space vs Kernel Space.	1. Identify the features of OS and RTOS (C2) 2. Distinguish between single processor and multi-processor systems (C2) 3. Identify the features of batch processing, time sharing, multi programming and interactive systems (C2) 4. Distinguish between user and kernel modes (C2) 5. Distinguish between function and system calls (C2)
Unit 2: Process Management	
The process concept, synchronization, mutual exclusion, semaphores, and monitors, Threads, Inter-process communication	1. Describe a process, process state, process control block (C2) 2. Apply scheduling algorithms, scheduling queues (C3) 3. Examine process related system calls (C1) 4. Experiment inter process communication through share memory and sockets (C4)
Unit 3: Resource Allocation, Deadlock prevention, avoidance, and detection	
The OS Kernel, Micro and Monolithic kernels, Multi-tasking, privilege, interrupt handling, System and user processes, System calls	1. Examine methods for handling dead locks (C3) 2. Write dead lock prevention algorithms (C3) 3. Write dead lock avoidance algorithm (C3) 4. Write dead lock recovery algorithm(C3)
Unit 4: Memory Management	
Description of problems of allocation, protection and sharing, Virtual to Physical memory mapping schemes, Segmented paged virtual memory,	1. Examine various memory management strategies(C3) 2. Examine the evolution of memory management (C3)

Paging control, replacement algorithms, the working set model, Sharing code and data	3. Illustrate the benefits of paging and segmentation(C2) 4. Examine the implementation of demand paging(C3) 5. Examine the various virtual memory concepts (C3)
Unit 5: Time Management	
Time Management, CPU scheduling algorithms, Real-time scheduling, Disc access scheduling	1. Distinguish between scheduling algorithms (C2) 2. Examine the criteria for scheduling (C3) 3. Examine Disc access scheduling (C3)
Unit 6: RealTime OS	
Real Time OS, OS calls in RTOS, RTx Kernel OS calls – Examples	1. Examine Real Time OS (C3) 2. Illustrate OS calls in RTOS (C3) 3. Illustrate OS calls in RTx (C3)
Unit 7: Real Time Systems	
Operating systems for IoT, Pre emption vs Event Driven, Event Driven Programming, Tiny OS vs Contiki	1. Examine the concepts involved in the design of real time systems (C3) 2. Illustrate real time clocks in various real time languages(C3) 3. Describe the concepts of time outs in message passing, semaphores and monitors (C1) 4. Compare various priority inheritance algorithms (C4) 5. Explain the concept of response time analysis (C2) 6. Examine Event driven programming using Tiny OS and Contiki (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60

Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation		*	*		*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Abraham Silberschatz, Peter Galvvin, Grag Gagne, "Operating System principles", Seventh Edition, John Wiley Publications, 2006. 2. Allan Burns, Andy Wellings, "Real – Time Systems and Programming Languages", Fourth Edition, Pearson Education Canada, 2009. 3. Milan Milenkovic, "Operating Stems Concepts and Design", McGraw Hill Higher Education, 1987.

	4. Maurice Bach (IPC), "Design of Unix Operating System", Prentice-Hall, Inc., 1986. 5. Kerninghan & Ritchie, "The C Programming Language", Second Edition, Prentice-Hall, 1988. 6. www.freertos.org, "The FreeRTOS Reference Manual", Real Time Engineers Ltd. 2016.

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Networks and Protocols
Course Code: IOT 602	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Network Concepts

Synopsis:	This Course provides insight on 1. To IoT Architecture, eco system, different levels and IoT communication. 2. To understand the concepts of basic wired and wireless networks 3. To understand network components. 4. To learn different layers of OSI Model. 5. To learn about Software Defined Networks (SDN), Network Function Virtualization (NFV).
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain IoT architecture, eco system, differentiate between IoT and Machine to Machine.
CO 2:	Illustrate classification of networks.
CO 3:	Describe different network components.
CO 4:	Explain different protocols used in OSI Layers.
CO 5:	Describe Software Defined Networks (SDN), Network Function Virtualization (NFV).

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*									
CO 3			*	*							
CO 4	*	*									
CO 5				*							

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to IoT	
IoT Characteristics, Architecture, IoT Ecosystem, IoT Enabling Technologies, IoT Levels, IoT vs M2M, Technologies of IoT, Layers of IoT Network, IoT Communications	At the end of the topic student should be able to: 1. Explain IoT characteristics, IoT eco system (C2) 2. Describe IoT architecture, different levels and Machine to Machine architecture (C3) 3. Describe IoT design methodologies (c2) 4. Explain IoT enabling technologies (c2)
Unit 2: Introduction to Basic Networks	
Classification of Networks, Wired vs Wireless Networks.	1. Distinguish between wired and wireless network, classification of network (c2)
Unit 3: Components of Networks	
Network Interface card, modem, hub, switch, repeater, bridge, router and gateway, MAC address, IP Address	1. Describe different network components(C2) 2. Explain MAC and IP address (C3)
Unit 4: Network OSI Model	
Physical, Data link, Network, Session, Transport, Applications Layer, OSI vs TCP/IP Model vs IoT Model	1. Explain different OSI Layer (C3) 2. Differentiate OSI vs TCP/IP Model vs IoT Model(C1) 3. Demonstrate simple network using NS2(C3)
Unit 5: Application layer	
http, ftp, SMTP, CoAP, MQTT, XMPP, AMQP, SSH, DNS, NTP, DHCP	1. Explain working of http protocol. (C2) 2. Describe ftp and SMTP protocol. (C2) 3. Illustrate CoAP, MQTT, XMPP, AMQP protocol. (C3) 4. Demonstrate SSH, DNS, NTP, DHCP protocol (C2)
Unit 6: Transport Layer	
Ipv6/ IPv4, RPL, TCP/UDP, uIP, SLIP, 6LowPAN	1. Demonstrate various transport layer protocol (C2)
Unit 7: Physical Layer & Network Layer	

IEEE 802.15.4, 802.3, 802.11	1. Describe IEEE 802.3 architecture. (C2) 2. Describe IEEE 802.11 architecture. (C2) 3. Describe IEEE 802.15.4 architecture. (C2)
Unit 8: SDN NFV	
Software Defined Networks (SDN), Network Function Virtualization (NFV)	1. Explain Software Defined Networks (SDN), Network Function Virtualization (NFV). (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Jim Doherty, "SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization", Addison-Wesley Professional, 2016. 2. Larry L Peterson & Bruce S Davie, "Computer Networks – a Systems Approach", 5th Ed. Elsevier, MK Publishers, 2011. 3. Behrouz A Forouzan, "TCP/IP Protocol Suite", TMH, 3rd Edition, 2005. 4. Arshdeep Bhaga, Vijay Madishetti, "Internet of things: A hands on Approach", Universities Press, ISBN:978172719547, 2015. 5. William Stallings, "Wireless Communications & Networks", Pearson, 2nd Edition, 2004. 6. Jean-Philippe Vasseur and Adam Dunkels." Interconnecting Smart Objects with IP – The Next Internet", Morgan Kaufmann, 2010. 7. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", Willey, 2009. 8. RFC's on COAP, XMPP, MQTT, AMQP - Internet resources.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Security
Course Code: IOT 603	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Cryptography Basics, Networking Basics, Programming aspects

Synopsis:	This Course provides insight on 1. The Security Architecture and requirements of IoT. 2. Basics of Cryptography, Symmetric Key Cryptography, Asymmetric Key Cryptography, PKI, Hashing, Digital signatures. 3. Various types of Threats, Attacks in network and IoT architecture and the methods to mitigate the same using various network security strategies. 4. Concepts of Blockchain, Crypto-currencies, IOTA Cyber security strategies like Intrusion Detection Systems, Intrusion Prevention System.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe the core components of Security requirements and architecture of IoT.
CO 2:	Apply the concepts of cryptography to maintain the Confidentiality, Integrity and Availability of a data against the threats in the networks.
CO 3:	Analyse various types of Threats, Attacks in network and IoT architecture and the methods to mitigate the same using various network security strategies.
CO 4:	Illustrate the concepts of blockchain and cyber security strategies.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*	*	*	*						
CO 3	*	*	*		*						
CO 4			*		*						

Course content and outcomes:	
Content	***Competencies***
Unit 1: Introduction	
Need for Security in IoT, CIA triad, Security Concerns in IoT Applications, Security Architecture in the Internet of Things - Security Requirements in IoT, threats to CIA in IoT, Cross layer architecture, IoT Security life cycle.	At the end of the topic student should be able to: 1. Outline the Need for Security in IoT, CIA triad. (C1) 2. Identify Security Concerns in IoT Applications. (C2) 3. Explain Security Architecture in the Internet of Things - Security Requirements in IoT, threats to CIA in IoT, Cross layer architecture, IoT Security life cycle. (C2)
Unit 2: Security Fundamentals	
Cryptography basics, A Taxonomy of Cryptography and cryptanalysis, Characteristic of Cryptographic Systems, Symmetric Key Cryptography, Asymmetric Key Cryptography, PKI, Hashing, Digital signatures.	1. Demonstrate Cryptography basics, A Taxonomy of Cryptography and cryptanalysis. (C3) 2. Practice Characteristic of Cryptographic Systems, Symmetric Key Cryptography, Asymmetric Key Cryptography, PKI, Hashing. (C3) 3. Apply various cryptographic algorithms like AES,DES, SHA256, SHA512 using JAVA, Python Programming. (C3)
Unit 3: Threats, Attacks and Mitigation in IoT	
Vulnerabilities, Attacks, and Countermeasures, Attacks specific to IoT, Identity and Access Management Solutions for the IoT, Mitigating IoT Privacy Concerns, DoS, DDoS	1. Describe various types of Vulnerabilities, Threats, Attacks in network and IoT architecture. (C2) 2. Identity access management solutions for the IoT, Mitigating IoT Privacy Concerns, DoS, DDoS. (C2)
Unit 4: Network Security	

Web security, SQL injection, Authentication. Worm hole, Tunneling, TLS, SSH, Certificates	1. Interpret the concepts of web security, SQL injection, Authentication, Worm hole, Tunneling, TLS, SSH, Certificates. (C3) 2. Demonstrate the SQL injection technique. (C3) 3. Interpret TLS, SSH, Certificates. (C3)
Unit 5: Block chain	
Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, scripts and smart contracts, wallets: hot and cold storage, anonymity, altcoins, IOTA (next generation Blockchain).	1. Explain the concepts of Bitcoin P2P network, distributed consensus, Crypto-currencies. (C2) 2. Describe smart contracts, wallets storage, anonymity, altcoins, IOTA. (C2) 3. Illustrate a use case of block chain implementation showing distributed consensus, incentives and proof-of-work. (C3)
Unit 6: IDS, IPS	
Intrusion Detection Systems, Intrusion Prevention System.	1. Describe cyber security strategies like IDS, IPS. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-

TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	
Assignment/Presentation		*	*	*
End Semester Examination	*	*	*	*
Laboratory examination		*		*

Feedback Process	• End-Semester Feedback
Reference Material	1. Fei Hu," Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 2016. 2. Stephen Northcutt, Donald McLachlan, Judy Novak, "Network Intrusion Detection: An Analyst's Handbook", New Riders, 2000. 3. Stephen A. Thomas, "SSL & TLS Essentials: Securing the Web", John Wiley & Sons, 2000. 4. Don Tapscott and Alex Tapscott, "Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World", Portfolio, 2016. 5. B. Rusell and D. Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016. 6. A. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016. 7. A. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

	8. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach", Cambridge University Press, 2011.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Fundamentals of Machine Learning
Course Code: BDA-601	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Basic Programming – preferably Python

Synopsis:	This Course provides insight on 1. This course provide the concept of machine learning, applications, techniques, design issues and approaches to machine learning. 2. This course provide the fundamental knowledge about concept learning, hypothesis and bias. 3. To implement machine learning algorithms such as Decision Tree learning, Probably Approximately Correct (PAC) learning, Bayesian learning, Instance-based learning, Principal Component Analysis (PCA) and Ensemble methods in real time data set for various analysis.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify the goals, applications, types and design issues of machine learning techniques.
CO 2:	Relate concept learning and hypothesis space.
CO 3:	Apply PCA learning approach to reduce the dimension.
CO 4:	Analyse different machine learning algorithms.
CO 5:	Design ensemble methods.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction	
Definition of Machine Learning, Goals and applications of machine learning, Basic design issues and approaches to machine learning, Types of machine learning techniques	1. Define Machine Learning (C1) 2. Describe about any three applications for which machine learning approaches seem appropriate. (C2) 3. Illustrate different types of machine learning techniques (C3)
Unit 2: Inductive Classification	
The concept learning task, Concept learning as search through a hypothesis space, General-to-specific ordering of hypotheses, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, Inductive bias.	1. Relate concept learning and hypothesis space (C4). 2. Apply different algorithms to obtain most general and most specific hypotheses from the training examples. (C3)
Unit 3: Decision Tree learning	
Representing concepts as decision trees, Recursive induction of decision trees, Picking the best splitting attribute, Entropy and information gain, Searching for simple trees and computational complexity.	1. Apply decision tree algorithm to find the hypothesis space (C3) 2. Construct decision tree machine learning algorithm (C5) 3. Explain the method of choosing training examples and target function in the design of a machine learning system (C2) 4. Explain different validation technique to find the accuracy in training and testing of data set (C5)
Unit 4: Computational learning theory	
Models of learnability: learning in the limit, Probably Approximately Correct (PAC) learning, Sample Complexity: quantifying the number of examples	1. Define various terms related to computational learning approach (C1).

needed to PAC learn, Computational complexity of training. Sample complexity for finite hypothesis spaces, Noise Learning Multiple Classes, Bias-variance trade-off, under-fitting and over-fitting concepts	2. Describe different models learning in the limit (C2) 3. Calculate the number of training examples required in different types of learning approaches (C4).
Unit 5: Bayesian learning	
Probability theory and Bayes rule, Naive Bayes learning algorithm - Parameter smoothing, Generative vs. discriminative training, Logistic regression, Bayes nets and Markov nets for representing dependencies	1. Write the applications of Bayes theorem (C3) 2. Describe the use of Logistic Regression in Machine Learning (C2) 3. Predict the target value for the new instance using Naïve Bayes classifier. (C3)
Unit 6: Instance-based learning	
Constructing explicit generalizations versus comparing to past specific examples, K-Nearest Neighbour learning algorithm, Case-based reasoning (CBR) learning	1. Construct explicit generalizations (C5) 2. Discriminate Instances Based and Case-based learning (C4) 3. Explain K-nearest neighbour learning (C5)
Unit 7: Continuous Latent Variables	
Principal Component Analysis (PCA), Applications of PCA	1. Describe use of Principal Component Analysis for the complex data set (C2). 2. Apply PCA to choose principal components for the given data set (C3)
Unit 8: Ensemble methods (bagging and boosting)	
Using committees of multiple hypotheses, Bagging, Boosting, DECORATE, Active learning with ensembles	1. Choose a suitable method of ensemble learning approach (C3). 2. Explain various ensemble techniques (C5)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. T. Mitchell, "Machine Learning", McGraw-Hill, 1997. 2. E. Alpaydin, "Machine Learning", MIT Press, 2010. 3. C. Bishop," Pattern Recognition and Machine Learning", Springer, 2006.

	4. E. Hart, R. Duda and D. Stork, "Pattern Classification", Wiley-Interscience, 2000. 5. T. Hastie, R. Tibshirani and J. Friedman, "The Elements of Statistical Learning: Data Mining, Inference and Prediction", Springer, 2nd Edition, 2009. 6. Jason Bell, "Machine Learning for Big Data", Wiley Big Data Series, 2016. 7. Rama Murthy G," Multidimensional Neural Networks Unified Theory", New Age International, 2008.

MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Cloud Application Development with Java
Course Code: CDC-603	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Cloud Application Basics, OOP's concepts, Java programming language, IoT Basics

Synopsis:	This Course provides insight on 1. Cloud application development with IoT devices using Java Programming. 2. To Provide practical knowledge of design and develop of Java application with WebSocket, MQTT protocol and create RESTful API's.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Write Java application using swings.
CO 2:	Model Relational database to communicate with Java application.
CO 3:	Show interactive communication with IoT enabled devices. (C3)
CO 4:	Model application as RESTful API and deploy in Cloud Application Platform.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*		*								
CO 3	*	*									
CO 4	*				*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction	

Design Considerations for cloud Applications: Scalability – Reliability & Availability – reference Architecture for Cloud Applications – cloud Application Design Methodologies: Service Oriented Architecture – Cloud Component Model – Services of cloud Applications – Model View Controller – Restful Web Services – Data Storage Approaches: SQL – NOSQL Approaches.	1. Explain Design Considerations for cloud Applications(C2) 2. Discuss Reference Architecture for Cloud Applications like CDN, analytics etc... (C2) 3. Explain cloud Application Design Methodologies like SOA, CCM, MVC etc.(C3) 4. Discuss Data Storage Approaches Relational and Non-Relational.(C2)
Unit 2: Introduction to OOPS	
OOPS – Procedural vs Object Oriented languages – Abstraction – Encapsulation – Polymorphism – Inheritance.	1. Explain advantages of object-oriented programming over Procedural oriented programming language. (C1) 2. Explain OOPS concepts like Class, Object Abstraction, Encapsulation, Polymorphism, Inheritance. (C1)
Unit 3: Introduction to JAVA	
JAVA Features – Present JAVA language and .. - JVM – JVM Architecture - JAVA Datatypes, Variables, Arrays– JAVA Basic Constructs.	1. Know about JAVA Features, advantages of Java over other programming languages. (C1) 2. Explain what is JVM and its Architecture. (C2) 3. Discuss Java basics - Datatypes, Variables, Arrays, Operators, methods, reserved Java keywords. (C1) 4. Explain “this” keyword, Exception handling, Constructs, access specifiers. (C1) 5. Discuss about Encapsulation and Abstraction in java. (C1)

Unit 4: Class Concepts	
Objects – Methods – Revisiting Inheritance – Multilevel – Method Overriding – Abstract Class – Interface – Package-IO.	1. Explain Inheritance and its types in Java. (C1) 2. Why multiple inheritance cannot be achieved.? (C1) 3. Discuss about implementing of method overloading and method overriding. (C1) 4. Importance of using Packages in java. (C1) 5. Explain Abstract class and why it is important. (C1) 6. Achieve Multiple inheritance using Interfaces. (C1)
Unit 5: Internet of Things	
Introduction – IoT Architecture – Physical Design – Logical Design – IoT Enabling technologies –IOT Levels and Deployment Templates –IoT-Cloud Platform - IoT Protocols: MQTT – WebSockets.	1. Outline the integration of various elements of IoT ecosystem. (C2)
Unit 6: JAVA Websockets	
Websocket Lifecycle – Basic Messaging – Advanced Messaging – Securing Web Sockets.	1. Outline Client Server Architecture using Java. (C1)
Unit 7: REST API	
REST Style Architecture – http – URI – Request Methods – Status Codes – JAVA JSON Processing – JAX RS API.	1. Illustrate REST API. (C3)
Unit 8: JAVA MQTT	
M2M with JAVA – MQTT Applications with PAHO	1. Illustrate MQTT Protocol. (C3)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2		*	*	
Assignment/Presentation		*		*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	• William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854

	• Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN-13: 978-1558608740, ISBN-10: 1558608745 • David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional. • Steve Furber,"ARM System-on-Chip Architecture",2nd Edition,Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196 • Douglas V. Hall,"Microprocessors and Interfacing",Mcgraw Hill Educatin ,ISBN-10 1259006158,ISBN-13 9781259006159,2012. • Websites & Transaction Papers

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Digital Signal Processing
Course Code: ESD-603	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Knowledge of Signals and Systems and Basic Knowledge of MATLAB

Synopsis:	This Course provides insight on 1. Understanding of basics of Signal and Systems as pre-requisite. 2. Understanding the concepts of Fast Fourier Transforms. 3. Learning hardware implementation of systems. 4. Learning FIR and IIR Filter Designs. 5. Learning concepts of multi-rate signal processing in the form of sampling rate conversion, structures of sampling rate converters and some applications of sampling rate converters 6. Understanding three optimum Weiner filters, adaptive algorithm and transforming Weiner filters in to adaptive filters 7. Understanding architecture, memory management and pipelining concepts of TMS320C67XX processor through self-stud.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Analyse Fast Fourier Transform (FFT) algorithms on computational complexity.
CO 2:	Describe the structures for IIR and FIR filters.
CO 3:	Interpret Multirate Signal Processing and Adaptive Filters.
CO 4:	Explain architecture, memory management and pipelining concepts of General and TMS320C67XX Digital Signal Processor.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2	*	*	*	*	*						
CO 3		*	*	*							
CO 4	*	*									

Course content and outcomes:	
Content	***Competencies***
Unit 1: Review: (Self Study)	
Introduction Classification of signals and systems, brief discussions on z-transform, inverse z-transform & Fourier transform, DFT, linear convolution using circular convolution & DFT	1. Outline types of signals and system. (C1) 2. Summarize z-transform, Fourier transform, convolution. (C2)
Unit 2: FFT Algorithms	
Radix-2 DIT-FFT Algorithm, DIF-FFT Algorithm. Assignments (Problems).	3. Identify Computation complexity of DFT, Introduction to Fast Fourier Transform (FFT) algorithm (C1) 4. Describe and Sketch Radix-2 Decimation in Time FFT (DIT-FFT) Algorithm and analyse its computation complexity (C2, C3, C4) 5. Describe and Sketch Radix-2 Decimation in Frequency FFT (DIF-FFT) Algorithm and analyse its computation complexity (C2, C3, C4)
Unit 3: Filter Structures	
IIR Filter Structure – Direct Form I & II, CSOS, PSOS & Transpose structures - FIR Filter Structures – Direct Form, Cascade form, Linear Phase Filter structures. Assignments (Problems).	1. List Components used in filter structures, System Representations, relation between the representations, classify of IIR and FIR Systems (C1, C2) 2. Explain and construct IIR Filter Structure – Direct Form-I, Direct Form–II, Cascade Form (CSOS), Parallel Form (PSOS) & Transpose of structures (C2, C5) 3. Explain and construct FIR Filter Structures – Direct Form, Cascade form (C2, C5)

	4. Explain Linear Phase FIR Filter structure: Derivation, Frequency Response, Compute Computation Complexity and construct with number of filter coefficients being even and odd. (C3, C5)
Unit 4: Design of FIR filters	
Using Frequency Sampling & Windows - Assignments (Problems).	1. Introduction to Frequency sampling technique design 2. Describe Derivation of a Transfer Function for the system designed using frequency sampling technique when number of samples of impulse response / number of point DFT is even or odd. Construct hardware for the transfer functions. Concept of Comb filter and resonator (C6, C5) 3. Sample example to Design and implement FIR filter using Frequency Sampling technique to meet required impulse response (C5, P4) 4. Illustrate Frequency responses of frequency selective (LP, HP, BP and BR) filters, concept of frequency sampling in the frequency responses (C3) 5. Sample examples to Design and implement FIR filters with ideal frequency response using frequency sampling technique (C5, P4) 6. Discuss Concept of windowing in the design of FIR filter, Concept of Gibb's Phenomenon and its effect on frequency response, Use of window functions to eliminate Gibb's effect (C2) 7. Comparison of performances of filters designed with different window functions (C4)

	8. Explain Steps involved in the design of FIR filters with ideal frequency response and non-ideal frequency response (C2) 9. Express Impulse responses of frequency selective filters (C2) 10. Sample examples to design ideal and non-ideal frequency selective filters using windows. (C5, P4)
Unit 5: Design of IIR Filters	
Butterworth & Chebychev filters design using impulse invariance & bilinear transformation techniques, Design of IIR filter using pole placement technique. Assignments (Problems).	1. Discuss Concepts of Analog Butterworth LP filter, concept of Cut-off frequency, order of the filter, compute poles, pole locations in S-Plane, transfer function (C2, C3) 2. Explain Design steps of Analog Butterworth LP filter (C2) 3. Explain Chebychev polynomials, their properties, Analog Chebychev LP filter function, concepts of frequency response, order of filter, pole placements of Chebychev LP filters on S-Plane, compute poles, Transfer function of LP Chebychev filter (C2, C3) 4. Discuss Concepts of Impulse Invariance Transformation, S-Plane to Z-Plane mapping, steps in transformation (C2) 5. Discuss Concepts of Bilinear Transformation, frequency warping, pre-warping for the purpose of analog filter (Butterworth / Chebychev) design (C2) 6. Sample examples to design Butterworth and Chebychev LP filter using impulse invariance and bilinear transformations (C5)
Unit 6: Multirate Signal Processing	

Decimation, Interpolation, Sampling rate conversion by a rational factor, structures, Polyphase filter structures, Time variant Filter structure, Application of Multirate signal processing to Phase Shifter, Subband coding of Speech signal, Digital Filter Bank Implementation, QMF Filter bank	1. Introduction, need for multi-rate signal processing, explain concept of sampling rate conversion (C2) 2. Explain Decimation by an integer factor, block diagram, analyse of decimator in time domain and frequency domain (C2, C4) 3. Explain Interpolation by an integer factor, block diagram, analyse of interpolator in time domain and frequency domain (C2, C4) 4. Explain Sampling rate conversion by a rational factor, block diagram, analyse in time domain and frequency domain (C2, C4) 5. Construct Implementation of Sampling rate converters (C5) 6. Discuss Concepts and construction of Poly-phase filter (C2, C5) 7. Construct Time variant Filter (C5) 8. Apply Multi-rate signal processing concept to Phase Shifter, Sub-band coding of Speech signal, Digital Filter bank Implementation, QMF Filter bank. (C3)
Unit 7: Adaptive Filters	
Class of Optimal Filters – Predictive Configuration, Filter Configuration, Concept of adaptive noise cancellation, Noise Canceller Configuration. LMS adaptive Algorithm, Application of LMS algorithm to the optimal filter configurations. Adaptive noise canceller as a high-pass filter	1. Outline adaptive filters, some matrix operation.(C1) 2. Explain Optimal Weiner Filters – Predictive Configuration, Filter Configuration, Noise Canceller Configuration (C2) 3. Explain Concept of LMS adaptive Algorithm (C2) 4. Apply LMS algorithm to the optimal filter configurations (C3)
Unit 7: DSP Processor	

Introduction to PDSPs – Multiplier and Multiplier Accumulator (MAC), Modified Bus structures and memory access schemes, Multiple access memory, Multiported Memory, VLIW architecture, Pipelining, Special addressing modes, On-chip Peripherals. TMS320C6711 DSP processor: Architecture, Instruction set and assembly language programming	1. Discuss Introduction to PDSPs – Multiplier and Multiplier Accumulator (MAC), Modified Bus structures and memory access schemes (C2) 2. Explain Concept of Multiple access memory, Multiported Memory, VLIW architecture (C2) 3. Explain Concept of Pipelining, Special addressing modes, On-chip Peripherals. (C2) 4. Explain Concepts on Architecture, memory organization and pipelining of TMS320c67XX (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		

Sessional Examination 2			*	
Assignment/Presentation		*	*	
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Sanjith K Mitra, "Digital Signal Processing", McGraw Hill Education, 4 Edition, July 2013. 2. Oppenheim and Schafer, "Digital Signal Processing", Pearson, First Edition, 1975. 3. Roman Kuc, "Digital Signal Processing", McGraw-Hill Education, 1988. 4. Proakis and Manolakis, "Digital Signal Processing", Prentice – Hall, Inc., Third Edition, 1996. 5. Rabinder and Gold, "Theory and Application of Digital Signal Processing", Prentice Hall India Learning Private Limited, 1988. 6. Hwei P Hsu, Schaum's Outline of "Signals and Systems", 3rd Edition, 2013. 7. Symon Haykins, "Signals and Systems", Wiley, Second Edition, 2002.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Application Development
Course Code: IOT-606	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Introductory Course in IoT, Networking Basics, Programming aspects, Operating system, Linux

Synopsis:	This Course provides insight on 1. Various steps involved in the development of application for IoT. 2. Functional aspects of linux Operating system for desktop applications and embedded boards. 3. Scripting languages like shell and python. 4. Client Server architecture and Python APIs of Socket programming. Database and Python Database connectivity, Python Web Programming, IoT Framework.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe the developmental aspects of the application in IoT.
CO 2:	Demonstrate the usage of linux Operating system for desktop and embedded environment.
CO 3:	Demonstrate the programming skills in scripting languages like shell and python.
CO 4:	Demonstrate the fundamental concepts in Client Server architecture and database.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*			*							
CO 2		*	*								
CO 3				*	*						
CO 4			*	*	*						

Course content and outcomes:

Content	*Competencies*
Unit 1: IoT Application	
Development Cycle of IoT, Software & Hardware, Application Types, IoT Platforms, Cloud Platforms for IoT	At the end of the topic student should be able to: 1. Outline the various elements of IoT ecosystem. (C2)
Unit 2: Booting	
Introduction to Linux, Functions of an OS, OS Structure, Linux Structure, Booting of Process, GRUB, GRUB2, UEFI, Booting with Embedded boards, Embedded Boot Loaders, Toolchain, Cross Compilation of the Kernel .	1. Explain the Linux OS structure. (C2) 2. Operate Boot Loaders, Toolchain, Cross Compilation of the Kernel. (C2)
Unit 3: Embedded Linux	
Introduction to Embedded Linux, Boot Loaders: U-Boot, Compiling U-Boot, U-boot Source Code, Kernel Compilation, Types of Linux Kernel, Monolithic vs Microkernel, Makefile Concepts	1. Distinguish various types of Linux Kernel, Monolithic vs Microkernel . (C3) 2. Interpret and Analyse concepts of make file. (C3)
Unit 4: Linux Commands - File Commands	
Viewing & Creating, Properties, Location, Manipulation, Compression, Disk & File Systems, Process - Scheduling, Networking	1. Demonstrate the usage of linux commands. (C3)
Unit 5: Shell Scripting	
Introduction, Constructs, File and Directory Reading, Scripting for real time applications, Document Here – Make Concepts, sed, grep, awk, Regular Expressions	1. Usage of various shell commands and scripting for real time applications. (C3)
Unit 6: Python Scripting	

Introduction to Python, Python Datatypes, Constructs, Sockets, Python Socket Programming, Python Database Connectivity, MQTT Application	1. Demonstrate the programming skills in Python for socket communication, database, MQTT application. (C3)
Unit 7: Sockets	
Introduction to Sockets, Client Server Architecture, Unix Sockets, PORTS, Python APIs of Sockets, TCP socket programming using Python, UDP – RAW packets python programming	1. Outline Client Server Architecture. (C1) 2. Illustrate the socket communication using python API's for stream and datagram-oriented use cases. (C4)
Unit 8: Databases & Web Programming	
Introduction to Databases, File System vs RDBMS, ER Diagram, Python Database connectivity (CRUD), Web Server Concepts, Python Web Programming, IoT Framework	1. Discuss File System vs RDBMS (C2) 2. Describe Python Database connectivity (CRUD) (C2) 3. Describe web Server Concepts (C2) 4. Demonstrate Python Web Programming and IoT Framework (C3)
Unit 9: IoT Applications with Cloud	
Case Study	**1.** Discuss a case study on IoT Applications with Cloud. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-

TOTAL	44	74

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation	*	*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Arshdeep Bhaga, Vijay Madishetti, "Internet of things: A hands on Approach", Universities Press, ISBN:978172719547, 2015. 2. "Beginning Linux Programming", Wrox, 3rd edition, 2004. 3. Yaswant Kannetkar, "Unix Shell Scripting", BPB Publications, 2003. 4. Brandon Rhodes and John Goerzen, "Foundations of Python Network Programming", 2nd Edition, Apress, 2010. 5. Pankaj Tanwar, "Socket Programming Article Series", 2011.

MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Data Structures and Algorithms Lab
Course Code:	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** C Programming

Synopsis:	This Course provides insight on 1. This course introduces students to elementary data structures and design of algorithms. 2. Students learn how to design optimal algorithms with respect to time and space 3. Students learn how to implement link list, stack, queues, searching and sorting techniques, sets, trees and graphs. 4. Students learn the design of divide and conquer technique, dynamic programming, greedy technique and back tracking
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Specify and analyse algorithms
CO 2:	Learn and design programs for implementation of linear and non-linear data structure.
CO 3:	Learn and design programs for sorting and searching.
CO 4:	Illustrate application of divide and conquer technique, dynamic programming, greedy technique and back tracking.
CO 5:	Learn to organise the code for scalability and maintainability.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1		*									
CO 2		*	*		*			*			
CO 3		*	*		*			*			
CO 4		*	*		*			*			
CO 5		*	*		*			*			

Course content and outcomes:	
Content	***Competencies***
Unit 1: Elementary data structures	
Implementation of Lists, Stacks, Queues	1. Design and Implement singly linked list 2. Design and Implement doubly linked list 3. Design and Implement array-based stack 4. Design and Implement pointer-based stack 5. Design and Implement array-based queues. 6. Design and Implement pointer-based queues.
Unit 2: Sorting & Searching Techniques	
Quick sort, Heap sort, Merge sort, Binary search, linear search, Fibonacci search	1. Design and implement programs for insertion sort, bubble sort and selection sort. 2. Design and implement programs for quick sort 3. Design and implement programs for heap sort 4. Design and implement programs for merge sort 5. Design and implement programs for binary, linear and Fibonacci search
Unit 3: Trees	
Basic Terminology, Implementation of Trees, Binary Trees, Binary Search Trees	1. Write a program to implement binary trees 2. Write a program to implement binary search trees 3. Tree traversal technique
Unit 4: Graphs	
Basic definitions, Representation of Graphs, Minimum Cost Spanning Tree,	1. Write programs to represent a graph using adjacency matrix and adjacency list techniques

Single Source Shortest Paths, All-Pairs Shortest Path	2. Write a program to implement minimum cost spanning tree 3. Write a program to solve Single source shortest path problem 4. Write a program to solve All- pair shortest path problem
Unit 5: Algorithm Design Techniques	
Divide-and-Conquer Algorithms, Dynamic Programming, Greedy Algorithms, Backtracking	Write a program to solve max min problem Write a program to solve Strassen's matrix multiplication problem 3. Write a program to solve matrix chain order problem 4.Write programs to solve knap-sack, job scheduling with dead line and optima storage on taps problems. 5. Write programs to solve n queens and graph colouring problems

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:		
Formative:		**Summative:**
Internal practical Test		Sessional examination
Theory Assignments		End semester examination
Lab Assignment & Viva		Viva

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2		*	*	*	
Assignment/Presentation	*	*	*	*	*
Laboratory Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Introduction to Algorithms" Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest. 2. "Data Structures& Algorithms" Aho, Hopcroft and Ulmann 3. "Data structures and algorithm analysis in C" Mark Allen Weiss 4. "Computer Algorithms" : Ellis Horowitz, SartajSahni, SanguthevarRajasekaran

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Operating Systems for IoT Lab
Course Code: IoT 601L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Programming skills

Synopsis:	This Course provides insight on 1. Basics of operating systems and real time operating systems. 2. Understand the concepts of process management, scheduling, synchronization and dead locks. 3. Concept of memory management. 4. The salient features of real time operating systems with case study of RTx 5. To understand the concepts of event driven programming with case study of tiny OS and Contiki
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Implementation of various scheduling algorithms
CO 2:	implement and evaluate FCFS, SJF, PS, RR, Multi-level queues, multi-level feedback queues scheduling algorithms
CO 3:	Understand real time scheduling concepts through RTx programming
CO 4:	Understand the concept of IoT operating system through tiny OS programming
CO 5:	Understand the concept of event driven programming through Contiki

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*			*						
CO 2		*	*								
CO 3		*									
CO 4		*			*						
CO 5		*			*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction	

OS vs RTOS, Functions of Operating Systems, Introduction to Kernel, Types of Kernel, User space vs Kernel Space.	1. Identify the features of OS and RTOS (C2) 2. Distinguish between single processor and multi-processor systems (C2) 3. Identify the features of batch processing, time sharing, multi programming and interactive systems (C2) 4. Distinguish between user and kernel modes (C2) 5. Distinguish between function and system calls (C2)
Unit 2: Process Management	
The process concept, synchronization, mutual exclusion, semaphores, and monitors, Threads, Inter- process communication	1. Describe a process, process state, process control block (C2) 2. Apply scheduling algorithms, scheduling queues (C3) 3. Examine process related system calls (C1) 4. Experiment inter process communication through share memory and sockets (C4)
Unit 3: Resource Allocation, Deadlock prevention, avoidance, and detection	
The OS Kernel, Micro and Monolithic kernels, Multi-tasking, privilege, interrupt handling, System and user processes, System calls	1. Examine methods for handling dead locks (C3) 2. Write dead lock prevention algorithms (C3) 3. Write dead lock avoidance algorithm (C3) 4. Write dead lock recovery algorithm(C3)
Unit 4: Time Management	
Time Management, CPU scheduling algorithms, Real-time scheduling, Disc access scheduling	1. Distinguish between scheduling algorithms (C2) 2. Examine the criteria for scheduling (C3) 3. Examine Disc access scheduling (C3)
Unit 5: Real Time OS	
Real Time OS, OS calls in RTOS, RTx Kernel OS calls – Examples	1. Examine Real Time OS (C3) 2. Illustrate OS calls in RTOS (C3) 3. Illustrate OS calls in RTx (C3)
Unit 6: Real Time Systems	

Operating systems for IoT, Pre emption vs Event Driven, Event Driven Programming, Tiny OS vs Contiki	1. Examine the concepts involved in the design of real time systems (C3) 2. Illustrate real time clocks in various real time languages(C3) 3. Describe the concepts of time outs in message passing, semaphores and monitors (C1) 4. Compare various priority inheritance algorithms (C4) 5. Explain the concept of response time analysis (C2) 6. Examine Event driven programming using Tiny OS and Contiki (C3)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*		*		*
Laboratory Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Abraham Silberschatz, Peter Galvvin, Grag Gagne, "Operating System principles", Seventh Edition, John Wiley Publications, 2006. 2. Allan Burns, Andy Wellings, "Real – Time Systems and Programming Languages", Fourth Edition, Pearson Education Canada, 2009. 3. Milan Milenkovic, "Operating Stems Concepts and Design", McGraw Hill Higher Education, 1987. 4. Maurice Bach (IPC), "Design of Unix Operating System", Prentice-Hall, Inc., 1986. 5. Kerninghan & Ritchie, "The C Programming Language", Second Edition, Prentice-Hall, 1988. 6. www.freertos.org , "The FreeRTOS Reference Manual", Real Time Engineers Ltd. 2016.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Networks and Protocols Lab
Course Code: IoT 602L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Basic Programming Skills

Synopsis:	This Course provides insight on 1. To understand the concepts of basic wired and wireless networks 2. To learn different layers of OSI Model. 3. To learn about Software Defined Networks (SDN), Network Function Virtualization (NFV)
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Illustrate classification of networks.
CO 2:	Implement different protocols used in OSI Layers.
CO 3:	Implement Software Defined Networks (SDN), Network Function Virtualization (NFV).

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*				*	*					
CO 2	*					*					
CO 3	*				*	*					

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Components of Networks, Network OSI Model	1. Demonstrate simple network using NS2
Unit 2:	
Application layer, Transport Layer	1. Demonstrate HTTP Protocol 2. Demonstrate FTP and SMTP Protocol 3. Demonstrate CoAP Protocol

	4. Demonstrate MQTT Protocol 5. Demonstrate SSH, DHCP Protocol
Unit 3:	
Software Defined Networks (SDN), Network Function Virtualization (NFV)	2. Demonstrate SDN in a virtual environment

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*		

Sessional Examination 2		*	
Assignment/Presentation	*	*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Jim Doherty, "SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization", Addison-Wesley Professional, 2016. 2. Larry L Peterson & Bruce S Davie, "Computer Networks – a Systems Approach", 5th Ed. Elsevier, MK Publishers, 2011. 3. Behrouz A Forouzan, "TCP/IP Protocol Suite", TMH, 3rd Edition, 2005. 4. Arshdeep Bhaga, Vijay Madishetti, "Internet of things: A hands on Approach", Universities Press, ISBN:978172719547, 2015. 5. William Stallings, "Wireless Communications & Networks", Pearson, 2nd Edition, 2004. 6. Jean-Philippe Vasseur and Adam Dunkels." Interconnecting Smart Objects with IP – The Next Internet", Morgan Kaufmann, 2010. 7. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", Willey, 2009. 8. RFC's on COAP, XMPP, MQTT, AMQP - Internet resources.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Security Lab
Course Code: IOT 603L	**Course Instructor:**
Academic Year: 2020 – 2021	**Semester:** First Year, Semester 1
No of Credits: 3	**Prerequisites:** Cryptography Basics, Networking Basics, Programming aspects

Synopsis:	This Course provides insight on 1. The Security Architecture and requirements of IoT. 2. Basics of Cryptography, Symmetric Key Cryptography, Asymmetric Key Cryptography, PKI, Hashing, Digital signatures. 3. Various types of Threats, Attacks in network and IoT architecture and the methods to mitigate the same using various network security strategies. 4. Concepts of Blockchain, Crypto-currencies, IOTA Cyber security strategies like Intrusion Detection Systems, Intrusion Prevention System.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the concepts of cryptography, Hashing and digital signature to maintain the Confidentiality, Integrity of a data against the threats in the networks.
CO 2:	Model and construct the block chain application.
CO 3:	Experiment the SQL injection vulnerability attack on websites.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*	*	*					*	
CO 2	*		*	*	*					*	
CO 3	*		*	*	*					*	

Course content and outcomes:

Content	*Competencies*
Unit 1: Installation and usage of Eclipse IDE	
Installation of Java SDK, Eclipse IDE, environment setting, Project creation, building a project, running a sample project	At the end of the topic student should be able to: 1. Demonstrate the usage of Eclipse IDE. (C3)
Unit 2: Implementation of Cryptographic Algorithms	
Implementation of Cryptographic Algorithms: Transposition cipher, Hill Cipher, playfair cipher, Ceaser Cipher, AES, DES, RSA.	1. Practice various Cryptographic Algorithms (C3)
Unit 3: Implementation of Hashing Algorithms	
SHA0, SHA1, SHA 256.	1. Experiment various Hashing Algorithms. (C4)
Unit 4: Usage of Digital Signatures	
How to get a Digital Signatures, verification of digital signatures.	1. Discover the Usage of Digital Signatures
Unit 5: Block chain	
Creation and verification of block chain	1. Model a simple block chain scenario. (C4)
Unit 6: SQL Injection	
Evaluating and launching of SQL injection attack for different cases.	1. Experiment SQL injection attack for different cases. (C4)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*

Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	
Laboratory examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Fei Hu," Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 2016. 2. Stephen Northcutt, Donald McLachlan, Judy Novak, "Network Intrusion Detection: An Analyst's Handbook", New Riders, 2000. 3. Stephen A. Thomas, "SSL & TLS Essentials: Securing the Web", John Wiley & Sons, 2000.

	4. Don Tapscott and Alex Tapscott, "Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World", Portfolio, 2016. 5. B. Rusell and D. Van Duren, "Practical Internet of Things Security", Packt Publishing, 2016. 6. A. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016. 7. A. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014. 8. Internet Resources. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach", Cambridge University Press, 2011.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Fundamentals of Machine Learning Lab
Course Code: BDA-601L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Basics of Programming

Synopsis:	This Course provides insight on
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify the software and tools for designing machine learning applications.
CO 2:	Apply concept learning and hypothesis space.
CO 3:	Apply machine learning approach to reduce the dimension.
CO 4:	Analyse different machine learning algorithms.
CO 5:	Design ensemble methods.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction	
Definition of Machine Learning Goals and applications of machine learning	1. Identify programming environments available for the machine learning (C1)

Basic design issues and approaches to machine learning Types of machine learning techniques	2. Classify the pros and cons of various environments for ML coding (C2)
Unit 2: Inductive Classification	
The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Inductive bias.	1. Design a machine learning model to get a Maximally Specific Hypothesis for the given training examples (C5). 2. Construct a machine learning model to obtain most general and most specific hypotheses for the given training examples (C5)
Unit 3: Decision Tree learning	
Representing concepts as decision trees. Recursive induction of decision trees. Picking the best splitting attribute Entropy and information gain. Searching for simple trees and computational complexity.	1. Develop a machine learning classifier using decision tree and random forest (C5) 2. Examine different applications of decision tree and random forest (C4)
Unit 4: Computational learning theory	
Models of learnability: learning in the limit. Probably Approximately Correct (PAC) learning.	1. Design a learning method to determine the sample complexity of training examples (C5) 2. Analyse bias-variance trade-off, under-fitting and over-fitting concepts (C4)

Sample complexity: quantifying the number of examples needed to PAC learn. Computational complexity of training. Sample complexity for finite hypothesis spaces. Noise. Learning Multiple Classes. Bias-variance trade-off, under-fitting and over-fitting concepts.	
Unit 5: Bayesian learning	
Probability theory and Bayes rule. Naive Bayes learning algorithm - Parameter smoothing. Generative vs. discriminative training Logistic regression. Bayes nets and Markov nets for representing dependencies	1. Design a machine learning model using Bayes learning (C5). 2. Develop a machine learning classifier models using different approach (C5) 3. Design Bayes nets and Markov nets for representing dependencies (C5)
Unit 6: Instance-based learning	
Constructing explicit generalizations versus comparing to past specific examples. K-Nearest Neighbour learning algorithm. Case-based reasoning (CBR) learning.	1. Design machine learning models to classify the instances using K-NN and CBR approaches (C5).
Unit 7: Continuous Latent Variables	
Principal Component Analysis (PCA), Applications of PCA	1. Apply PCA for different complex applications (C3)
Unit 8: Ensemble methods (bagging and boosting)	

Using committees of multiple hypotheses. Bagging Boosting DECORATE Active learning with ensembles.	1. Design a Bayesian Networks (C5) 2. Develop machine learning models using Ensemble models. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5

Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation	*	*	*	*	*
Laboratory Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Machine Learning, T. Mitchell, McGraw-Hill, 1997 2. Machine Learning, E. Alpaydin, MIT Press, 2010 3. Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006 4. Pattern Classification, R. Duda, E. Hart, and D. Stork, Wiley-Interscience, 2000 5. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, 2nd Edition, 2009 6. Machine Learning for Big Data, Jason Bell, Wiley Big Data Series 7. Multidimensional Neural Networks Unified Theory, Rama Murthy G 8. Current literature

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Cloud Application Development with JAVA Lab
Course Code: CDC-603L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** Year, Semester
No of Credits: 1	**Prerequisites:** Cloud Application Basics, OOP's concepts, Java programming language, IoT Basics

Synopsis:	This Course provides insight on 1. Cloud application development with IoT devices using Java Programming. 2. To Provide practical knowledge of design and develop of Java application with WebSocket, MQTT protocol and create RESTful API's.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Develop java application using MySQL database.
CO 2:	Develop Java Web application for client server communication.
CO 3:	Deploy web application to cloud.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*						
CO 2	*				*						
CO 3	*				*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Basic Java Programming	
OOPS Concepts, Basics of Java Programming, IDE usage.	1. Basic Java program to Implement mathematical calculation concepts. (C1)
Unit 2: Databases Using Java	

CRUD Operations	1. Using MySQL database to implement create, select, update and delete operations. (C1) 2. Develop java application to connect to MySQL database and interact. (C1)
Unit 3: Server Client Implementation	
Web Socket Programming.	1. Implementation of Web Socket's using java for real time communication. (C3) 2. Develop Java Web application for client server communication for simple chat application. (C3)
Unit 4: Web Application Development	
Web Application Development using Swings.	1. Develop Java Application to create student registration portal using swings and MySQL database. (C2) 2. Deploy web application to cloud hosing. (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	*
Assignment/Presentation	*	*	
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. William Hohl, Christopher Hinds,"ARM Assembly Language: Fundamentals and Techniques",2nd Edition, ISBN-13: 978-1482229851, ISBN-10: 1482229854 2. Andrew Sloss, Dominic Symes, Chris Wright,"ARM System Developer's Guide: Designing and Optimizing System Software",1st Edition,The Morgan Kaufmann Series in Computer Architecture and Design, ISBN-13: 978-1558608740, ISBN-10: 1558608745 3. David Seal, "ARM Architecture Reference Manual", 2nd Edition, Addison-Wesley Professional. 4. Steve Furber,"ARM System-on-Chip Architecture",2nd Edition,Addison-Wesley Professional, ISBN-13: 078-5342675191,ISBN-10: 0201675196 5. Douglas V. Hall,"Microprocessors and Interfacing",Mcgraw Hill Educatin ,ISBN-10 1259006158,ISBN-13 9781259006159,2012. 6. Websites & Transaction Papers

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IoT Application Development Lab
Course Code: IOT-606L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 1
No of Credits: 1	**Prerequisites:** Introductory Course in IoT, Networking Basics, Programming aspects, Operating system, Linux

Synopsis:	This Course provides insight on 1. Various steps involved in the development of application for IoT. 2. Functional aspects of Linux Operating system for desktop applications and embedded boards. 3. Scripting languages like shell and python. 4. Client Server architecture and Python APIs of Socket programming. 5. Database and Python Database connectivity, Python Web Programming, IoT Framework.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Demonstrate the developmental aspects of the application in IoT.
CO 2:	Demonstrate the usage of Linux Operating system for desktop and embedded environment.
CO 3:	Demonstrate the programming skills in scripting languages like shell and python.
CO 4:	Demonstrate the fundamental concepts of database management.

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	PO9	*PO 10*	*PO 11*
CO 1	*				*						
CO 2	*			*	*						
CO 3	*			*	*						
CO 4	*			*	*						

Content	***Competencies***
Unit 1	
IoT Application, IoT Applications with Cloud, Booting, Embedded Linux	Demonstrate the various levels of IoT from level-1 to level-6. (C3)

Unit 2	
Linux Commands - File Commands, Shell Scripting, Python Scripting	1. usage of linux commands for various operational purposes. (C3) 2. Practice scripting for real time applications. (C3) 3. Demonstrate the programming skills in Python for socket communication, database, MQTT application. (C3)
Unit 3	
Sockets, Databases & Web Programming	1. Demonstrate client server application using socket programming. (C3) 2. Demonstrate the use case for database application in python. (C3) 3. Show the server-side implementation of Web Programming using python. (C3)

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination

Lab Assignment & Viva	Viva

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation	*	*	*	*
Laboratory Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Arshdeep Bhaga, Vijay Madishetti, "Internet of things: A hands on Approach", Universities Press, ISBN:978172719547, 2015. 2. "Beginning Linux Programming", Wrox, 3rd edition, 2004. 3. Yaswant Kannetkar, "Unix Shell Scripting", BPB Publications, 2003. 4. Brandon Rhodes and John Goerzen, "Foundations of Python Network Programming", 2nd Edition, Apress, 2010. 5. Pankaj Tanwar, "Socket Programming Article Series", 2011.

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Digital Signal Processing Lab
Course Code: ESD-603L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** Year 1, Semester 1
No of Credits: 1	**Prerequisites:** Knowledge of Signals and Systems and Basic Knowledge of Matlab

Synopsis:	This Course provides insight on 1. Understanding of basics of Signal and Systems as pre-requisite. 2. Understanding the concepts of Fast Fourier Transforms. 3. Learning hardware implementation of systems. 4. Learning FIR and IIR Filter Designs. 5. Learning concepts of multi-rate signal processing in the form of sampling rate conversion, structures of sampling rate converters and some applications of sampling rate converters 6. Understanding three optimum Weiner filters, adaptive algorithm and transforming Weiner filters in to adaptive filters 7. Understanding architecture, memory management and pipelining concepts of TMS320C67XX processor through self-stud.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Use matlab to implement various DSP techniques. (C3)
CO 2:	Experiment DFT, LTI techniques and analyse the results. (C4)
CO 3:	Design FIR, Butterworth and Chebychev filters in matlab. (C5)

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*		*	*						
CO 2	*	*			*						
CO 3	*	*		*	*						

Course content and outcomes:

Content	*Competencies*
Unit 1:	
Write matlab programs to Generate waves Write matlab programs to Addition of two sequences Write matlab programs to Find convolution of two sequences and verify the result using built-in function User defined Matlab function to find convolution of two sequences and verify the result	1. Use Matlab to generate waves.(C3) 2. Use Matlab for addition of two sequences.(C3) 3. Compute convolution of two sequences using Matlab. (C3) 4. Analyse the convolution usinf built in functions. (C4) 5. Practice convolution user defined function in Matlab (C3)
Unit 2:	
Write matlab programs to Find DTFT of a sequence. Write matlab programs to Find DFT of a sequence and verify using built-in function User defined Matlab function to find DFT and verify the result Write matlab programs to Find convolution of two sequences using DFT Write matlab programs to Find the time response of an LTI system defined by either difference equation or transfer function	1. Experiment DTFT of a sequence using Matlab (C4) 2. Analyse the DFT of a sequence with built in function (C4) 3. Experiment DFT using Matlab (C4) 4. Compute convolution of two sequence using DFT in Matlab. (C3) 5. Experiment time response of an LTI system in Matlab (C4)
Unit 3:	
Write Matlab programs to find DFT using DIT-FFT and DIF-FFT algorithms, compare the result using built in function. Design FIR filters with frequency domain specification (LP, HP, BP	1. Analyse DIT-FFT and DIF-FFT algorithms. (C4) 2. Design FIR filters with frequency domain specifications. (C5)

and BR) using Frequency Sampling Technique and verify frequency response. Design FIR filter to meet required impulse response using Frequency Sampling Technique.	
Unit 4:	
Write Matlab programs to Design FIR filters with frequency domain specification (LP, HP, BP and BR) using different window functions and verify frequency response. Design analog Butterworth and Chebychev filters using built-in functions, transform them to digital filter and verify their frequency response (C2). Design digital Butterworth and Chebychev filters using built-in functions verify the frequency response (C2)	1. Design FIR filters with frequency domain specifications. (C5) 2. Design analog Butterworth and Chebychev filters using built-in functions. (C5) 3. Design digital Butterworth and Chebychev filters using built-in functions. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-

Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Assignment/Presentation			*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Digital Signal Processing", Sanjith K Mitra 2. "Digital Signal Processing", Oppenheim and Schafer 3. "Digital Signal Processing", Roman Kuc 4. "Digital Signal Processing", Proakis and Manolakis 5. "Digital Signal Processing ", Rabinder and Gold Shaum Out-Line Series 6. "Signals and Systems", Symon Haykins DSP Processors and Fundamentals 7. "Multirate signal processing", Vaidyanathan 8. "Handbook of DSP", Elliot

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Mini Project - 1
Course Code: IOT 695	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester1
No of Credits: 4	**Prerequisites:** Any programming language and circuit basics

Synopsis:	Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the objectives of the project work and provide an adequate background with a detailed literature survey
CO 2:	Breakdown the project into sub blocks with sufficient details to allow the work to be reproduced by an independent researcher
CO 3:	Compose hardware/software design, algorithms, flowchart, methodology, and block diagram
CO 4:	Evaluate the results
CO 5:	Summarize the work carried out

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1				*							
CO 2					*			*			
CO 3							*			*	
CO 4						*					*
CO5:							*				

Course content and outcomes:

Content	***Competencies***
Phase 1	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2) 3. Prepare the outline (C3) 4. Describe the status of the project (C2) 5. Prepare a mid-term project presentation report (C3) 6. Prepare and present mid-term project presentation slides (C3, C5) 7. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	48	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-

Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	03	-
TOTAL	**51**	**09**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Seminar - 1
Course Code: IOT 697	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester2
No of Credits: 1	**Prerequisites:** Communication Skill
Synopsis:	1. To select, search and learn technical literature. 2. To Identify a current and relevant research topic. 3. To prepare a topic and deliver a presentation. 4. To develop the skill to write a technical report. 5. Develop ability to work in groups to review and modify technical content.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Show competence in identifying relevant information, defining and explaining topics under discussion.
CO 2:	Show competence in working with a methodology, structuring their oral work, and synthesizing information.
CO 3:	Use appropriate registers and vocabulary, and will demonstrate command of voice modulation, voice projection, and pacing.
CO 4:	Demonstrate that they have paid close attention to what others say and can respond constructively.
CO 5:	Develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*							*	*		*
CO 2	*							*	*		*
CO 3	*							*	*		*

CO 4	*							*	*		*
CO5:	*							*	*		*

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:

Formative:	**Summative:**
Seminar Topic Selection	
Synopsys review	
PPT Review	

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen Seminar

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Big Data and Data Visualization
Course Code: BDA 614	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Programing in Python or Java

Synopsis:	This Course provides insight on 1. This course aims to help students get started with Architectures of distributed file systems and distributed computing. 2. Students learn probability and statistical Inference techniques. 3. Students learn machine learning algorithms required for big data applications. 4. Students learn to map data attributes to graphical attributes, and strategic visual encoding based on known properties of visual perception.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Understand the architecture of distributed systems and distributed computing.
CO 2:	Identify the characteristics of datasets and compare the trivial data and big data for various applications.
CO 3:	Explain concept learning task and hypothesis space, distinguish between general and specific hypotheses, identify the maximally specific hypotheses, Describe version spaces and candidate elimination algorithm.
CO 4:	To solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
CO 5:	Practical experience building and evaluating visualization systems.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*

CO 1	*	*	*								
CO 2	*	*	*								
CO 3	*	*	*	*							
CO 4	*	*	*								
CO 5	*	*	*				*				

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Big Data	
Terminology – Challenges - Architectures – Distributed File Systems – Google File System – Hadoop File Systems - Hadoop Ecosystems.	5. Describe architecture of Google file system. (C2) 6. Describe architecture of Hadoop systems. (C2)
Unit 2: Statistics	
Sampling Techniques - Data classification, Tabulation, Frequency and Graphic reporesentation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis.	1. Define True Error of a hypothesis, ε-exhausted Version Space, PAC Learning and Agnostic Learning (C1). 2. Describe data sampling techniques. (C2)
Unit 3: Databases for Big Data	
Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing	1. Describe is Data Science. (C2) 2. Describe the characteristics of NoSQL. (C2)

data – cleaning and sampling for modeling and validation – Big Table vs HBase introduction to NoSQL - HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing.	3. Describe the principle of Map Reduce technique. (C2)
Unit 4: Machine Learning for Big Data	
Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – supervised and unsupervised learning - Issues regarding classification and prediction, Bayesian Classification, Classification by backpropagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.	5. Apply candidate-elimination algorithm to obtain most general and most specific hypotheses for the training examples. (C3) 6. Apply the concept of entropy and information gain to find the root node of the decision tree (C3). 7. Design a model using K-means classifier to predict how well products are accepted by the clients (C3).
Unit 5: Stream Computing in Big Data	
Introduction - Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines – Issues in Stream Processing - Phases in Streaming Analytics Architecture - Vital Attributes - High Availability – Low Latency – Horizontal Scalability-	1. Understanding issues with stream processing in big data (C3). 2. Describe how big data systems achieve high availability and low latency. (C2) 3. Describe how Spark does in memory processing. (C3)

Fault Tolerance - Service Configuration and Management - Apache ZooKeeper - Distributed Stream Data Processing: Co-ordination, Partition and Merges, Transactions. Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing a storage system – NoSQL Storage Systems.	
Unit 6: Security in Big Data	
Privacy – Identification of Anonymous People – Why Big Data Privacy is self-regulating? – Ethics – Ownership – Ethical Guidelines – Big Data Security – Organizational Security - Steps to secure big data – Classifying Data – Protecting – Big Data Compliance - HADOOP SECURITY DESIGN	1. Describe why Big Data Privacy is self-regulating. (C2) 2. Describe the steps to secure big data systems. (C2)
Unit 7: Data Visualization, Characterization – Data Wrangling	
Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions - DATA AGGREGATION, GROUP OPERATIONS ,TIMESERIES - GoupBy Mechanics – Data Aggregation – Groupwise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting - WEB SCRAPING - Data Acquisition by	1. Understanding various formats of data. (C1) 2. Design programs to dynamically extract data from web. (C4) 3. Design programs to read data from various data sources. (C4) 4. Create visualization for time series data. (C4) 5. Create visualization for statistical distributions. (C4) 6. Create visualization for maps, Hierarchical data and network data. (C4)

Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors - Data Visualization Tools	

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*	*		
Sessional Examination 2			*	*	*
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*
Laboratory examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. HADOOP: The definitive Guide, Tom White 4th edition, O Reilly Publication 2. Python for Data Analysis, Wes Mc Kinney, O Reilly Publication. 3. Practical Data Science with R, Nina Zumel, John Mount, Manning Publications. 4. Machine Learning, E. Alpaydin, MIT Press, 2010

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Embedded Systems
Course Code: ESD 605	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Microprocessor architecture, Microcontroller Architecture, Assembly language and Number systems.

Synopsis:	This Course provides insight on 1. This course provides the knowledge of ARM Cortex M3 Processor architecture 2. This course provides the knowledge of Microcontroller based on ARM Processor architecture and its Registers and Instruction sets to write Assembly and Embedded C Programming. 3. This course provides the concept of Interfacing and Programming Sensors and Peripherals to Microcontrollers. 4. This course provides the concept of Communication Protocols required for multi-processor communication. 5. This course provides the concept of Real time operating systems on Microcontrollers. 6. This course provides the concept of Designing Real Time Embedded Systems using ARM Microcontroller.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Employ the knowledge of Microcontrollers to build Embedded systems. (C3)
CO 2:	Explain the concept of Programming ARM Microcontrollers using Assembly and Embedded C. (C2)
CO 3:	Design a Real time Embedded Systems by interfacing Sensors, Actuators and porting Real time operating systems. (C5)

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2	*	*	*		*						
CO 3	*	*	*		*						

Course content and outcomes:	
Content	***Competencies***
Unit 1: Introduction to Embedded Systems	
Design Challenges, Processors Technology, Design Technology	At the end of the topic student should be able to: 1. Describe the Design issues in designing the Embedded Systems.(C1) 2. Discuss the design technology associated with Embedded Systems.(C2)
Unit 2: Introduction to ARM Cortex processor	
Variants of Cortex and ARM versions, Comparison of M-series processor, Architecture, Programmers Model, APSR register, Memory Model, Exception, Interrupts, Reset	1. Explain about ARM Processor architecture (C2) 2. Describe ARM Cortex m3 processor data path, Register set, Programming models and memory map (C2) 3. Describe about ARM Cortex M3 Processor Instruction set. (C2) 4. Describe about ARM Processor system bus and Interrupt controller (C2) 5. Describe about interrupt and Exception handling (C2) 6. Describe ARM Microcontroller architecture. (C2)
Unit 3: Instruction Set Architecture	
More on Memory System, Exceptions and Interrupts, NVIC, Memory Protection Unit, Assembly Programming, Embedded C programming, CMSIS, Startup Code	1. Describe ARM Cortex memory system. 2. Describe interrupt and Exception handling (C2) 3. Describe NVIC, Memory Protection Unit. (C2) 4. Discuss CMSIS implementation in ARM Cortex.(C2)
Unit 4: Introduction to LPC13/17xx Microcontroller	
Memory Mapping, Registers involved and programming with GPIO, PWM	1. Discuss Memory Mapping, Registers involved and programming with GPIO, PWM. (C3)

	2. Apply knowledge of ARM Microcontroller architecture to rig up Embedded system circuits(C3)
Unit 5: Data Acquisition System	
ADC, Types of ADC, Choosing the ADC, DAC	1. Identifying various types of ADC. (C1) 2. Review ADC and DAC selection criteria. (C2)
Unit 6: Serial Communication	
UART, I2C, SPI, Interfacing	1. Discussing various types of Serial Communication mechanism. (C2)
Unit 7: USB BUS	
Speed Identification on the bus, States, Packets, Data flow types, Enumeration, Descriptors, USB Interface –C Programs	1. Identify USB types, Firewire devices, ports, cables. 2. Describing Enumeration, Descriptors mechanism in USB.(C2)
Unit 8: CAN BUS	
Introduction, Frames, Bit stuffing, Types of errors, Nominal Bit Timing, A simple application with CAN	1. Describe the nature of CAN and the basic CAN protocol, and the basic structure of a CAN network. (C2) **2.** Prepare a simple application with CAN. (C3)
Unit 9: Introduction to Multitasking in Microcontrollers	
Variants of RTOS, FreeRTOS, UCOS, uCLinux, FreeRTOS on Cortex based Microcontrollers, TASK CREATION, QUEQUES, SEMAPHORE, MUTEX, Application development	1. Describe about Real time operating systems role in building real time systems (C3) 2. Describe about Designing Real Time Embedded systems by interfacing peripherals and actuators (C2) 3. Design a Real time Embedded system by writing applications on

	top of Real time operating systems (C5)
Unit 10: Designing a Digital Camera	
Introduction, Requirement, Specifications, Implementation, Testing	**1.** Summarize the stages involved in designing a digital camera. (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	
End Semester Examination	*	*	*

Feedback Process	• Mid-Semester feedback

	• End-Semester Feedback
Reference Material	1. Joseph Yiu, "The definitive guide to the ARM Cortex-M3", Elsevier, 2nd Edition, 2010. 2. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India, ISBN:81-265-0837-X, 2007. 3. Richard Barry, "NXP Semiconductors, LPC13xx/17xx User Manual", 2012. 4. NXP Semiconductors, "LPCzone Examples", 2012. 5. "FreeRTOS Reference Manual", Real Time Engineers Ltd., 2016.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Embedded Sensing Systems and Networks
Course Code: IOT 604	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basics of sensors, Basics of communication

Synopsis:	This Course provides insight on: 1. Various types of sensors used in practical applications and their characteristics. 2. Protocols for Wireless Communications. 3. Principle of working of Global Positioning System 4. Concepts and applications of Wireless Sensor Networks
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Identify various types of sensors available and its applications.
CO 2:	Discuss different wireless communication protocols used and the standards.
CO 3:	Describe the working of Global Positioning System and issues related in it.
CO 4:	Describe the working of Wireless Sensors Networks and its applications.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*						
CO 2	*				*					*	
CO 3				*				*		*	
CO 4	*			*						*	

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Embedded Systems and Networks	
Sensor and Transducers, Types of Sensors, Humidity, Pressure, Light, Magnetics, Temperature	At the end of the topic student should be able to: 1. Identify different types of sensors available for practical applications (C1) 2. Describe input – output characteristics of the sensors (C2)

	3. Demonstrate the working of few sensors through a small project (C3)
Unit 2	
Sensing Mechanism, Actuating Mechanism, Different Sensors, Sampling, Digital and Analog Sensor, Electrical Characteristics of Sensors, Choosing a sensor for IoT Network applications.	1. Describe the working of Digital and Analog sensors (C2) 2. Apply the knowledge of the sensors to acquire a real time data (C3) 3. Examine the performance of the designed network through few solved problems (C4)
Unit 3: Protocols for WPAN, Introduction to WPAN standards, Bluetooth	
Introduction, Protocol Stack, RF Classes, Radio Technologies, Service Discovery, Device Discovery, Profiles, Security (Discovering Bluetooth), Hardware, Bluetooth BLE, Bluetooth Devices, BlueZ software stack	1. Describe various types of wireless standards (C2) 2. Identity access management solutions in the protocol stack (C2) 3. Discuss Bluetooth software stack (C2)
Unit 4: Zigbee	
Frequency, Channels, Topology, Zigbee Protocol Stack, PHY, MAC Layer, Working, Frame Structure, Beacon, Non-Beacon Communication, Zigbee PDU, Zigbee Hardware devices, API Mode and AT mode communication	1. Explain frequency channel, topology of zigbee network (C2) 2. Describe the API mode & AT mode of Zigbee communication (C2)
Unit 5: Near Field Communication	
Passive and Active Devices, NFC cards Interfacing, Read and Write	1. Explain the concepts of Active and Passive NFC (C2) 2. Discuss the read write mechanism of these NFC devices (C2)
Unit 6: GPS	
Differential GPS, NMEA protocols, GPS devices, Concepts	1. Understanding the working of GPS (C3). 2. Understanding protocols used in GPS (C3). 3. Identifying the devices used in GPS system (C3)

Unit 7: Wireless Sensor Networks	
Deployment, Localization, Routing, Time Synchronization, Power Management	1. Describe the working of Wireless Sensor devices and networks (C1) 2. Design a wireless sensors network and demonstrate the working (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	
Assignment/Presentation		*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback

Reference Material	1. M.H. Bao, Micro Mechanical Transducers, "Handbook of Sensors and Actuators", Volume 8, Elsevier, 2000. 2. Ljubisa Ristic, Editor, "Sensor Technology and Devices", Artech House, 1994. 3. Vedat Coskun, Kerem Ok and Busra Ozdenizci, "Near Field Communication", Wiley Publications, 2011. 4. Todor Cooklev, "Wireless communication standards", IEEE Press, John Wiley & Sons, 2011. 5. Houda Labiod, Hossam Afifi, Costantino De Santis, "Wi-Fi, Bluetooth, Zigbee and WiMAX", Springer Publications, 2007. 6. Madhushree Ganguli, "Getting started with Bluetooth", Premier Press, ISBN 1931841837, 9781931841832, 2002. 7. Jörg Eberspächer, Hans-Jörg Vögel, Christian Bettstetter, Christian Hartmann, "GSM – Architecture, Protocols and Services" Third Edition, Wiley Publications, 2008. 8. www.trimble.com /gps_tutorial. 9. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005. 10. Ian F. Akyildiz, "Wireless Sensor Networks", Wiley & Sons, 2010. 11. Jun Zheng & Abbas Jamalipour, "Wireless Sensor Networks - A Networking Perspective", John Wiley & Sons, Inc., Publication, 2008. 12. Kazem Sohraby, Daniel Minoli & Taieb Znati "Wireless Sensor Networks - Technology, Protocols, and Applications", 2007. 13. F. Zhao and L. Guibas. Morgan Kaufmann, "Wireless Sensor Networks: An Information Processing Approach", Jul. 2004. 14. N. P. Mahalik. Springer Verlag, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications", Nov. 2006. 15. N. Bulusu and S. Jha, "Wireless Sensor Networks: A Systems Perspective", Editors, Artech House, August 2005.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Responsive Web Application Development
Course Code: IOT 605	**Course Instructor:**
Academic Year: 2019-2020	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basic Programming

Synopsis:	This Course provides insight on 1. The front-end section includes working with HTML, CSS3 and Bootstrap to design interactive and responsive web pages whereas the back-end section consists of programming in PHP with MySQL, XML, and JSON. 2. Develop a platform friendly web application or a website using Bootstrap, Angular JS, React JS, and Node JS.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Prepare a dynamic webpage by the use of java script.
CO 2:	Summarize a well-formed / valid XML document.
CO 3:	Schedule web application connect to a DBMS to perform insert, update and delete operations.
CO 4:	Practice converting the string and parse using JSON objects
CO 5:	Apply Bootstrap, Angular JS, React JS, Node JS to construct modern website

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*			*							
CO 2		*	*								
CO 3	*		*	*							
CO 4			*	*							
CO 5	*		*	*	*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction to Internet and Web Technology	

Client Server Model, Tier Architecture, Types of Servers, Web Hosting, Responsive Design	1. Explain Client Server Model, Tier Architecture 2. List out the types of Servers 3. Describe the importance of Web Hosting and Responsive Design
Unit 2: HTML	
Basic tags of HTML, Common Tags, Formatting Tags, Images and Linking, List and Table Structure, Forms, and control: Text, Radio, Checkbox, Select, Button, Input, HTML5: HTML Graphics, HTML Media, HTML API .	1. Construct the Basic web page using tags of HTML (C4). 2. Compare the difference between semantic and non-semantic tags (C5) 3. Design web page using Common Tags, Formatting Tags, Images and Linking, List and Table Structure. (C5) 4. Forms and control Text, Radio, Checkbox, Select, Button, Input(C5) 5. Explain the importance of HTML Graphics, HTML Media, HTML API (C4)
Unit 3: CSS3	
Inline styles, internal style sheets, linking external style sheets, positioning elements, backgrounds, element dimensions, Box Model and text flow, Media Types, Building a CSS drop-down menu.	1. Design web pages using Inline styles, internal style sheets, linking external style sheets(c5) 2. Differentiate between absolute and relative positioning elements(C4) 3. Apply backgrounds to web pages (c5). list out the different element dimensions (c1) 4. Importance of Box Model and text flow, Media Types (C2) 5. Building a CSS drop-down menu(c5)
Unit 4: Javascript	
Elements of Java Script - Variables, Data Types, Operators, Control Statements, Functions, Dialog - obtaining user input with prompt dialogs, Document Object	1. List out the applications of JavaScript (C1). 2. Explain the elements of Java Script - Variables, Data Types, and Operators (C3). 3. Develop web page by using conditional statement to control the execution (C5).

Model(DOM) - Document, Form, Event Handling, JQUERY, AJAX	4. Create web page to perform repetitive task using looping statements (C5) 5. Develop web page using Functions Dialog - obtaining user input with prompt dialogs. (C5) 6. Explain the importance of Document Object Model – Document(C3) 7. Validate a Form using pattern matching operators (C3). 8. Distinguish between traditional web applications and AJAX applications(C4). 9. Create web page with AJAX (C5).
Unit 5: XML vs JSON vs YAM	
Introduction and Features, Use of XML, XML document, Creating XML, DTD, Reading XML, Introduction to JSON, JSON Structure, Object Representation, YAML, YAML structure, USE Case	1. Representation, YAML, YAML structure (C3) 2. Create JSON data (C3) 3. Explain the importance of XML.(C3) 4. List out the applications of XML,(C1) 5. Construct XML document and Reading XML (C4)
Unit 6	
PHP, MYSQL Connection, CRUD Operations, Handling JSON, XML data	1. Explain the concept of server side scripting language like PHP(C2). 2. Able to connect database using MYSQL(C5) 3. Create JSON, XML data (C4)
Unit 7	
BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS	4. Create a Responsive web page using Bootstrap, Angular JS, React JS and Node JS(C5) **5.** Develop web page using the framework(C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60

Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	*	*				
Sessional Examination 2			*	*		
Assignment/Presentation	*	*	*	*	*	*
End Semester Examination	*	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004. 2. Jamsa Krishna, "Introduction to web development using HTML5", 2014. 3. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010. 4. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014. 5. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. .

	6. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008. 7. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009. 8. Brian Totty, David Gourley, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy, "HTTP: The Definitive Guide", O'Reilly Media, 2009.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Machine Learning for Big Data
Course Code: BDA-605	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Programming with Python and Data Visualization

Synopsis:	This Course provides insight on 1. This course provide the concept of neurons and biological motivation, activation functions and threshold units, supervised and unsupervised learning, perceptron network models in Artificial Neural Networks. 2. This course provide the knowledge about learning from unclassified data using clustering techniques. 3. This course provide the concept of Support Vector Machines for linear and non-linear classification. 4. This course provide the concept of Deep Learning and design of convolutional neural network for Deep Learning. 5. This course provide the knowledge about the applications and design of Reinforcement Learning algorithms.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Describe activation functions, weights and threshold units used in artificial neural networks, supervised and unsupervised learning, gradient descent approach, types of perceptron models, overfitting
CO 2:	Explain the concept of hierarchical clustering and non-hierarchical clustering, support vector machine, deep neural networks and reinforcement learning
CO 3:	Demonstrate artificial neural network models, clustering models, support vector classifier models, Deep learning models and reinforcement learning models
CO 4:	Compare and contrast single layer, multilayer and deep neural networks in terms of accuracy in classification
CO 5:	Design back propagation neural network, K-means and agglomerative clustering, deep neural network, reinforcement learning models and selection of a machine learning algorithm for the given data analysis.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Artificial Neural Networks	
Neurons and biological motivation, Activation functions and threshold units, Supervised and unsupervised learning, Perceptron Model: representational limitation and gradient descent training, Multilayer networks and back propagation, Overfitting	1. Relate biological neurons with artificial neurons and the motivation for ANN development. (C1) 2. Distinguish Supervised and unsupervised learning (C2). 3. Describe about error reduction techniques in used Artificial Neural Networks based learning (C2) 4. Write the usability of different activation functions for ANN learning system. (C3) 5. Describe the architecture of various perceptron networks. (C2)
Unit 2: Clustering	
Learning from unclassified data, Clustering. Hierarchical Agglomerative Clustering, Non- Hierarchical Clustering - k-means partitional clustering, Expectation maximization (EM) for soft clustering, Semi-supervised learning with EM using labelled and unlabelled data.	1. Write the different methods of learning from unclassified data (C3). 2. Explain the operations of various clustering models in machine learning (C5) 3. Describe the methods used for measuring dissimilarity between two clusters. (C2)

	4. Apply clustering techniques for data analysis. (C3)
Unit 3: Kernel Methods	
Dual Representations, Design of Kernels .	1. Describe Dual Representations. (C2) 2. Explain the Kernel trick for learning non-linear functions (C5)
Unit 4: Support Vector Machines (SMV)	
Maximum margin linear separators, Quadratic programming solution to finding maximum margin separators, Kernels for learning non-linear functions, Varying length pattern classification using SVM	1. Describe about Maximum Margin and Support Vector Machine. (C2) 2. Examine the advantages of maximum margin linear separators technique in SVM (C4) 3. Explain the Kernel trick for learning non-linear functions (C5) 4. Show the relation between two forms of representation of a hyperplane (C3)
Unit 5: Deep Learning	
Introduction to Deep Learning, Introduction to convolutional Neural Network (CNN), CNN Architecture and layers, Building simple CNN model for classification, Training and Testing the CNN model	1. Define Deep Learning. (C1) 2. Describe the applications of deep learning. (C2) 3. Explain the architecture of Deep Neural Network and CNN (C5) 4. Design a classifier for the image classification system. (C5)
Unit 6: Reinforcement Learning	
Characteristics, N-arm Bandit Problem, Calculating the Value Function, Associative Learning – Adding States, The Markov Property & Markov Decision Process	1. Explain the concept of Multi-Armed Bandit Problem (MABP). (C2) 2. Write the functions of Upper Confidence Bound (UCB) algorithm. (C3) 3. Outline the learning process and characteristics of reinforcement learning. (C4)

	4. Explain about Markov decision process. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*	*		*
Sessional Examination 2	*	*	*	*	*
Assignment/Presentation	*	*	*	*	*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. T. Mitchell, “Machine Learning”, McGraw-Hill, 1997. 2. E. Alpaydin, “Machine Learning”, MIT Press, 2010.

	3. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006. 4. R. Duda, E. Hart, and D. Stork, "Pattern Classification", Wiley Interscience, 2000. 5. Satish Kumar, "Neural Networks - A Class Room Approach", Second Edition, Tata McGraw-Hill, 2013. 6. T. Hastie, R. Tibshirani and J. Friedman," The Elements of Statistical Learning: Data Mining", Inference and Prediction, Springer, 2nd Edition, 2009. 7. Jason Bell, "Machine Learning for Big Data", Wiley Big Data Series, 2016. 8. J. Shawe-Taylor and N. Cristianini, "Kernel Methods for Pattern Analysis", Cambridge University Press, 2004. 9. S. Haykin, "Neural Networks and Learning Machines", Prentice Hall of India, 2010. 10. Rama Murthy G, "Multidimensional Neural Networks Unified Theory", New Age International, 2008. 11. F. Camastra and A. Vinciarelli, "Machine Learning for Audio, Image and Video Analysis – Theory and Applications", Springer, 2008.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Mobile Application Development using Android
Course Code: CSE-605	**Course Instructor:**
Academic Year: 2019-2020	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basic knowledge of OOP's concepts, Java programming language

Synopsis:	This Course provides insight on 1. This course would provide fundamental knowledge about android platform. 2. The course will also provide skill sets to design and develop android applications for mobile devices. 3. This course will provide basic knowledge about android application communication of data which are hosted in remote systems.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain android architecture and framework
CO 2:	Discuss major building blocks of an android application
CO 3:	Write android applications using various UI components and data handling using SQLiIte
CO 4:	Discuss advanced topics such as LBS, Mapping, Network connectivity, background threads, adapters

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2	*	*		*							
CO 3		*	*		*						
CO 4		*	*	*	*						

Course content and outcomes:

Content	***Competencies***
Unit 1: Introduction	

Introduction to Android and Eclipse environment, Android application framework, Unique aspects of mobile application, software engineering issues for mobile application development	1. Explain android architecture (C2) 2. Discuss major building blocks such as activity, services, broadcast receiver and content provider (C2) 3. Identify different features in android studio (C1) 4. Discuss software engineering issues for mobile application development (C2)
Unit 2: Android building blocks	
Android manifest file, Dalvik virtual machine, DDMS, ADT, Adb, Android emulator, Activities and intents, creating a project, Android activity lifecycle, starting a new 'Hello World' Android application, Running and Debugging applications.	1. Explain Android manifest file (C2) 2. Discuss DVM, DDMS, android emulator (C2) 3. Describe android activity (C2) 4. Illustrate android activity lifecycle (C2) 5. Discuss the issues related running and debugging applications (C2)
Unit 3: Android Screen UI Components	
Layouts: LinearLayout, AbsoluteLayout, TableLayout, RelativeLayout, FrameLayout, ScrollView, Views: TextView, EditText, and Button views, TimePicker and DatePicker views, ListView and the Spinner views, Gallery and ImageSwitcher views, context sensitive menu .	1. Describe different types of layouts (C2) 2. Distinguish between various types of layout (C2) 3. Identify different types of android UI elements required for developing forms (C1)
Unit 4: Data management with SQLite	
SQLite architecture, creating and using databases, DBAdapter class, Common SQLite commands, creating triggers, logging insert, delete, update using SQLite, managing persistent data,	1. Describe SQLite architecture (C2) 2. Discuss the use of SQLite database (C2) 3. Discuss the CRUD operations (C2) 4. Apply CRUD operations to develop a simple healthcare application (C3)

Development of a simple healthcare application	
Unit 5: Advanced topics	
Adapters, background threads, Notifications, Location based services, Mapping, network connectivity services, telephony services	1. Explain adapter class (C2) 2. Discuss the various components of notification object in an android application (C2) 3. Discuss the use location based service classes (C2) 4. Identify the classes required for network applications (C1) 5. Define android service (C2) 6. Explain life cycle of service (C2) 7. Discuss on background threads in android applications (C2)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos				
Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation		*	*	*
End Semester Examination	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Lauren Darcey and Shane Conder, "Sams Teach Yourself Android Application Development in 24 Hours", Sams Publishing, First Edition, ISBN-10: 0321673352, ISBN-13: 978-0321673350, 2010. 2. Ed Burnette, "Hello, Android: Introducing Google's Mobile Development Platform", Pragamatic, Third Edition, ISBN-10: 1934356565, ISBN-13: 978-1934356562, 2011. 3. Rick Rogers and John Lombardo, "Android Application Development: Programming", O'Reilly Media, First Edition, ISBN-10: 0596521472 , ISBN-13: 978-0596521479 , 2009. 4. Reto Meier , "Professional Android 2 Application Development (Wrox Programmer to Programmer)", Wrox, Second Edition, ISBN-10: 0470565527, ISBN-13: 978-0470565520, 2010.

Name of the Program:		Master of Engineering - ME (Internet of Things)
Course Title:		Entrepreneurship
Course Code: ENP-601		**Course Instructor:**
Academic Year: 2020 - 2021		**Semester:** First Year, Semester 2
No of Credits: 3		**Prerequisites:**
Synopsis:	This course introduces students to the theory of entrepreneurship and its practical implementation. It focuses on different stages related to the entrepreneurial process, including business model innovation, monetization, small business management as well as strategies that improve performance of new business ventures. Centered on a mixture of theoretical exploration as well as case studies of real-world examples and guest lectures, students will develop an understanding of successes, opportunities and risks of entrepreneurship. This course has an interdisciplinary approach and is therefore open to students from other Majors.	
Course Outcomes (COs):	On successful completion of this course, students will be able to:	
CO 1:	To impart knowledge on the basics of entrepreneurial skills and competencies to provide the participants with necessary inputs for creation of new ventures.	
CO 2:	To familiarize the participants with the concept and overview of entrepreneurship with a view to enhance entrepreneurial talent	
CO 3:	To appraise the entrepreneurial process starting with pre-venture stage	
CO 4:	To Create and exploit innovative business ideas and market opportunities	
CO 5:	To Build a mind-set focusing on developing novel and unique approaches to market opportunities	
CO 6:	To explore new vistas of entrepreneurship in 21st century environment to generate innovative business ideas through case studies.	

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2				*							
CO 3			*								

CO 4						*					
CO 5								*			
CO 6										*	

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to Entrepreneurship	
Meaning and Definition of Entrepreneurship-Employment vs Entrepreneurship, Theories of Entrepreneurship, approach to entrepreneurship, Entrepreneurs VS Manager	1. Explain the meaning of Entrepreneurship (C1) 2. Discuss the theories of Entrepreneurship (C1) 3. Discuss the approaches to Entrepreneurship (C1)
Unit 2: Entrepreneurial Traits	
Personality of an entrepreneur, Types of Entrepreneurs	1. Discuss the Personality traits of entrepreneurs. (C2)
Unit 3: Process of Entrepreneurship	
Factors affecting Entrepreneurship process	1. Identify the fundamentals and responsibilities of entrepreneurship (C2) 2. Exemplify one's capabilities in relation to the rigors of successful ventures (C3) 3. Identify and differentiates the different characteristics and competencies of an entrepreneurs (C2)
Unit 4: Business Start-up Process	
Idea Generation, Scanning the Environment, Macro and Micro analysis	1. Explain the Process of Business start up (C1) 2. Develop creativity and critical thinking in identifying opportunities (C5) 3. Apply innovative approaches in envisioning ones entrepreneurial career (C3)
Unit 5: Business Plan writing	
Points to be considered, Model Business plan	1. Identify different business models (C3) 2. Describe different parts of a business plan(C2)

Unit 6: Case studies	
Indian and International Entrepreneurship	1. Perform self-assessment and analyse entrepreneurial personal traits and competencies (C4) 2. Evaluate oneself and plan courses of action to help develop one's entrepreneurial characteristics and competencies. (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5	CO 6
Sessional Examination 1	*	*				
Sessional Examination 2			*	*		
Assignment/Presentation					*	*

End Semester Examination	*	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. NVR Naidu and T. Krishna Rao, "Management and Entrepreneurship", IK International Publishing House Pvt. Ltd 2008. 2. Mohanthy Sangram Keshari, "Fundamentals of Entrepreneurship", PHI Publications, 2005 3. Butler, D. (2006). Enterprise planning and development. USA: Elsevier Ltd. Gerber, M.E. (2008) Awakening the entrepreneur within. NY: Harper Collins.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Device Drivers
Course Code: ESD-604	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Basic C Programming

Synopsis:	This Course provides insight on 1. Insight into Linux kernel programming. 2. Knowledge about the framework used in building the Linux device driver. 3. Concept of designing proc and ioctl needed to build a device driver 4. Techniques to debug kernel programs 5. Insight into designing USB drivers.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Explain the broad concept of device drivers and build character drivers
CO 2:	Describe design of kernel modules and debugging these modules
CO 3:	Handle concurrency, race condition and understand the importance of time while designing a device driver
CO 4:	Allocate dynamic memory and communicating with devices though I/O ports
CO 5:	Demonstrate and design USB drivers on a kit

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2	*	*	*								
CO 3		*	*								
CO 4	*		*								
CO 5	*				*						

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Introduction to Device Drivers	2. Describe the broad design of device driver (C3)
Unit 2:	

Building & Running Modules.	1. Compile and load modules using a make file (C4)
Unit 3:	
Character Driver.	1. Explain the structure of a character driver (C3)
Unit 4:	
Debugging Techniques.	1. Debug modules using prink, proc and kdb (C4) 2. Design of Ioctl used in building device drivers (C5)
Unit 5:	
Concurrency and Race Condition	1. Illustrate the problems associated with concurrent device drivers (C3) 2. Describe the problems associated with race condition while designing a device driver (C3)
Unit 6:	
Advanced Character Driver Operations	1. Execute bottom half through deferred work (C4)
Unit 7:	
Time, Delay and Deferred Work	1. Use the concept of delays (C2) 2. Explain the concept of timers in Linux kernel (C2)
Unit 8:	
Allocating Memory	1. Allocate dynamic memory (C3) 2. Explain the concept of memory barriers (C3)
Unit 9:	
Communicating with Hardware	1. Communicate with the devices through I/O ports (C4)
Unit 10:	
Interrupt Handling	1. Illustrate the concept of writing interrupt handlers (C4)
Unit 11:	
PCI Drivers, USB Drivers	1. Structure of a USB driver (C4) 2. Design a USB driver. (C6)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-
TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation		*		*	*
End Semester Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Alessandro Rubini, “Linux Device Drivers”, (Nutshell Handbook), O'Reilly Publishers, 2009. 2. John Madieu, “Linux Device Drivers Development: Develop customized drivers for embedded Linux”, Packt Publishing, 2017. 3. Robert Love, “Linux Kernel Development”, Addison Wesley, Third Edition, 2010.

	4. Daniel P. Bovet, Marco Cesati, "Understanding the Linux Kernel", O'Reilly Media, Third Edition, 2008. 5. Wolfgang Mauerer, "Professional Linux Kernel Architecture", Wrox, 2008. 6. Sreekrishnan Venkateswaran, "Essential Linux Device Drivers", Prentice Hall, 2008. 7. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX Environment", Addison Wesley, Third Edition, 2013. 8. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, "Unix Network Programming, Vol1: Sockets", Pearson Education India, Third Edition, 2015.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IT Project Management
Course Code: CSE 631	**Course Instructor:**
Academic Year: 2020 – 2021	**Semester:** First Year, Semester 2
No of Credits: 3	**Prerequisites:** Familiarity in developing application using any high level language

Synopsis:	This Course provides insight on 1. The concept of software development process and project management 2. Illustrates the difference between a lab assignment and group project 3. Help the students to understand the finer points of Project management 4. Bring awareness about the processes, tools and techniques involved in the field of IT project management
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Illustrate the importance of project planning.
CO 2:	Discuss and demonstrate various tools applicable for different phases of the software project.
CO 3:	Illustrate the importance of Change management.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*									
CO 2		*	*								
CO 3	*		*								

Course content and outcomes:

Content	***Competencies***
Unit 1: Software Project Planning	
Understand the Project Needs, Create the Project Plan, Diagnosing Project Planning Problems	1. Understand the project needs, necessity of plan, Define the Project Plan, Diagnosing Project Planning Problems (C1)
Unit 2: Estimation	

Elements of a Successful Estimate, Wideband Delphi Estimation, Other Estimation Techniques, Diagnosing Estimation Problems.	1. List the importance of estimation and describe different estimation techniques (C2) 2. Discuss the significance of Reviews and different review techniques (C2)
Unit 3: Project Schedules	
Building the Project Schedule, Managing Multiple Projects, Use the Schedule to Manage Commitments, Diagnosing Scheduling Problems.	1. Outline the steps in building project schedule.(C1) 2. Indicate mechanism of managing multiple projects. (C2)
Unit 4: Reviews	
Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming, Use Inspections to Manage Commitments, Diagnosing Review Problems.	1. Discuss the significance of Reviews and different review techniques (C2)
Unit 5: Software Requirements	
Requirements Elicitation, Use Cases, Software Requirements Specification, Change Control, Introduce Software Requirements Carefully, Diagnosing Software Requirements Problems	1. Introduce to requirement elicitation techniques, design and demonstrate the requirement documentation by field visits(C2)
Unit 6 : Design and Programming	
Review the Design, Version Control with Subversion, Refactoring, Unit Testing, Use Automation, Be Careful with Existing Projects, Diagnosing Design and Programming Problems	1. Illustrate the key steps in design and programming phase. Version control and unit testing significance (C3)
Unit 7: Software Testing	
Test Plans and Test Cases, Test Execution, Defect Tracking and Triage, Test Environment and Performance Testing, Smoke Tests, Test Automation,	1. Define the test plans, significance of test phase and the test case characteristics. Introduce different types testing and significance of type of testing.(C2)

Postmortem Reports, Using Software Testing Effectively, Diagnosing Software Testing Problems	
Unit 8: Understanding Change	
Why Change Fails, How to Make Change Succeed	1. Illustrate the necessity of Change management system – developing impact analysis document and its importance (C3).
Unit 9: Management and Leadership	
Take Responsibility, Do Everything Out in the Open, Manage the Organization, Manage Your Team	1. Understand the role of management in motivating the team, finer points of managing the team (C2)
Unit 10: Managing an Outsourced Project	
Prevent Major Sources of Project Failure, Management Issues in Outsourced Projects, Collaborate with the Vendor	1. Describe the differences of managing the outsourced project, typical point of conflicts(C2) 2. Review of the project management process (C2)
Unit 10: Process Improvement	
Life Without a Software Process, Software Process Improvement, Moving Forward	**1.** Analyse the projects without process and continuous process improvements initiatives needed for success of the project (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	30	60
Quiz	02	04
Small Group Discussion (SGD)	02	02
Self-directed learning (SDL)	-	04
Problem Based Learning (PBL)	02	04
Case Based Learning (CBL)	-	-
Revision	02	-
Assessment	06	-

TOTAL	**44**	**74**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2	*		*
Assignment/Presentation	*	*	
End Semester Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. "Applied Software Project Management" By Jennifer Greene, Andrew Stellman (O'Reilly Publications) 2005. 2. "The Art of Project Management" By Scott Berkun (O'Reilly Publications) 2005.

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Big Data and Data Visualization Lab
Course Code: BDA 614L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First year, semester 2
No of Credits: 1	**Prerequisites:** Programming in Python or Java

Synopsis:	1. Students learn to handle big data in distributed computing architecture. 2. Installation and working on Hadoop and ecosystem 3. Build machine learning Models 4. Processing of data stream 5. Choose proper data visualization techniques
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Handle big data using Hadoop and its ecosystems.
CO 2:	Building machine learning algorithm using Spark.
CO 3:	Data Cleaning and Data Visualization.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*	*					
CO 2	*	*	*	*	*	*			*	*	
CO 3	*	*	*	*	*	*		*			

Course content and outcomes:

Content	***Competencies***
Unit 1: Big Data	
Introduction to Hadoop. Data Analysis using Hadoop ecosystems	1. Installation of Hadoop and Spark distributed systems. (C4) 2. Reading and writing data into HDFS (C2). 3. Develop scripts to transfer structured data from SQL database to HDFS. (C3)

	4. Develop script to query the data from HDFS using Hive. (C4)
Unit 2: Machine Learning	
Machine Learning in Big Data. Stream processing in Big Data.	5. Design a model using K-means classifier to predict how well products are accepted by the clients (C4). 6. Develop applications using Stream processing in big data (C4).
Unit 3: Data Visualization	
Video encoding and processing techniques.	1. Design programs to dynamically extract data from web. (C4) 2. Develop visualization application for time series data. (C4) 3. Develop visualization application for statistical distributions. (C4) 4. Develop visualization application for maps, Hierarchical data and network data. (C4)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-

Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2		*	*
Assignment/Presentation	*	*	*
End Semester Examination	*	*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, 2nd Edition, 2009 2. Machine Learning for Big Data, Jason Bell, Wiley Big Data Series 3. Big Data: Principles and best practices of scalable real-time data systems - Nathan Marz and James Warren. Manning Publisher. 4. Hadoop: The Definitive Guide: Storage and Analysis at Internet Scale – Tom White, O'Reilly Publication 4th Edition. 5. Spark: The Definitive Guide: Big Data Processing Made Simple – Bill Chambers, Matei Zaharia, O'Reilly Publication 1st Edition

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Embedded Systems Lab
Course Code: ESD 605L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Microprocessor architecture , Microcontroller Architecture , Assembly language and Number systems

Synopsis:	This Course provides insight on 1. This course provides the knowledge of ARM Cortex M3 Processor architecture. 2. This course provides the knowledge of Microcontroller based on ARM Processor architecture and its Registers and Instruction sets to write Assembly and Embedded C Programming. 3. This course provides the concept of Interfacing and Programming Sensors and Peripherals to Microcontrollers. 4. his course provides the concept of Real time operating systems on Microcontrollers.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Illustrate the features of embedded systems, architecture of ARM7, Instruction set and development tools of ARM.
CO 2:	Experiment the architectural features of LPC13/17XX microcontrollers, interfacing peripheral devices to LPC2148.
CO 3:	Design a Real time Embedded Systems by interfacing Sensors and Actuators and porting Real time operating systems.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*	*		*						
CO 2	*	*			*						
CO 3	*	*	*		*						

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to LPC13/17xx Microcontroller	
Introduction to LPC13/17xx Microcontroller - Hardware, SW.	At the end of the topic student should be able to: 1. Summarise LPC13/17xx Microcontroller architecture and development tools of ARM. (C2)
Unit 2: Interfacing LPC13/17xx Microcontroller	
Interfacing With LED, LCD Seven Segment Display, UART, HEX Keypad.	Experiment interfacing LPC13/17xx Microcontroller with I/O devices. (C2)
Unit 3:	
Introduction to Free RTOS, FreeRTOS API Calls, Task Creation, Queques, semaphore, mutex, RTOS application development.	1. Summarise FreeRTOS architecture. (C2) 2. Practise different API call in FreeRTOS. (C2) 3. Design a Real time Embedded system by writing applications on top of Real time operating systems (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-

Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:	
Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos			
Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	*
Assignment		*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Joseph Yiu, "The definitive guide to the ARM Cortex-M3", Elsevier, 2nd Edition, 2010. 2. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India, ISBN:81-265-0837-X, 2007. 3. Richard Barry, "NXP Semiconductors, LPC13xx/17xx User Manual", 2012. 4. NXP Semiconductors, "LPCzone Examples", 2012. 5. "FreeRTOS Reference Manual", Real Time Engineers Ltd., 2016.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Embedded Sensing Systems and Networks Lab
Course Code: IOT 604L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Basics of sensors, Basics of communication

Synopsis:	This Course provides insight on: 1. Various types of sensors used in practical applications and their characteristics. 2. Protocols for Wireless Communications. 3. Principle of working of Global Positioning System 4. Concepts and applications of Wireless Sensor Networks
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Analyse the input output characteristics of selected sensors
CO 2:	Design a Data Acquisition System using sensors
CO 3:	Setup wireless protocol and test
CO 4:	Design and evaluate a wireless communication network

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*		*						
CO 2	*				*						
CO 3				*				*		*	
CO 4	*			*	*			*		*	

Course content and outcomes:

Content	***Competencies***
Unit 1:	
Introduction to Embedded Sensing Systems and Networks: Sensor and Transducers, Types of Sensors,	1. Experiment on various sensors (C4)

Humidity, Pressure, Light, Magnetics, Temperature	
Unit 2:	
Sensing Mechanism, Actuating Mechanism, Different Sensors, Sampling, Digital and Analog Sensor, Electrical Characteristics of Sensors, Choosing a sensor for IoT Network applications	1. Construct a Data Acquisition System using sensors and evaluate its performance (C5)
Unit 3:	
Protocols for WPAN, Introduction to WPAN standards, Bluetooth: Introduction, Protocol Stack, RF Classes, Radio Technologies, Service Discovery, Device Discovery, Profiles, Security (Discovering Bluetooth), Hardware, Bluetooth BLE, Bluetooth Devices, BlueZ software stack	1. Demonstrate the working of a Blue tooth communication (C3)
Unit 4:	
Zigbee: Frequency, Channels, Topology, Zigbee Protocol Stack, PHY, MAC Layer, Working, Frame Structure, Beacon, Non-Beacon Communication, Zigbee PDU, Zigbee Hardware devices, API Mode and AT mode communication	1. Demonstrate the working of a ZigBee communication protocol(C3)
Unit 5:	

Near Field Communication: Passive and Active Devices, NFC cards Interfacing, Read and Write	1. Demonstrate the working of a Near Field Communication protocol (C3)
Unit 6:	
GPS: Differential GPS, NMEA protocols, GPS devices, Concepts **Wireless Sensor Networks:** Deployment, Localization, Routing, Time Synchronization, Power Management	1. Design and test wireless sensors network using NS2 Network Simulator (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2			*	*
Assignment/Presentation	*	*	*	*
Laboratory Examination		*		*

Feedback Process	• End-Semester Feedback
Reference Material	1. M.H. Bao, Micro Mechanical Transducers, **"Handbook of Sensors and Actuators"**, Volume 8, Elsevier, 2000. 2.Ljubisa Ristic, Editor, **"Sensor Technology and Devices"**, Artech House, 1994. 3. Vedat Coskun, Kerem Ok and Busra Ozdenizci, **"Near Field Communication",** Wiley Publications, 2011. 4. Todor Cooklev, **"Wireless communication standards",** IEEE Press, John Wiley & Sons, 2011. 5. Houda Labiod, Hossam Afifi, Costantino De Santis, **"Wi-Fi, Bluetooth, Zigbee and WiMAX"**, Springer Publications, 2007. 6. Madhushree Ganguli, **"Getting started with Bluetooth",** Premier Press, ISBN 1931841837, 9781931841832, 2002. 7. Jörg Eberspächer, Hans-Jörg Vögel, Christian Bettstetter, Christian Hartmann, **"GSM – Architecture, Protocols and Services"** Third Edition, Wiley Publications, 2008. 8. www.trimble.com /gps_tutorial. 9. Holger Karl and Andreas Willig **"Protocols and Architectures for Wireless Sensor Networks"**, John Wiley & Sons, 2005. 10. Ian F. Akyildiz, **"Wireless Sensor Networks"**, Wiley & Sons, 2010.

	11. Jun Zheng & Abbas Jamalipour, **"Wireless Sensor Networks - A Networking Perspective"**, John Wiley & Sons, Inc., Publication, 2008. 12. Kazem Sohraby, Daniel Minoli & Taieb Znati **"Wireless Sensor Networks - Technology, Protocols, and Applications",** 2007**.** 13. F. Zhao and L. Guibas. Morgan Kaufmann**, "Wireless Sensor Networks: An Information Processing Approach"**, Jul. 2004. 14. N. P. Mahalik. Springer Verlag**, "Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications",** Nov. 2006. 15. N. Bulusu and S. Jha, **"Wireless Sensor Networks: A Systems Perspective",** Editors, Artech House, August 2005.

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Responsive Web Application Development Lab
Course Code: IOT 605L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Basic Programming

Synopsis:	This Course provides insight on • The front-end section includes working with HTML, CSS3 and Bootstrap to design interactive and responsive web pages whereas the back-end section consists of programming in PHP with MySQL, XML, and JSON. • Develop a platform friendly web application or a website using Bootstrap, Angular JS, React JS, and Node JS.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Develop A Dynamic Webpage By The Use Of Java Script.
CO 2:	Write A Well Formed / Valid XML Document.
CO 3:	Connect Web Application to A DBMS To Perform Insert, Update and Delete Operations.
CO 4:	Convert the String And Parse Using JSON Objects.
CO 5:	Use Bootstrap, Angular JS, React JS, Node JS To Construct Modern Website

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	PO 9	*PO 10*	*PO 11*
CO 1	*										
CO 2	*			*							
CO 3	*		*		*						
CO 4	*			*							
CO 5	*			*	*						

Content	
Unit 1:	

Introduction to Internet and Web Technology	1. Experiment on various problem, to provide the solution using web development (C4).
Unit 2:	
HTML	1. Develop a web page using semantic tags (C4). 2. Create a web page using form, add validation using patterns(C4).
Unit 3:	
CSS3	1. Develop different types of layout using css (C4) 2. Develop responsive web page (C4) 3. Develop web page using drop down menu(C4)
Unit 4:	
JavaScript	1. Validate form using JavaScript pattern matching, develop an application using Ajax. (C3)
Unit 5:	
XML vs JSON vs YAML	1. Create xml, YAML JSOM document able to parse. (C3)
Unit 6:	
Database connection	1. Analyse and solve various database task using PHP Parse the sting using json (C5)
Unit 7:	
BOOTSTRAP, ANGULAR JS, REACT JS, NODEJS	1. Develop web page using the framework (C5)

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-

Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva
	Summative:

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	*
Assignment/Presentation		*	*		
Laboratory Examination	*	*	*		*

Feedback Process	• End-Semester Feedback
Reference Material	1. Thomas A. Powell, Fritz Schneider," JavaScript: The Complete Reference", McGraw-Hill Osborne, Second Edition, 2004. 2. Jamsa Krishna, "Introduction to web development using HTML5", 2014. 3. Danny Goodman, "JavaScript bible", Wiley, Seventh Edition, 2010. 4. Azat Mardan, " Practical Node.js: Building Real-World Scalable Web Apps", Apress Publications, 2014. 5. Krasimir Tsonev, "Node.js by Example", Packt Publications, 2015. 6. Luke Welling, Laura Thomson, "PHP and MySQL Web Development (Developer's Library)", Addison Wesley Publications, 2008.

	7. Ben Laurie, Peter Laurie, "Apache: The Definitive Guide", 3rd Edition, O'Reilly Media,2009. 8. Brian Totty, David Gourley, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy, "HTTP: The Definitive Guide", O'Reilly Media, 2009.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Machine Learning for Big Data Lab
Course Code: BDA 605L	**Course Instructor:**
Academic Year: 2020-2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Programming with Python and Data Visualization

Synopsis:	This Course provides insight on
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Demonstrate activation functions, weights and threshold units in artificial neural networks
CO 2:	Demonstrate Artificial Neural Network, Clustering, Support Vector Machine, Deep Neural Network and Reinforcement Learning models
CO 3:	Analyse Artificial Neural Network, Clustering, Support Vector Machine, Deep Neural Network and Reinforcement Learning models
CO 4:	Compare and contrast single layer, multilayer and deep neural networks in terms of accuracy in classification
CO 5:	Design different types of artificial neural network models, clustering models, deep neural network models, reinforcement learning models

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*										
CO 2		*									
CO 3			*								
CO 4				*							
CO 5				*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Artificial Neural Networks	

Neurons and biological motivation. Activation functions and threshold units. Supervised and unsupervised learning Perceptron Model: representational limitation and gradient descent training. Multilayer networks and back propagation. Overfitting.	1. Demonstrate activation functions, weights and threshold units in artificial neural networks (C3) 2. Demonstrate ANN models (C3) 3. Design of ANN models for classification (C5) 4. Analyse the performance issues (C4)
Unit 2: Clustering	
Learning from unclassified data. Clustering. Hierarchical Aglomerative Clustering. Non-Hierarchical Clustering - k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabled data.	1. Demonstrate various clustering models in machine learning (C3) 2. Design different types of clusters (C5) 3. Analyse the performance of clustering techniques on different data (C4) 4. Apply clustering techniques for data analysis. (C3)
Unit 3 Kernel Methods	
Dual Representations Design of Kernels	1. Design of different kernel techniques (C5)
Unit 4: Support Vector Machines (SMV)	
Maximum margin linear separators. Quadractic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Varying length pattern classification using SVM	1. Demonstrate Maximum margin linear separators. (C3) 2. Design SVM classifiers (C5) 3. Analyse the performance of SVM (C4)
Unit 5: Deep Learning	
Introduction to Deep Learning	1. Develop Deep Neural Network/ CNN (C5)

Introduction to convolutional Neural Network (CNN) CNN Architecture and layers Building simple CNN model for classification Training and Testing the CNN model	2. Design a classifier for the image classification system. (C5) 3. Compare performance of CNN and ANN for image classification (C4)

Unit 6: Reinforcement Learning

Characteristics N-arm Bandit Problem Calculating the Value Function Associative Learning – Adding States The Markov Property & Markov Decision Process	1. Apply reinforcement learning model using different principles (C3) 2. Analyse various reinforcement learning techniques (C4) 3. Design of reinforcement learning models (C5)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**

Internal practical Test - yes	Sessional examination
Theory Assignments	End semester examination - yes
Lab Assignment & Viva - yes	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation			*	*	*
Laboratory examination			*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. Machine Learning, T. Mitchell, McGraw-Hill, 1997 2. Machine Learning, E. Alpaydin, MIT Press, 2010 3. Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006 4. Pattern Classification, R. Duda, E. Hart, and D. Stork, Wiley-Interscience, 2000 5. Neural Networks - A Class Room Approach, Satish Kumar, Second Edition, Tata McGraw-Hill, 2013 6. The Elements of Statistical Learning: Data Mining, Inference and Prediction, T. Hastie, R. Tibshirani and J. Friedman, Springer, 2nd Edition, 2009 7. Machine Learning for Big Data, Jason Bell, Wiley Big Data Series 8. Kernel Methods for Pattern Analysis, J. Shawe-Taylor and N. Cristianini, Cambridge University Press, 2004 9. Neural Networks and Learning Machines, S. Haykin, Prentice Hall of India, 2010 10. Multidimensional Neural Networks Unified Theory, Rama Murthy G 11. F.Camastra and A.Vinciarelli, Machine Learning for Audio, Image and Video Analysis – Theory and Applications, Springer, 2008

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Mobile Application Development using Android Lab
Course Code: CSE-605L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:**

Synopsis:	This Course provides insight on 1. This course would provide fundamental knowledge about android platform. 2. The course will also provide skill sets to design and develop android applications for mobile devices. 3. This course will provide basic knowledge about android application communication of data which are hosted in remote systems.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Use of major building blocks in an android application
CO 2:	Solve different issues associate with design of android applications
CO 3:	Write android applications using various UI components and data handling using SQLiIte
CO 4:	Experiment advanced topics on android applications

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*		*								
CO 2	*	*	*	*	*						
CO 3			*		*						
CO 4		*		*							

Course content and outcomes:

Content	***Competencies***
Unit 1: Part - 1: Installation of Android Studio	

Installation of Android Studio, environment setting, Project creation, building a project, running a sample project	1. Identify different features in android studio (C1) 2. Explain Android manifest file (C2) 3. Discuss DVM, DDMS, android emulator (C2) 4. Discuss the issues related running and debugging applications (C2)
Unit 2: Introduction to Android Screen UI Components	
Implementation of android applications using various android UI components and layouts	1. Practice by creating android applications using different types of layouts (C3) 2. Develop android applications using different types of views such as Listview, spinner, time picker and date picker (C3) 3. Illustrate the use of Gallery and ImageSwitcher views (C2)
Unit 3: Introduction to Data Management with SQLite	
Develop android applications for data handling	1. Implement android applications for content provider (C3) 2. Apply shared preferences concept to android UI screen (C3) 3. Apply CRUD operations to develop a simple healthcare application (C3)
Unit 4: Advanced topics	
Adapters, background threads, Notifications, Location based services, Mapping, network connectivity services, telephony services	1. Practice to generate notification object in an android application (C3) 2. Apply Location based services in android applications (C3) 3. Demonstrate android service life cycle in an android application (C3) 4. Understand the use of background threads in android applications (C3)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4
Sessional Examination 1	*	*		
Sessional Examination 2		*	*	*
Assignment/Presentation	*	*		*
Laboratory Examination	*	*	*	*

Feedback Process	• End-Semester Feedback

Reference Material	5. "Sams Teach Yourself Android Application Development in 24 Hours" , Lauren Darcey and Shane Conder , ISBN-10: 0321673352 | ISBN-13: 978-0321673350 | Edition: 1 6. "Android: Introducing Google's Mobile Development Platform", Ed Burnette, ISBN10: 1934356565 | ISBN-13: 978-1934356562 | Edition: Third Edition 7. "Android Application Development: Programming", Rick Rogers and John Lombardo, ISBN10: 0596521472 | ISBN-13: 978-0596521479 | Edition: 1 8. "Professional Android 2 Application Development" (Wrox Programmer to Programmer) , Reto Meier , ISBN-10: 0470565527 | ISBN-13: 978-0470565520 | Edition: 2

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Entrepreneurship Lab
Course Code: ENP-601L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:**

Synopsis:	This Course provides insight on This course introduces students to the theory of entrepreneurship and its practical implementation. It focuses on different stages related to the entrepreneurial process, including business model innovation, monetization, small business management as well as strategies that improve performance of new business ventures. Cantered on a mixture of theoretical exploration as well as case studies of real-world examples and guest lectures, students will develop an understanding of successes, opportunities and risks of entrepreneurship. This course has an interdisciplinary approach and is therefore open to students from other Majors.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Understand the concept of entrepreneurship
CO 2:	To appraise the entrepreneurial process starting with pre-venture stage through group discussion
CO 3:	To Build a mind-set focusing on developing novel and unique approaches to market opportunities by considering case studies and understand the complete flow of entrepreneurship

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*					*		*			
CO 2						*					
CO 3								*		*	

Course content and outcomes:

Content	*Competencies*
Unit 1: Introduction to Entrepreneurship	
Meaning and Definition of Entrepreneurship-Employment vs Entrepreneurship, Theories of Entrepreneurship, approach to entrepreneurship, Entrepreneurs VS Manager	1. Discuss the theories of Entrepreneurship (C1) 2. Discuss the approaches to Entrepreneurship (C1)
Unit 2: Process of Entrepreneurship	
Factors affecting Entrepreneurship process	1. Exemplify one's capabilities in relation to the rigors of successful ventures (C3) 2. Identify and differentiates the different characteristics and competencies of an entrepreneurs (C2)
Unit 3: Business Plan writing	
Points to be considered, Model Business plan	1. Identify different business models (C3) Describe different parts of a business plan(C2)
Unit 4: Case studies	
Indian and International Entrepreneurship	1. Perform self-assessment and analyse entrepreneurial personal traits and competencies (C4) 2. Evaluate oneself and plan courses of action to help develop one's entrepreneurial characteristics and competencies. (C5)

Learning strategies, contact hours and student learning time		
Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-

Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2			*
Assignment/Presentation		*	*
Laboratory Examination	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	1. NVR Naidu and T. Krishna Rao, "Management and Entrepreneurship", IK International Publishing House Pvt. Ltd 2008. 2. Mohanthy Sangram Keshari, "Fundamentals of Entrepreneurship", PHI Publications, 2005

	3. Butler, D. (2006). Enterprise planning and development. USA: Elsevier Ltd. Gerber, M.E. (2008) Awakening the entrepreneur within. NY: Harper Collins.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Device Drivers Lab
Course Code: ESD-604L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:**

Synopsis:	This Course provides insight on 1. Insight into Linux kernel programming. 2. Knowledge about the framework used in building the Linux device driver. 3. Concept of designing proc and ioctl needed to build a device driver 4. Techniques to debug kernel programs 5. Insight into designing USB drivers
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Understand basic Linux kernel programming with an introduction to kernel modules
CO 2:	Understand the concept of file operation with implementation of open, close, read, write system calls
CO 3:	Implement proc entries
CO 4:	Implementation of ioctls
CO 5:	Use tools to debug the kernel modules

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*	*			*						
CO 2		*			*						
CO 3	*		*								
CO 4		*	*								
CO 5	*		*		*						

Course content and outcomes:

Content	*Competencies*
Unit 1:	
Introduction to Device Drivers	Describe the broad design of device driver (C3)
Unit 2:	
Building & Running Modules.	Compile and load modules using a make file (C4)
Unit 3:	
Character Driver.	Explain the structure of a character driver (C3)
Unit 4:	
Debugging Techniques.	1. Debug modules using prink, proc and kdb (C4) 2. Design of Ioctl used in building device drivers (C5)
Unit 5:	
Concurrency and Race Condition	1. Illustrate the problems associated with concurrent device drivers (C3) 2. Describe the problems associated with race condition while designing a device driver (C3)
Unit 6:	
Advanced Character Driver Operations	Execute bottom half through deferred work (C4)
Unit 7:	
Communicating with Hardware	Communicate with the devices through I/O ports (C4)
Unit 8:	
Interrupt Handling	Illustrate the concept of writing interrupt handlers (C4)
Unit 9:	

PCI Drivers, USB Drivers	1. Structure of a USB driver (C4) 2. Design a USB driver. (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	**-**

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Sessional Examination 1	*	*			
Sessional Examination 2			*	*	
Assignment/Presentation		*		*	*
Laboratory Examination	*	*	*	*	*

Feedback Process	• End-Semester Feedback

Reference Material	1. Alessandro Rubini**, "Linux Device Drivers"**, (Nutshell Handbook), O'Reilly Publishers, 2009. 2. John Madieu, "**Linux Device Drivers Development: Develop customized drivers for embedded Linux"**, Packt Publishing, 2017. 3. Robert Love, **"Linux Kernel Development**", Addison Wesley, Third Edition, 2010. 4. Daniel P. Bovet, Marco Cesati, **"Understanding the Linux Kernel"**, O'Reilly Media, Third Edition, 2008. 5. Wolfgang Mauerer, **"Professional Linux Kernel Architecture"**, Wrox, 2008. 6. Sreekrishnan Venkateswaran, **"Essential Linux Device Drivers"**, Prentice Hall, 2008. 7. W. Richard Stevens, Stephen A. Rago, **"Advanced Programming in the UNIX Environment"**, Addison Wesley, Third Edition, 2013. 8. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, **"Unix Network Programming, Vol1: Sockets",** Pearson Education India, Third Edition, 2015.

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Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	IT Project Management Lab
Course Code: CSE-631L	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 1	**Prerequisites:** Familiarity in developing application using any high level language

Synopsis:	This Course provides insight on 1. The concept of software development process and project management 2. Illustrates the difference between a lab assignment and group project 3. Help the students to understand the finer points of Project management 4. Bring awareness about the processes, tools and techniques involved in the field of IT project management.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Practice the project development through project planning.
CO 2:	Understand the finer points of Project management.
CO 3:	Bring awareness about the processes, tools and techniques involved in the field of IT project management.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1			*	*							
CO 2					*				*		
CO 3			*		*						

Course content and outcomes:

Content	*Competencies*
Unit 1: Software Project Planning	

Understand the Project Needs, Create the Project Plan, Diagnosing Project Planning Problems.	1. Discussion on tools needed for project management (C3)
Unit 2: Estimation	
Elements of a Successful Estimate, Wideband Delphi Estimation, Other Estimation Techniques, Diagnosing Estimation Problems.	1. Download and demonstrate the tools typically used for UML design. (C3)
Unit 3: Project Schedules	
Building the Project Schedule, Managing Multiple Projects, Use the Schedule to Manage Commitments, Diagnosing Scheduling Problems.	1. Design the application through the UML tool practiced (C4) 2. Develop the team with different roles assigned to each member – namely project manager, developer, tester and assign appropriate tasks (C4)
Unit 4: Reviews	
Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming, Use Inspections to Manage Commitments, Diagnosing Review Problems.	1. Develop basic set of programs and to illustrate the unit tests (C2)
Unit 5: Software Requirements	
Requirements Elicitation, Use Cases, Software Requirements Specification, Change Control, Introduce Software Requirements Carefully, Diagnosing Software Requirements Problems	1. Field visit to develop and practice the requirement elicitation (C3)
Unit 6: Design and Programming	
Review the Design, Version Control with Subversion, Refactoring, Unit Testing, Use Automation, Be Careful	1. Illustrate the key steps in design and programming phase. Version control and unit testing significance (C3)

with Existing Projects, Diagnosing Design and Programming Problems	2. Review of various artefacts generated by project and revise the project management methodology to the team (C5)
Unit 7: Software Testing	
Test Plans and Test Cases, Test Execution, Defect Tracking and Triage, Test Environment and Performance Testing, Smoke Tests, Test Automation, Postmortem Reports, Using Software Testing Effectively, Diagnosing Software Testing Problems	1. Inter team testing set up based on requirement document(C5)
Unit 8: Understanding Change	
Why Change Fails, How to Make Change Succeed	1. Illustrate the necessity of Change management system – SVN hands on (C3).
Unit 9: Management and Leadership	
Take Responsibility, Do Everything Out in the Open, Manage the Organization, Manage Your Team	1. Discussion on the topic with the help of case study (C3)
Unit 10: Managing an Outsourced Project	
Prevent Major Sources of Project Failure, Management Issues in Outsourced Projects, Collaborate with the Vendor	2. Discussion on the topic with the help of case study (C3)
Unit 11: Process Improvement	
Life Without a Software Process, Software Process Improvement, Moving Forward	1. Post-mortem report generation of respective project by each team – review of the report and suggest areas of improvement (C4)
Learning strategies, contact hours and student learning time	

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	12	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	03	-
Clinic	-	-
Practical	24	-
Revision	03	-
Assessment	06	-
TOTAL	**48**	-

Assessment Methods:

Formative:	**Summative:**
Internal practical Test	Sessional examination
Theory Assignments	End semester examination
Lab Assignment & Viva	Viva

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3
Sessional Examination 1	*	*	
Sessional Examination 2			*
Assignment/Presentation	*		
Laboratory Examination	*	*	*

Feedback Process	• Mid-Semester feedback • End-Semester Feedback

Reference Material	1. "Applied Software Project Management" By Jennifer Greene, Andrew Stellman (O'Reilly Publications) 2005. 2. "The Art of Project Management" By Scott Berkun (O'Reilly Publications) 2005.

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Mini Project - 2
Course Code: IOT 696	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester 2
No of Credits: 4	**Prerequisites:** Any programming language and circuit basics

Synopsis:	Students are expected to select a problem in the area of their interest and the area of their specialization that would require an implementation in hardware / software or both in a semester
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Apply the objectives of the project work and provide an adequate background with a detailed literature survey
CO 2:	Breakdown the project into sub blocks with sufficient details to allow the work to be reproduced by an independent researcher
CO 3:	Compose hardware/software design, algorithms, flowchart, methodology, and block diagram
CO 4:	Evaluate the results
CO 5:	Summarize the work carried out

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1				*							
CO 2					*			*			
CO 3							*			*	
CO 4						*					*
CO5:							*				

Course content and outcomes:

Content	***Competencies***
Phase 1	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 8. Identify the problem/specification (C1) 9. Discuss the project (C2) 10. Prepare the outline (C3) 11. Describe the status of the project (C2) 12. Prepare a mid-term project presentation report (C3) 13. Prepare and present mid-term project presentation slides (C3, C5) 14. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	6. Prepare the progress report (C3) 7. Prepare the final project presentation report (C3) 8. Prepare and present final project presentation slides (C3, C5) 9. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 10. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	48	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-

Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	03	-
TOTAL	**51**	**09**

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Seminar - 2
Course Code: IOT 698	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** First Year, Semester2
No of Credits: 1	**Prerequisites:** Communication Skill
Synopsis:	6. To select, search and learn technical literature. 7. To Identify a current and relevant research topic. 8. To prepare a topic and deliver a presentation. 9. To develop the skill to write a technical report. 10. Develop ability to work in groups to review and modify technical content.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	Show competence in identifying relevant information, defining and explaining topics under discussion.
CO 2:	Show competence in working with a methodology, structuring their oral work, and synthesizing information.
CO 3:	Use appropriate registers and vocabulary, and will demonstrate command of voice modulation, voice projection, and pacing.
CO 4:	Demonstrate that they have paid close attention to what others say and can respond constructively.
CO 5:	Develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1	*							*	*		*
CO 2	*							*	*		*
CO 3	*							*	*		*

CO 4	*							*	*		*
CO5:	*							*	*		*

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	14	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-
Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	**14**	**-**

Assessment Methods:

Formative:	**Summative:**
Seminar Topic Selection	
Synopsys review	
PPT Review	

Mapping of assessment with Cos

Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen Seminar

Name of the Program:	Master of Engineering - ME (Internet of Things)
Course Title:	Project Work
Course Code: IOT 799	**Course Instructor:**
Academic Year: 2020 - 2021	**Semester:** Second Year, Semester 3, 4
No of Credits: 25	**Prerequisites:** SDLC, Communication Skills, technical skills.

Synopsis:	The project work aims to challenge analytical, creative ability and to allow students to synthesize, apply the expertise and insight learned in the core discipline. Students build self-confidence, demonstrate independence, and develop professionalism on successfully completion of the project.
Course Outcomes (COs):	On successful completion of this course, students will be able to
CO 1:	To be acquainted with working environment and processes that in place at the relevant Industries.
CO 2:	To familiarize the challenges as relevant professionals.
CO 3:	Review the literature and develop solutions for real time onboard projects.
CO 4:	Write technical report and deliver presentation.
CO 5:	Apply engineering and management principles to achieve project goal.

Mapping of COs to POs

COs	*PO 1*	*PO 2*	*PO 3*	*PO 4*	*PO 5*	*PO 6*	*PO 7*	*PO 8*	*PO 9*	*PO 10*	*PO 11*
CO 1						*	*	*	*	*	*
CO 2					*						
CO 3	*	*	*	*	*						
CO 4	*	*	*	*							
CO5:						*	*	*	*	*	*

Course content and outcomes:

Content	***Competencies***
Phase 1:	

Problem identification, synopsis submission, status submission, mid evaluation.	At the end of the topic student should be able to: 1. Identify the problem/specification (C1) 2. Discuss the project (C2) 3. Prepare the outline (C3) 4. Prepare a mid-term project presentation report (C3) 5. Prepare and present mid-term project presentation slides (C3, C5) 6. Develop project implementation in hardware/software or both in chosen platform (C5)
Phase 2	
Status submission, final evaluation.	1. Prepare the progress report (C3) 2. Prepare the final project presentation report (C3) 3. Prepare and present final project presentation slides (C3, C5) 4. Modify and Develop implementation in hardware/software or both in chosen platform (C3, C5) 5. Justify the methods used and obtained results (C6)

Learning strategies, contact hours and student learning time

Learning strategy	*Contact hours*	*Student learning time (Hrs)*
Lecture	-	-
Seminar	-	-
Quiz	-	-
Small Group Discussion (SGD)	-	-
Self-directed learning (SDL)	-	-
Problem Based Learning (PBL)	-	-
Case Based Learning (CBL)	-	-

Clinic	-	-
Practical	-	-
Revision	-	-
Assessment	-	-
TOTAL	-	-

Assessment Methods:	
Formative:	**Summative:**
Project Problem Selection	Mid-Term Presentation
Synopsys review	Second status review
First status review	Demo & Final Presentation

Mapping of assessment with Cos					
Nature of assessment	CO 1	CO 2	CO 3	CO 4	CO 5
Mid Presentation	*	*			
Presentation	*	*	*	*	*

Feedback Process	• End-Semester Feedback
Reference Material	Particular to the chosen project

PROGRAM OUTCOMES (POS) AND COURSE OUTCMES (COS) MAP

Sl.No.	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	CSE 601	Data Structures and Algorithms	3	*	*		*		*					
2	IOT 601	Operating Systems for IoT	3	*	*	*		*						
3	IOT 602	IoT Networks and Protocols	3	*	*	*	*							
4	IOT 603	IoT Security	3	*	*	*	*	*						
5	BDA-601	Fundamentals of Machine Learning	3	*	*	*	*							
6	CDC-603	Cloud Application Development with JAVA	3	*	*	*		*						
7	ESD-603	Digital Signal Processing	3	*	*	*	*	*						
8	IOT-606	IoT Application Development	3	*	*	*	*	*						
9	CSE 601L	Data Structures and Algorithms Lab	1		*	*		*			*			
10	IOT 601L	Operating Systems for IoT Lab	1	*	*	*		*						
11	IOT 602L	IoT Networks and Protocols Lab	1	*				*	*					
12	IOT 603L	IoT Security Lab	1	*		*	*	*					*	
10	BDA-601L	Fundamentals of Machine Learning Lab	1	*	*	*	*							
11	CDC-603L	Cloud Application Development with JAVA Lab	1	*		*		*						
12	ESD-603 L	Digital Signal Processing Lab	1	*	*		*	*						
13	IOT-606L	IoT Application Development Lab	1	*			*	*						
11	IOT 695	Mini Project - 1	4				*	*	*	*	*	*	*	*
12	IOT 697	Seminar - 1	1	*							*	*		*
13	BDA 614	Big Data and Data Visualization	3	*	*	*	*			*				
14	ESD 605	Embedded Systems	3	*	*	*		*						

15	IOT 604	Embedded Sensing Systems and Networks	3	*		*	*	*			*		*	
16	IOT 605	Responsive Web Application Development	3	*	*	*	*	*						
17	BDA-605	Machine Learning for Big Data	3	*	*	*	*	*						
18	CSE-605	Mobile Application Development using Android	3	*	*	*	*	*						
19	ENP-601	Entrepreneurship	3	*		*	*		*		*		*	
20	ESD-604	Device Drivers	3	*	*	*		*						
21	CSE-631	IT Project Management	3	*	*	*								
22	BDA 614L	Big Data and Data Visualization Lab	1	*	*	*	*	*	*		*	*	*	
23	ESD 605L	Embedded Systems Lab	1	*	*	*		*						
24	IOT 604L	Embedded Sensing Systems and Networks Lab	1	*		*	*	*			*		*	
25	IOT 605L	Responsive Web Application Development Lab	1	*		*	*	*						
26	BDA-605L	Machine Learning for Big Data lab	1	*	*	*	*							
27	CSE-605L	Mobile Application Development using Android lab	1	*	*	*	*	*						
28	ENP-601L	Entrepreneurship lab	1	*					*		*		*	
29	ESD-604L	Device Drivers lab	1	*	*	*		*						
30	CSE-631L	IT Project Management lab	1			*	*	*				*		
31	IOT 696	Mini Project - 2	4				*	*	*	*	*	*	*	*

32	IOT 698	Seminar - 2	1	*							*	*		*
33	IOT 799	Project Work	25	*	*	*	*	*	*	*	*	*	*	*