

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester VIII/ Fourth Year
Subject Title:	Basic DevOps Engineering
Subject Code:	18-ITM406-4C
Pre-requisite:	Operating System Basics

Course Objective:

- These objectives aim to provide students with a solid foundation in DevOps practices and prepare them for real-world challenges in software development and operations.
- It focuses on teaching effective version control using Git and collaboration through platforms like GitHub.
- The course introduces containerization with Docker, enabling students to create, manage, and deploy containerized applications.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03		02	04	50	25	-	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Introduction to DevOps: Overview of DevOps principles, benefits, tools, and its relationship with Agile methodology.	4	15
2	Version Control with Git: Focus on using Git for version control, including branching, merging, and collaboration through GitHub Continuous Integration (CI): Setting up CI pipelines, Jenkins/GitLab CI integration, automating builds and tests	10	25
3	Containerization with Docker: Basics of Docker, Container life cycle, creating Docker images, running containers, and managing multi-container applications.	7	20
4	Continuous Deployment (CD): Implementing CD pipelines for automated deployments, including testing, staging, and production environments.	6	15
5	Monitoring and Logging: Introduction to monitoring tools like Prometheus/Grafana and logging with the ELK stack. Security in DevOps: Integrating security into DevOps pipelines, including vulnerability scanning and secrets management	8	25

List of Reference Books:

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations, Gene Kim, Patrick Debois, John Willis, and Jez Humble , IT Revolution Press
2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Jez Humble and David Farley, Addison-Wesley Professional
3. Docker Deep Dive, Nigel Poulton , Independently Published .

List of Suggested titles of Experiments:

1. Understand basic Git operations and workflows..
2. Create a simple Continuous Integration pipeline using Jenkins or GitHub Actions
3. Learn how to containerize an application using Docker.
4. Host a simple static website inside a Docker container.
5. Create a Dockerized application that uses secrets via environment variables
6. Learn how to collaborate on a project using Git and GitHub.
7. Create a local Git repository.
8. Create actionable alerts for application monitoring.
9. Learn basic infrastructure automation using Ansible.
10. Manage application secrets securely.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand DevOps Principles.	1 Remembering 2. Understanding
CLO2	Design and Implement Continuous Deployment.	2 Understanding 3 Applying
CLO3	Utilize Docker Compose to manage multi-container applications.	2 Understanding 1 Remembering
CLO4	Secure CI/CD pipelines by integrating automated security tools and processes.	2 Understanding 3 Applying 5 Evaluate

Mapping of CLOs with POs & PSOs

Course	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	H	H	H	M	M	M							L	M	H	M
CLO2	H	H	M	H	M	M							H	M	L	M
CLO3	M	H	L	M	M	M							M	M	L	M
CLO4	H	M	M	L	M	L							M	M	L	M
CLO5	H	M	H	M	H	M							H	M	L	H

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester VIII/ Fourth Year
Subject Title:	Advance Computer Networking
Subject Code:	18-ITM407-4C
Pre-requisite:	Computer Networks

Course Objective:

- To understand the significance and usage of computer networks at an advanced level.
- To provide comprehensive knowledge of advanced networking concepts and technologies.
- To understand the services and network management being offered in large-scale networks.
- To gain insight into various routing techniques and protocols.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03		02	04	50	25	-	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Optical Networking: Introduction to Optical Networking, Distributed Queue Dual Bus (DQDB), SONET/SDH standards.	6	15
2	ATM: The WAN Protocol — Introduction, Faces of ATM, B-ISDN Reference Model, ATM Layers, Choosing ATM Public Service.	8	15
3	Packet Switching Protocols — Virtual Circuit Packet Switching, X.25, Switched Multimegabit Data Service.	6	10
4	Protocols and Interfaces in Upper Layers of TCP/IP — TCP/IP Suite, Network/Transport/Application Layer Protocols.	5	15
5	Routing in the Internet — Intra-domain and Inter-domain Routing, Unicast and Multicast Protocols, IP over ATM, MPLS.	6	10
6	Network Management and Services — Remote Monitoring, Polling, Traps, Performance & Security Management, VLANs, Proxy Servers.	4	10
7	Traffic Engineering Basics — Traffic Definition, Sizing, Characteristics, Protocols, Time & Delay Consideration, Connectivity.	5	15
8	IP Routing — Basics, IP Routing Process, Configuring IP Routing. Dynamic Routing Protocols — RIP, IGRP, Configuration and Verification.	3	10

List of Reference Books:

1. Computer Networking- A Top-Down approach, 5th edition, Kurose and Ross, Pearson
2. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill
3. Data Communications and Networking (4th edition), Behrouz Forouzan, McGraw Hill.
4. TCP/IP Protocol Suite (3rd edition), Behrouz Forouzan, McGraw Hill.

List of Suggested Experiments

1. Perform IP exercises, sharing and mapping network drives.
2. Introduction to Cisco Packet Tracer and implementation of a basic network.
3. Configure a network with static routing.
4. Implement dynamic routing using appropriate protocols.
5. Study SONET network configuration and elements.
6. Configure ATM switching.
7. Perform VLAN configuration using Packet Tracer.
8. Implement DSL connection using Packet Tracer.
9. Create virtual circuit network using Frame Relay and ATM.
10. Configure Frame Relay on Cisco Routers.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the state-of-the-art in network protocols, architectures, and applications.	1Remembering, 2Understanding
CLO2	Analyze and compare different routing and switching techniques.	2Understanding, 3Applying
CLO3	Implement routing configurations using Cisco IOS commands.	3Applying, 5Evaluating
CLO4	Manage network services, traffic engineering, and monitoring tools.	2Understanding, 3Applying
CLO5	Investigate and design optimized solutions for network management and performance.	3Applying, 5 Evaluating

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	H	H	M	H	M	L							L	M	L	M
CLO2	H	H	M	H	H	M							H	M	L	M
CLO3	M	H	L	M	H	M							M	H	L	M
CLO4	H	L	M	L	M	L							M	M	L	M
CLO5	H	M	M	M	H	M							H	M	L	H

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester VIII/ Fourth Year
Course Title:	Research and Publication Ethics
Course Code:	18-ITM407-4C
Pre-requisite Course:	Basic understanding of research methodology and academic writing

Course Objectives:

1. To familiarize students with the basic concepts and of research and approaches to the study public ethics.
2. To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact Factor, etc.).
3. To understand the usage of plagiarism tools.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3		2	4	50	25	-	25	100

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Philosophy and Ethics : Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions.	3	10%
2	Scientific Conduct : Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.	5	15%
3	Publication Ethics : Publication ethics: definition, introduction and importance - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals.	7	25%
4	Open Access Publishing : Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	4	10%
5	Publication Misconduct : Group Discussion : a) Subject specific ethical issues, FFP, authorship b) Conflicts of interest c) Complaints and appeals: examples and fraud from India and abroad Software tools : Use of plagiarism software like Turnitin, Urkund and other open source software tools.	4	15%

6	Databases and Research Metrics : Databases : Indexing databases, Citation databases: Web of Science, Scopus Research Metrics : Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics.	7	25%
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Text Books:

1. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
2. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003

Reference Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: <https://ori.hhs.gov/sites/default/files/rcrintro.pdf>

LIST OF EXPERIMENTS / PRACTICALS

1. Identify plagiarism in sample documents using plagiarism detection tools such as Turnitin or Urkund.
2. Perform citation and referencing using different styles such as APA, IEEE, and MLA.
3. Explore indexing databases such as Scopus and Web of Science to identify indexed journals.
4. Analyze journal metrics such as Impact Factor, h-index, CiteScore, SJR, and SNIP.
5. Identify predatory journals and publishers using journal evaluation criteria and online tools.
6. Use journal finder tools such as JANE, Elsevier Journal Finder, and Springer Journal Suggester for suitable journal selection.
7. Study case examples of publication misconduct, duplicate publication, and ethical violations.
8. Prepare a plagiarism-free mini review report with proper citation and references.

Course Learning Outcomes (CLO):

COs	Statements	Bloom's Level
CO1	Explain the concepts of philosophy, ethics, research integrity, and scientific conduct in academic research.	2-Understand
CO2	Identify and differentiate various forms of research and publication misconduct including plagiarism, fabrication, falsification, and predatory publishing.	3-Apply
CO3	Apply ethical practices in authorship, citation, referencing, publication, and use of plagiarism detection tools in research work.	3-Apply
CO4	Use indexing databases, open access resources, journal finder tools, and citation databases for scholarly publication and literature exploration.	3-Apply
CO5	Analyze and evaluate research quality and publication impact using research metrics such as Impact Factor, h-index, Scopus metrics, and citation indicators. citation standards, plagiarism guidelines and IPR concepts.	3-Applying 5-Evaluate

Mapping of CLO with PO and PSO

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	L	M	H	L		M		H				M	L			
CLO2	L	H	H	L	L	M		H				M	L			
CLO3	L	M	H	M	H	M		H				M	M	L		
CLO4	M	M	L	L	H	H		M				H	M	M		
CLO5	M	H	M	L	M	H		M				H	M	M	L	

H:High, M:Medium, L:Low

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester - VIII/ Fourth Year
Subject Title:	Security Auditing, Risk & Compliance
Subject Code:	18-ITE404-4C
Pre-requisite:	Cyber security fundamentals

Course Objective:

- Design information security risk management framework and methodologies
- Identify and modeling information security risks
- Judge the difference between qualitative and quantitative risk assessment methods.
- Articulate information security risks as business consequences.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03		02	04	50	25	-	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Fundamentals of Risk and Cyber Systems: Definition of risk, risk management, and its importance, Risk assessment process, Risk monitoring and review techniques, Understanding cyberspace and its components, Cyber systems: definition, components, and examples, Role of cyberspace in modern risk landscapes	5	10
2	Cyber Security and Cyber Risk: Definition and importance of cyber security, Relationship between cyber security and information security, Cyber security and its role in critical infrastructure protection, Cyber security's impact on safety, Definition of cyber risk, Communication and consultation of cyber risk, Cyber risk assessment process, Monitoring and review of cyber risk	8	25
3	Context Establishment and Risk Identification: Goals, objectives, and scope of risk assessment, Interface to cyberspace and attack surface, Assumptions, assets, scale, and evaluation criteria, Techniques for identifying risks (e.g., checklists, brainstorming, scenario analysis), Malicious risks vs. non-malicious risks, Threat analysis and vulnerability analysis, Likelihood and consequences of incidents.	10	30
4	Risk Evaluation and Treatment: Consolidation of risk analysis results, Evaluation of risk levels, Risk aggregation and grouping, Identification of risk treatment options, Risk acceptance process	6	15

	and criteria,		
5	Information Security Metrics and Risk Analysis Techniques: Purpose and role of security metrics, Development and application of effective metrics for information security, Techniques for analyzing cyber risks (e.g., fault tree analysis, FMEA, Monte Carlo simulation), Application of risk analysis techniques for decision-making, Continuous monitoring and review of risks.	8	20

List of Reference Books:

1. Cyber-Risk Management by Atle Refsdal, Bjørnar Solhaug and Ketil Stlen - Springer
2. Auditing IT Infrastructures for Compliance by Marty M. Weiss and Michael G. Solomon – Jones & Bartlett Learning
3. Quantitative Risk Assessment: The Scientific Platform by Terje Aven – Cambridge University Press
4. Information Security Risk Assessment Toolkit by Mark Talabis and Jason Martin – Elsevier
5. IT Security Risk Control Management – An Audit Preparation Plan by Raymond Pompon – Apress

List of Suggested titles of Experiments:

1. Implementation of a Comprehensive Risk Management Framework.
2. Mapping and Analysis of Cyberspace and Cyber Systems
3. Application of a Cybersecurity Framework for Risk Mitigation
4. Comprehensive Cyber Risk Assessment Exercise
5. Simulation of Real-World Risk Scenarios and Incident Consequences
6. Development and Presentation of Risk Treatment Options
7. Development and Application of Information Security Metrics.
8. Conducting Fault Tree Analysis for Risk Identification
9. Implement Internal Compliance Assessment and Auditing for Security Standards

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the fundamental concepts of risk, risk management, and cyber systems, including their definitions, components, and role in modern risk landscapes.	1 Remembering 2. Understanding
CLO2	Analyze the relationship between cyber security, information security, and critical infrastructure protection, as well as their impact on safety and risk mitigation.	2. Understanding 4. Analyzing
CLO3	Identify and categorize risks in cyberspace using techniques such as checklists, brainstorming, and scenario analysis, and differentiate between malicious and non-malicious risks.	2 Understanding 3 Applying
CLO4	Evaluate threats, vulnerabilities, likelihoods, and consequences to establish a comprehensive risk assessment framework and define the attack surface.	3. Applying 5. Evaluating
CLO5	Develop and apply information security metrics and advanced risk analysis techniques, such as fault tree analysis, FMEA, and Monte Carlo simulations, for effective decision-making.	3. Applying 6. Creating

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	M	H	H	L	M	M							M	M	H	M
CLO2	M	M	L	H	H	L							M	H	L	H
CLO3	H	H	M	M	M	M							M	M	M	M
CLO4	L	H	M	M	H	M							H	M	L	M
CLO5	H	L	M	M	H	M							H	L	M	L

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester - VIII/ 4th Year
Subject Title:	Virtual and Augmented Reality
Subject Code:	18-ITE405-4C
Pre-requisite:	-

Course Objective:

- To gain the knowledge of historical and modern overviews and perspectives on virtual reality.
- To learn the fundamentals of sensation, perception, and perceptual training.
- To have the scientific, technical, and engineering aspects of augmented and virtual reality systems.
- To learn the Evaluation of virtual reality from the lens of design.
- To learn the technology of augmented reality and implement it to have practical knowledge.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03		02	04	50	25	-	25	100

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
1	Introduction : Introduction to Augmented-Virtual and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR ,VR and MR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality.	6	15	
2	VR systems : VR as a discipline, Basic features of VR systems, Architecture of VR systems, VR hardware : VR input hardware: tracking systems, motion capture systems, data gloves, VR output hardware: visual displays.	8	15	
3	Stereoscopic Vision & Haptic rendering : Fundamentals of the human visual system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Algorithms for haptic rendering and parallax, Synthesis of stereo pairs, Pipeline for stereo images.	7	20	
4	VR software development : Challenges in VR software development, Master/slave and Client/server architectures, Cluster rendering, Game Engines and available sdk to develop VR applications for different hardware (HTC VIVE, Oculus, Google VR).	6	20	
5	AR software development : AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.	4	15	

6	Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.	5	15
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List of Reference Books:

1. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.
2. The VR Book: Human-Centered Design for Virtual Reality, by Jason Jerald
3. Learning Virtual Reality by Tony Parisi, O' Reilly
4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006
5. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

List of Suggested titles of Experiments:

1. Study of different game engines
2. Implementation on Video/ Feature Viewing
3. Implementation on Virtual tour
4. Implementation on material animation
5. Implementation to show portal planets
6. Explore projects in Unity 2D and 3D
7. Mini Project on Augmented Reality or Virtual Reality

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the basic concepts of augmented reality (AR), virtual reality (VR), and mixed reality (MR), including their taxonomy, technologies, features, and challenges.	1 Remembering 2. Understanding
CLO2	Analyze and compare the differences between AR, VR, and MR systems, including their functionalities and visualization techniques.	2. Understanding 4. Analyzing
CLO3	Explore the architecture and hardware components of VR systems, including input and output devices, tracking systems, and motion capture technologies.	2. Understanding 3. Applying
CLO4	Examine stereoscopic vision, haptic rendering techniques, and related algorithms, including the synthesis of stereo pairs and depth perception.	2. Understanding 4. Analyzing 5. Evaluating
CLO5	Develop basic VR and AR software applications using relevant SDKs, game engines, and frameworks for various hardware platforms (e.g., HTC Vive, Oculus, Google VR).	3. Applying 6. Creating
CLO6	Apply VR and AR technologies in practical applications such as digital entertainment, film production, physical exercises, and gaming.	3. Applying 5. Evaluating

Mapping of CLOs with POs & PSOs

Course	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
Learning Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PS O1	PS O2	PS O3	PS O4
CLO1	M	M	H	L	H	M	M	H					L	M	M	M
CLO2	H	H	M	L	M	L	M	M					M	H	L	H
CLO3	M	L	H	M	M	M	L	L					H	L	H	H
CLO4	L	H	M	L	M	L	L	H					L	H	L	M
CLO5	M	M	H	M	H	M	H	M					M	M	H	M

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (Information Technology)
Program Code:	ET110
Semester/Year:	Semester - VIII/ 4 th Year
Subject Title:	Embedded Programming
Subject Code:	18-ITE406-4C
Pre-requisite:	Tools used during laboratory works: Keil, Cypress PSoC, relevant FPGA or MCU kits.

Course Objective:

The study of embedded systems software, programming and relevant applications. In the process of the laboratory work it is necessary to use and study standard and emerging development kit platforms for application development. The focus of the course is not on lecture, but a study of a real system and application development using its resources.

Teaching and Examination Scheme:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture (L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	-	02	04	50	25	-	25	100

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1	Introduction to Embedded Systems Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices In a System, Embedded Software in a system, Examples of Embedded Systems, Embedded System-on-chip (SOC) and Use of VLSI Circuit Design Technology, Complex Systems Design and Processors, Design Process in Embedded System, Formulation of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills Required for an Embedded System Designer	8	20
2	Device and Communication Bus for Devices Network IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol Parallel communication Network using ISA, PCI, PCI-X and advanced buses, Internet Enabled Systems- Network protocols, Wireless and mobile system protocol.	8	20
3	Device Drivers and Interrupt Services Mechanism Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing(Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Direct Memory Access, Device Driver Programming	7	20
4	Real Time Operating System: Operating system service, Process management, Timer function, Event function, Memory management, Device , File and I/O subsystem management, Interrupt	8	20

	routine in RTOS environment and handling of interrupt Sources calls, Real Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt Latency and Response of the Tasks as Performance Metrics, OS Security Issues		
5	Case Study: Case Study : Motivation for MSP 430 Microcontrollers: MSP430 RISC CPU architecture, Compiler-friendly features, Instruction set, Clock system, Memory subsystem. Understanding of different MSP430 families. Introduction to Code Composer Studio (CCS) and use CCS for Embedded C. Digital I/O – I/O ports programming using C, Understanding the muxing scheme of the MSP430 pins, interrupt programming On-chip peripherals - Watchdog Timer, Basic Timer, Real Time Clock (RTC), ADC, Universal Serial Communication Interface (USCI). Interfacing LED, LCD, Seven segment LED modules interfacing. Example – Real-time clock, Low-power features of MSP430.	8	20

List of Reference Books:

1. Embedded System: Architecture, Programming and Design by Rajkamal, 2nd edition, 2010, Tata McGraw Hill
2. MSP430 Microcontroller Basics by John H. Davies Elsevier; First edition (2010)
3. Computer as Components: Principles of Embedded Computing System Design, Wayne Wolf, 2nd edition, 2008, Morgan Kaufmann Publication

List of Suggested titles of Experiments:

1. Introduction to MSP430 Kit and Programming Environment with program to work with ports
2. Configure timer block with capture/compare channel 0 & 1 to generate 4.096 KHz & 1.024 KHz signal.
3. Configure watchdog timer in watchdog & interval mode.
4. Test various Power Down modes in MSP430.
5. Read Temperature of MSP430 with the help of ADC.
6. Use Timer to trigger ADC for reading analog signal in most efficient manner to reduce power consumption.
7. Configure DAC to generate positive ramp signal.
8. Use Comparator to compare the signal threshold level.
9. Implement Hardware Multiplier to multiply two arrays to perform MAC operation.
10. Implement DMA controller for basic convolution algorithm.
11. Use I2C protocol for communication between more than two MSP430 connected on I2C bus.
12. Use SPI protocol for communication between two MSP430.

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	Understand the properties of microprocessor, memory, peripheral components and buses in an embedded system.	1 Remembering 2. Understanding
CLO2	Design of an embedded system using an ARM processor.	2 Understanding 4 Analyze
CLO3	Understand concepts of architecture and code for embedded systems.	3 Applying
CLO4	Understand the basic properties of a real-time operating system	3 Applying
CLO5	role of the compiler in the embedded system design process	2. Understanding 3 Applying

Mapping of CLOs with POs & PSOs

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	H	M	H	L	L	M			L				H	L		
CLO2		L	M	H	L	L					L	L	M	L		
CLO3	M	H	M	L	M	H		M		L			M	L		
CLO4	M	M	L	L	M	H		M	L				M	L		
CLO5	M	L	L	L	M	H		M		L			H	L		

H: High, M: Medium, L: Low