

Branch Name:	Bachelor of Science (CS)
Program Code:	ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Security Auditing, Risk & Compliance
Subject Code:	15-CSM301-3C
Pre-requisite:	Cyber security fundamentals

Course Objective: The course focuses on identifying, analyzing, and modeling information security risks using qualitative and quantitative risk assessment techniques. It also aims to develop the ability to evaluate security risks and communicate their business impact and consequences effectively within an organizational environment.

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	00	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	6	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	20
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	25

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 and criteria,	6	15
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
6	Cyber Security Governance and Compliance Frameworks: ISO 27001 Information Security Framework, NIST Cyber Security Framework, Cyber Security Laws and Data Protection, GDPR and Indian IT Act overview, Security auditing tools and compliance automation	4	10

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.
10. Risk assessment using NIST model
11. Compliance check using ISO checklist

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

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Understand the concepts of risk, risk management and cyber systems, and their importance in modern technology environments.	1. Remembering, 2. Understanding
CLO2	Analyze the relationship between cyber security, information security and critical infrastructure, with emphasis on safety and risk mitigation.	2. Understanding, 4. Analyzing
CLO3	Identify and categorize cyber risks using suitable methods such as brainstorming, checklists and scenario analysis.	2. Understanding, 3. Applying
CLO4	Evaluate threats, vulnerabilities, likelihood and consequences to design and justify a cyber risk assessment framework.	3. Applying, 5. Evaluating
CLO5	Apply information security metrics and risk analysis techniques (FTA, FMEA, Monte Carlo) to support organizational cyber security 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	M	L	M	L	-	-	-	M	L	M	H	M	L	-
CLO2	M	M	L	H	H	L	-	-	-	M	L	H	M	H	M	L
CLO3	H	H	M	M	M	L	-	-	-	M	L	M	M	M	H	L
CLO4	M	H	M	H	H	M	-	-	-	M	L	M	M	H	H	M
CLO5	H	M	M	M	H	M	-	-	-	H	M	M	H	M	H	M

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (CS)
Program Code:	ET112
Semester/Year:	Semester - V/ Third Year
Course Title:	Linux Server Operating System
Course Code:	15-CSM302-3C
Pre-requisite Course:	Basic Operating System

Course Objectives: The course focuses on Linux installation, system hardening, user and privilege management, file system and data security, and network and server security techniques. It also aims to develop skills in system monitoring, auditing, vulnerability assessment, incident response, backup and recovery, and security automation for securing Linux-based environments.

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	0	2	4	50	25	-	25	100

Course Contents:

Unit No	Topic	Total Hours	Weightage (%)
1	Foundations of Linux & Security: History of Linux, Open-source philosophy, Linux distributions, Linux vs Windows Server/Unix, Linux Architecture: Kernel, Shell, Filesystem Hierarchy (FHS), process model, server roles, Initial Hardening: minimizing installed packages, disabling unused services, kernel hardening basics, Package management and repository security using apt, yum, dnf, zypper, system updates and patch management.	5	12
2	Linux Installation, Boot Process & System Hardening: Linux installation (Ubuntu Server/RHEL/CentOS), virtualization vs bare-metal, partitioning, ext4/XFS/Btrfs file systems, mounting and fstab, Boot process, GRUB security, systemd vs SysV init, hostname and network configuration, SSH setup, system services management, secure boot configuration, disabling unnecessary services and ports	6	12
3	User, Authentication & Privilege Management: User and group management, secure account creation/deletion, password aging and policies, PAM (Pluggable Authentication Modules), sudoers configuration, su restrictions, Linux permissions, chmod, chown, umask, ACLs, SUID, SGID, Sticky Bit, privilege escalation prevention, session management and authentication logging.	8	18
4	File System & Data Security: Disk management, LVM, RAID overview, quotas, file locking and record locking, file attributes, encryption concepts, GPG basics, file-level encryption, cryptsetup, LUKS disk encryption, backup security, integrity verification, AIDE (Advanced Intrusion Detection Environment), secure deletion, swap security, kernel modules and device security.	8	18

5	Network & Server Security: IP addressing, interfaces, routing, SSH hardening (key-based authentication, disabling root login), firewall configuration using iptables, nftables and UFW, network analysis using netstat and ss, DNS server (BIND) security, Apache/Nginx hardening, Postfix mail security, FTP/SFTP security, DHCP basics, proxy server concepts, intrusion detection using Snort/OSSEC, SELinux/AppArmor basics and policy management.	9	20
6	Monitoring, Auditing & Incident Response: System logging using syslog and journald, log rotation, auditd configuration and monitoring, service and process monitoring using systemctl, cron and at scheduling, vulnerability scanning using OpenVAS/Nessus/Lynis, incident response basics, backup and recovery strategies, disaster recovery planning, shell scripting for automation, configuration management fundamentals, performance monitoring and troubleshooting.	8	20

Text Book:

1. “The Linux Command Line: A Complete Introduction” by William Shotts.
2. “How Linux Works: What Every Superuser Should Know” by Brian Ward.
3. “UNIX & Linux System Administration Handbook” by Evi Nemeth et al.

Practical List: -

1. Lab sessions complement theory: installing Linux server, partitioning, file system creation.
2. User management, permissions, shell scripting tasks.
3. Service installation/configuration: DNS, Web, Mail, File share.
4. Networking tasks: configure static IP, firewall rules, SSH key authentication.
5. Security tasks: update system, disable root login, audit logs, backup/restore.
6. Project: “Build a fully functional Linux server” integrating multiple roles.
7. Log monitoring using **journalctl**
8. Vulnerability scanning using **Lynis**

Course Learning Outcomes (CLO):

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Understand the architecture, installation, and fundamental configuration of Linux server environments.	2. Understanding, 3. Applying
CLO2	Configure and manage users, file systems, permissions, and basic shell scripting for secure Linux operations.	3. Applying, 4. Analyzing
CLO3	Install, configure, and troubleshoot network-based services such as DNS, Web, Mail, and File servers.	3. Applying, 5. Evaluating
CLO4	Perform Linux server administration tasks including automation, monitoring, performance tuning, and backups.	3. Applying, 5. Evaluating
CLO5	Apply Linux system administration skills to support roles in Cyber Security, DevOps and server management careers.	3. Applying, 6. Creating

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	M	M	M	L	M	-	-	-	L	M	-	M	H	M	M	-
CLO2	M	H	H	M	H	-	-	-	M	M	-	M	H	H	H	L
CLO3	H	H	H	M	H	-	-	-	M	M	-	M	H	H	H	M
CLO4	M	H	H	H	H	L	-	-	M	M	-	H	H	H	H	M
CLO5	M	M	M	M	M	M	-	-	H	H	M	H	H	H	H	H

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (CS)
Program Code:	ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Cryptography and Network Security
Subject Code:	15-CSM303-3C
Pre-requisite:	Discrete Structures and Linear Algebra

Course Objective: The objective of this course is to provide students with theoretical and practical knowledge of Cryptography and network security principles used in secure communication systems. The course focuses on access control models, authentication mechanisms, secure system design, and cryptographic algorithms and protocols. It also aims to develop skills in applying security techniques for authentication, intrusion detection and prevention, and identifying and mitigating software security vulnerabilities in modern computing environments.

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	00	02	04	50	25	-	25	100

Subject Contents

Sr. No	Topic	Total Hours	Weight (%)
1	Foundations of Cryptography and Security: Introduction to Cryptography, Information Security Concepts, Security Threats and Vulnerabilities, Active and Passive Attacks, Security Services and Mechanisms, CIA Triad, Conventional Encryption Model, Mathematical Foundations for Cryptography including Modular Arithmetic, Euclidean and Extended Euclidean Algorithms, Prime Numbers, Fermat's Theorem, and Euler's Theorem	8	15
2	Classical and Symmetric Key Cryptography Principles and Dimensions of Cryptography, Classical Encryption Techniques, Feistel Cipher Structure, Simplified DES, DES, Double DES, Triple DES, Block Cipher Design Principles, Advanced Encryption Standard (AES), Modes of Operation, Performance and Security Considerations of Symmetric Cryptography	10	25
3	Public Key Cryptography and Key Exchange Principles of Public Key Cryptography, RSA Algorithm, Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Cryptography (ECC), Public and Private Key Management, Digital Certificates and PKI Concepts	10	20

4	Hash Functions, Authentication and Digital Signatures Authentication Requirements, Message Authentication Codes (MAC), Cryptographic Hash Functions, Security of Hash Functions and MACs, MD5, Secure Hash Algorithm (SHA), Digital Signatures, Key Distribution Techniques, Kerberos Authentication Protocol	8	20
5	Network and System Security Network Security Threats and Controls, Firewalls and Firewall Architectures, Intrusion Detection and Prevention Systems, Wireless Security, Email Security using PGP and S/MIME, Secure Communication Protocols, Honeypots, Traffic Flow Security, Access Control Mechanisms, Security in Modern Networked Systems	8	20

List of Reference Books:

1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.
3. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.
4. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata Mc Grawhill, India.
5. Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata Mc Grawhill, India.

List of Suggested titles of Experiments:

1. Write a program to implement Ceaser Cipher.
2. Write a program to implement Affine Cipher with equation $c=3x+12$.
3. Write a program to implement Playfair Cipher with key ldrp.
4. Write a program to implement polyalphabetic Cipher.
5. Write a program to implement AutoKey Cipher.
6. Write a program to implement Hill Cipher. (Use any matrix but find the inverse yourself).
7. Write a program to implement Rail fence technique.
8. Write a program to implement Simple Columnar Transposition technique.
9. Write a program to implement Advanced Columnar Transposition technique.
10. Write a program to implement Euclidean Algorithm.
11. Write a program to implement Advanced Euclidean Algorithm.
12. Implement OpenSSL encryption. Digital signatures, TLS certificate setup.

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

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Understand cryptographic fundamentals, security threats, and classical encryption techniques.	1. Remembering, 2. Understanding
CLO2	Apply block and public-key cryptographic algorithms (DES, AES, RSA, ECC) for securing data.	3. Applying, 4. Analyzing
CLO3	Analyze network vulnerabilities, security threats, and intrusion mechanisms.	2. Understanding, 4. Analyzing
CLO4	Design, implement, and evaluate secure authentication, hashing, and network security protocols.	3. Applying, 5. Evaluating, 6. Creating
CLO5	Demonstrate awareness of security standards, firewalls, IDS, email security and apply protection mechanisms.	3. Applying, 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	M	H	M	L	M	M	-	-	-	M	L	M	H	M	L	-
CLO2	H	H	H	M	H	M	-	-	M	M	-	M	H	H	H	M
CLO3	M	H	M	M	M	M	-	-	L	M	-	M	H	H	M	L
CLO4	H	H	H	H	H	M	-	-	M	M	-	H	H	H	H	M
CLO5	M	M	M	M	H	H	M	M	M	H	M	H	M	H	H	M

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (DS/CS)
Program Code:	ET111/ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Cloud Computing
Subject Code:	15-DSE301-3C
Pre-requisite:	Fundamentals of Distributed Computing

Course Objective: This course provides the knowledge of Cloud Computing paradigm. Students will be able to understand various platforms, applications and issues related to cloud environment. Students will explore Cloud virtualization, abstractions, and enablement technologies

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	00	02	04	50	25	-	25	100

Subject Contents				
Sr. No.	Topic	Total Hours	Weightage (%)	
1	Introduction: Cloud Computing, Layers and Types of Clouds, Cloud Infrastructure Management, Challenges and Applications, Virtualization of Computing, Storage and Resources.	4	10	
2	Virtualization: Introduction, Characteristics of Virtualized Environments, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples, Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management.	8	20	
3	Basics of Cloud Computing: Overview, Intranets and the cloud. Cloud computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of PaaS Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, Advantages, Identity as a Service (IDaaS).	8	20	
4	Fundamental Cloud Computing Architecture: Introduction, Fundamental Concepts and Models, Cloud Characteristics, Cloud Delivery Models, Cloud Deployment Models, Economics of the Cloud, Open Challenges. Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Elastic Resource Capacity Architecture, Service Load Balancing Architecture.	7	15	
5	Advanced Cloud Architectures: Hypervisor Clustering Architecture, Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture, Cloud Balancing Architecture, Storage Workload Management Architecture.	7	15	

6	Cloud Computing Security Architecture: Security Overview, Cloud Security Challenges and Risks, Software-as-a Service Security, Architectural Considerations, General Issues Securing the Cloud, Identity and Presence, Identity Management and Access Control.	5	10
7	Service Management: Service Level Agreement, Billing and Accounting. Case Study: OpenStack, Windows Azure, Google App Engine, Amazon AWS	5	10

List of Reference Books:

1. Rajkumar Buyya, James Broberg, Andrzej M Goscinski, Cloud Computing: Principles and Paradigms, Wiley publication.
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
4. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

Supplementary learning material:

1. NPTEL - Swayam Course Cloud computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur.
2. Coursera-<https://www.coursera.org/learn/introduction-to-cloud>.

List of Practicals / Tutorials:

1. Install OracleVirtual box.
2. VMware Workstation with different flavors of Linux or windows OS on top of Windows.
3. Installation and Configuration of virtualization using KVM.
4. Study and implementation of Infrastructure as a Service in public cloud.
5. Study and implementation of Storage as a Service in public cloud.
6. Study and implementation of Identity Management in public cloud.
7. Study and implement Load Balancing in public cloud.
8. Study and implement Elastic Management in public cloud.
9. Study and implement User Management in Cloud in public cloud.

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

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Understand virtualization concepts and apply cloud resource management in various environments.	2. Understanding, 3. Applying, 4. Analyzing
CLO2	Identify cloud computing architecture, deployment models and delivery models (SaaS, PaaS, IaaS, IDaaS).	1. Remembering, 2. Understanding, 3. Applying
CLO3	Address key cloud computing challenges such as security, privacy, and interoperability.	2. Understanding, 3. Applying, 4. Analyzing
CLO4	Evaluate cloud scalability, elasticity, resource pooling, and cost advantages to justify cloud-based solutions.	4. Analyzing, 5. Evaluating
CLO5	Select suitable cloud service providers and deployment strategies for practical application and development.	3. Applying, 5. Evaluating, 6. Creating

Mapping of CLOs with Pos & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	M	H	H	M	H	L	-	-	-	-	-	M	H	M	H	-
CLO2	H	M	H	M	M	L	-	-	L	M	-	M	H	M	H	-
CLO3	H	H	H	H	M	M	-	-	-	M	-	M	H	H	H	L
CLO4	M	H	H	H	H	M	-	-	M	M	-	H	H	M	H	M
CLO5	H	H	H	H	H	M	-	-	M	H	M	H	H	M	H	H

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (IT/DS/CS)
Program Code:	ET110/ET111/ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Wireless Networks
Subject Code:	15-ITE303-3C
Pre-requisite:	Computer Networks

Course Objective:

- To understand the concept about Wireless networks, protocol stack and standards.
- To understand and analyze the network layer solutions for Wireless networks.
- To study about fundamentals of 3G Services, its protocols and applications.
- To have in depth knowledge on internetworking of WLAN and WWAN.
- To learn about evolution of 4G Networks, its architecture and 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	00	02	04	50	25	-	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	WIRELESS LAN: Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART	8	15
2	MOBILE NETWORK LAYER: Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP	10	25
3	3G OVERVIEW: Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio	10	25

	Network, TD-CDMA, TD – SCDMA.		
4	INTERNETWORKING BETWEEN WLANS AND WWANS: Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.	8	20
5	4G & BEYOND: Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.	4	15

List of Reference Books:

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.(Unit IV,V)
3. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
4. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
5. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

List of Suggested titles of Experiments:

1. Program in NS 3 to connect WIFI TO BUS(CSMA).
2. Program in NS 3 to create WIFI SIMPLE INFRASTRUCTURE MODE.
3. Program in NS 3 to create WIFI SIMPLE ADHOC MODE.
4. Program in NS 3 to connect WIFI TO WIRED BRIDGING.
5. Program in NS 3 to create WIFI TO LTE(4G) CONNECTION.
6. Program in NS3 for CREATING A SIMPLE WIFI ADHOC GRID.
7. Introduction to GSM Architecture.
8. Introduction to 4G & BEYOND technologies.

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Identify and choose wireless transmission standard, physical layer protocol and MAC layer protocol on the basis of various network applications.	1 Remembering 2. Understanding
CLO2	Understand and explain mobile IP and data routing using it. Classify ad hoc network protocols	2 Understanding 3 Applying 4 Analyze 5 Evaluate
CLO3	Understand the TCP protocol for wireless networks and able to do congestion free transmission over wireless networks.	2 Understanding 3 Applying 4 Analyze
CLO4	Understand the major concepts involved in wireless wide-area networks and its architecture.	2 Understanding 3 Applying 5 Evaluate
CLO5	Have knowledge of 4G technologies and analyze various smart antenna techniques, modulation and coding techniques used in 4G technology	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	M				M					L		M	M	M	M	
CLO2	M	M	M	M	H					M		L	M	M	M	
CLO3	L	M	H	H	H					L		M	M	M	H	L
CLO4	M	M	L	H	L				M	M		H	M	M	H	L
CLO5	H	M	M	H	H				L	M	L	L	H	H	H	M

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (DS/CS)
Program Code:	ET111/ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Internet of Things
Subject Code:	15-DSE302-3C
Pre-requisite:	Basic knowledge of Computer Networks

Course Objective: The course aims to develop understanding of IoT hardware components, sensors, devices, and communication protocols used in interconnected systems. It also focuses on IoT platforms, cloud integration, and data analytics techniques for building smart and intelligent IoT-based 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	00	02	04	50	25	-	25	100

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
1	Introduction to IoT – Definition, characteristics, and applications of IoT; IoT architecture; Enabling technologies; IoT vs M2M vs CPS; IoT ecosystem.	8	15%	
2	IoT Hardware and Communication Technologies – Sensors and actuators, microcontrollers (Arduino, ESP32, Raspberry Pi), Communication protocols (Wi-Fi, Bluetooth, ZigBee, LoRa, MQTT, CoAP), IoT networks and connectivity.	10	20%	
3	IoT Platforms and Cloud Integration – Cloud computing and IoT, popular IoT platforms (ThingSpeak, AWS IoT, Google Cloud IoT, Azure IoT Hub), IoT data flow and analytics, Data storage and visualization.	8	15%	
4	IoT System Design and Development – IoT system architecture; hardware selection; interface design; edge computing; IoT project workflow; Case studies of IoT-based systems (Smart Home, Smart City, Smart Agriculture, Industry 4.0).	10	20%	
5	IoT Security, Privacy, and Challenges – Threats in IoT systems; security architecture; encryption; authentication; privacy-preserving IoT frameworks; regulatory and ethical issues.	6	10%	
6	IoT Analytics and Applications – Role of Artificial Intelligence, Big Data, and Cloud in IoT; Data-driven IoT; Machine Learning for IoT data; Real-world IoT case studies.	8	20%	

List of Reference Books:

1. Sudip Misra, Chandana Roy, Anandarup Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0, CRC Press, Taylor & Francis, 2021.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley Publications, 2012.
3. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017.
4. Arshdeep Bahga and Vijay Madisetti, Internet of Things: A Hands-on Approach, Universities Press, 2015.
5. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw-Hill Education, 2017.
6. Hakima Chaouchi, The Internet of Things – Connecting Objects to the Web, Wiley Publications, 2010.

List of Suggested titles of Experiments:

1. Study and setup of Arduino/ESP32 development environment.
2. Interfacing LEDs and controlling them through Arduino/Python.
3. Interfacing temperature and humidity sensor (DHT11/DHT22) and displaying values.
4. Interfacing motion sensor (PIR) for human detection.
5. Interfacing relay to control AC/DC loads.
6. Sending sensor data to cloud (ThingSpeak/AWS IoT) via Wi-Fi.
7. Working with MQTT protocol (publish/subscribe model).
8. Interfacing camera module and transmitting images to IoT dashboard.
9. Smart home automation system using IoT.
10. Design mini project: Smart agriculture / energy monitoring / environmental monitoring system.

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

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Explain IoT architecture, components, communication protocols, and enabling technologies.	1. Remembering 2. Understanding,
CLO2	Identify and interface sensors, actuators, and microcontrollers to build IoT-based systems.	2. Understanding 3. Applying,
CLO3	Develop IoT applications using open-source hardware, cloud platforms, and data integration.	3. Applying, 6. Creating
CLO4	Analyze IoT data using cloud analytics tools and visualization dashboards.	4. Analyzing, 5. Evaluating
CLO5	Demonstrate awareness of IoT security, privacy issues and apply basic protection mechanisms.	3. Applying, 5. Evaluating

Mapping of CLOs with POs & PSOs

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	M	H	M	L	M	L	-	-	L	L	-	M	H	M	M	-
CLO2	H	H	H	M	H	L	-	-	M	M	-	M	H	H	H	L
CLO3	H	H	H	H	H	L	-	-	M	M	-	H	H	H	H	M
CLO4	M	M	H	H	H	M	-	-	M	M	-	H	H	H	H	M
CLO5	M	M	M	M	H	H	M	M	M	M	M	H	M	H	H	H

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (CS)
Program Code:	ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Artificial Intelligence
Subject Code:	15-CSE301-3C
Pre-requisite:	Logic, Calculus, Linear Algebra, and Statistics

Course Objective: The objective of this course is to provide students with fundamental knowledge of Artificial Intelligence concepts including problem solving, inference, perception, knowledge representation, and learning techniques. The course focuses on heuristic search methods, knowledge representation approaches, predicate logic, and reasoning techniques used in intelligent systems and AI-based decision-making 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	00	02	04	50	25	-	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Introduction to AI: The AI Problems, AI Techniques, The Level of The Model, Examples	02	10
2	State Space Search & Heuristic Search Techniques: Defining the Problems as a State Space Search, Production Systems, Production Characteristics, Production System Characteristics, Issues in the Design of Search Programs, Additional Problems. Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction	06	15
3	Knowledge Representation Issues and Approaches: Representations and Mappings, Approaches to Knowledge Representation. Representation Simple Facts in Logic, Representing Instance and Is-A Relationships, Computable Functions and Predicates, Resolution. Procedural versus Declarative Knowledge, Logic Programming, forward versus Backward Reasoning.	07	15
4	Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse and Pragmatic Processing, Spell Checking	04	15
5	Connectionist Models: Introduction: Hopfield Network, Learning in Neural Network, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI and Symbolic AI.	06	15

6	Introduction To Machine Learning: Learning Problems, designing a learning system, Issues with machine learning. Concept Learning, Version Spaces and Candidate Eliminations, Inductive bias	06	12
7	Supervised and Unsupervised learning: Decision Tree Representation, Decision tree learning, Issues in Decision tree learning. K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Bases, Functions, Case Based Reasoning.	06	18

List of Reference Books:

1. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education
2. David Poole, Alan Mackworth, Randy Goebel, “Computational Intelligence: a logical approach”, Oxford University Press.
3. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education.
4. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers.
5. Peter Harrington, “Machine Learning in Action”, Dream Tech

List of Suggested titles of Experiments:

Exp. No.	Experiment Title
1	Implement Hill Climbing Algorithm
2	Implement Towers of Hanoi Problem
3	Implement Missionaries and Cannibals Problem
4	Implement 8-Queens Problem
5	Implement A* Algorithm
6	Implement Breadth First Search (BFS) Algorithm
7	Implement Depth First Search (DFS) Algorithm
8	Implement Predicate Logic
9	Implement Simple Chatbot using NLP Concepts
10	Implement Decision Tree Classification
11	Implement K-Nearest Neighbor (KNN) Algorithm
12	Mini Project on AI-based Real-world Problem

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

CLO	Course Learning Outcome	Bloom's Taxonomy Level
CLO1	Understand fundamental concepts of Artificial Intelligence, AI problem solving techniques, and intelligent agent models.	Understand (L2)
CLO2	Apply heuristic search techniques and knowledge representation methods to solve AI problems.	Apply (L3)
CLO3	Analyze logical reasoning, predicate logic, and inference mechanisms used in AI systems.	Analyze (L4)
CLO4	Evaluate AI techniques related to Natural Language Processing, Neural Networks, and Machine Learning models.	Evaluate (L5)
CLO5	Develop AI-based solutions using supervised and unsupervised learning approaches for real-world applications.	Create (L6)

Mapping of CLOs with POs & PSOs

CLO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1	M	M	L	-	-	-	-	-	-	L	-	M	M	L	L	-
CLO2	M	H	H	M	M	-	-	-	L	-	-	M	H	M	M	-
CLO3	M	H	M	H	M	-	-	-	-	M	-	M	H	H	H	-
CLO4	M	H	H	H	M	-	-	-	-	M	-	H	H	H	H	-
CLO5	L	M	M	M	L	L	L	M	M	H	M	M	H	M	H	H

H: High, M: Medium, L: Low

Branch Name:	B.Sc. (DS/CS)
Program Code:	ET111/ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Full Stack Web Development
Subject Code:	15-DSE304-3C
Pre-requisite:	Fundamental knowledge of computer networking and internet concepts.

Course Objective: The objective of this course is to provide students with fundamental and practical knowledge of Web Development for designing and developing robust web applications. The course focuses on client-side scripting, web programming concepts, and server-side development using NodeJS. It also aims to develop skills in API development using the Express framework and database design and management using NoSQL technologies for modern web applications.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	University Assessment		Continuous Assessment		University Assessment		Continuous Assessment		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	-	2	5	18	50	09	25	-	-	09	25	100

Subject Contents			
Sr. No	Topic	Total Hours	Weightage (%)
1	Introduction to Web: Server - Client - Communication Protocol (HTTP) – Structure of HTML Documents – Basic Markup tags – Working with Text and Images with CSS– CSS Selectors – CSS Flexbox - JavaScript: Data Types and Variables - Functions - Events – AJAX: GET and POST.	8	15
2	Introduction to Web Servers: – Javascript in the Desktop with NodeJS – NPM – Serving files with the http module – Introduction to the Express framework – Server-side rendering with Templating Engines – Static Files - async/await - Fetching JSON from Express.	9	20
3	Advanced Node JS and Database: Introduction to NoSQL databases – MongoDB system overview - Basic querying with MongoDB shell – Request body parsing in Express – NodeJS MongoDB connection – Adding and retrieving data to MongoDB from NodeJS – Handling SQL databases from NodeJS – Handling Cookies in NodeJS – Handling User Authentication with NodeJS.	10	25
4	Advanced Client Side Programming: React JS: ReactDOM - JSX - Components - Properties – Fetch API - State and Lifecycle - -JS Localstorage - Events - Lifting State Up - Composition and Inheritance.	10	25
5	App Implementation in Cloud: Cloud providers Overview – Virtual Private Cloud – Scaling (Horizontal and Vertical) – Virtual Machines, Ethernet and Switches – Docker Container – Kubernetes.	8	15

Textbook:

1. Internet and World Wide Web:How to Program, Paul Deitel , Harvey Deitel & Abbey Deitel, Pearson Education, 5th Edition, 2018.
2. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery), DT Editorial Services, Dreamtech Press, 2nd Edition, 2016.

Reference Books:

1. Chris Northwood, The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer, Apress Publications, 1st Edition, 2018.
2. Laura Lemay, Rafe Colburn & Jennifer Kyrnin, Mastering HTML, CSS & Javascript Web Publishing, BPB Publications, 1st Edition, 2016.
3. Matt Frisbie, "Professional JavaScript for Web Developers", Wiley Publishing, Inc, 4th Edition, ISBN: 978-1-119-36656-0, 2019
4. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by Step Guide to CreatingDynamic Websites by Robin Nixon
5. Alex Giamas, Mastering MongoDB 3.x, Packt Publishing Limited, First Edition, 2017.

Suggested Course Practical List:

1. Write a program to create a website using HTML CSS and JavaScript.
2. Write a program to build a Chat module using HTML CSS and JavaScript.
3. Build an online MCQ quiz app. The questions and options should be fetched based on the chosen topic from a Node JS server. The questions can be stored in a JSON file in the backend. Once the user has answered the questions, the frontend must send the chosen options to the backend and the backend must identify the right answers and send the score back to the front end. The frontend must display the score in a separate neatly designed page.
4. Build a blog website where you can add blog posts through a simple admin panel and the users can view the blog posts. The contents of the blog posts can be stored in either MongoDB or MySQL database. The home page should contain the titles of the blog post and the full post can be viewed by clicking the title. Frontend can be built either using React or through template engines served by the NodeJS server.
5. Take Amazon ecommerce or Facebook social media website/app. Analyze what the API endpoints would have been used for and how the frontend interacts with the backend. The networks tab in the browser's developer tools can be used if required.
6. Architect an entire database structure for an E-Commerce application for MongoDB. Discuss how the database would have been structured if you were using a SQL database.
7. Create a Simple Login form using React JS
8. Build a robust Todo List App with ReactJS.
9. Write a program to create a voting application using React JS
10. Build a simple calculator app with React. The user should be able to add numbers and operations to the app by clicking on buttons, just like you would do in a mobile phone. The moment the operation and the two operations are defined, the answer should be displayed
11. Create a project on Grocery delivery application

List of Laboratory/ Active Learning Assignment:

<https://www.coursera.org/learn/the-full-stack>

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

CLO	Description	Bloom's Taxonomy Level
CLO1	Explain the fundamentals of web technologies, client-server architecture, HTML, CSS, JavaScript, and AJAX.	1 Remember 2 Understand
CLO2	Develop server-side web applications using NodeJS, Express framework, and JSON-based communication.	2 Understanding, 3 Applying
CLO3	Design and manage NoSQL databases using MongoDB and integrate databases with web applications.	2 Understanding, 3 Applying
CLO4	Develop interactive client-side applications using ReactJS and API integration techniques.	4 Analyzing
CLO5	Build and deploy full-stack web applications using modern cloud and container technologies such as Docker and Kubernetes.	5 Evaluate, 6 Create

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	PSO1	PSO2	PSO3	PSO4
CLO1	H	M	L	-	M	-	-	-	-	M	-	M	H	M	-	-
CLO2	H	H	H	-	H	-	-	-	M	M	-	M	H	H	M	-
CLO3	H	H	H	M	H	-	-	-	M	M	-	M	H	H	H	M
CLO4	M	H	H	M	H	-	-	-	M	M	-	M	H	H	H	M
CLO5	H	H	H	M	H	-	-	-	H	M	M	H	H	H	H	M

H: High, M: Medium, L: Low

Branch Name:	Bachelor of Science (DS/CS)
Program Code:	ET111/ET112
Semester/Year:	Semester - V/ Third Year
Course Title:	Mobile Computing
Course Code:	15-DSE305-3C
Pre-requisite Course:	Analog and Digital Communication

Course Objectives: The course aims to develop understanding of mobile telecommunication architectures, network layer protocols, ad-hoc networks, and transport and application layer protocols used in mobile environments. It also focuses on mobile platforms and application development techniques for designing and developing modern mobile 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	
3	0	2	4	50	25	-	25	100

Course Contents:

Unit No	Topic	Total Hours	Weight age (%)
1	Introduction: Introduction to Mobile Computing, Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing , Spread spectrum -MAC Protocols – SDMA, TDMA, FDMA, CDMA	9	20
2	Mobile Telecommunication System: Introduction to Cellular Systems, GSM Services & Architecture , Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS/UMTS Architecture, Handover Security	9	25
3	Mobile Network Layer: Mobile IP, DHCP, AdHoc, Proactive protocol-DSDV, Reactive Routing Protocols, DSR, AODV , Hybrid routing, ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET), MANET Vs VANET – Security.	9	25
4	Mobile Transport And Application Layer: Mobile TCP, WAP – Architecture, WDP , WTLS , WTP, WSP , WAE , WTA Architecture – WML.	8	15
5	Mobile Platforms And Applications: Mobile Device Operating Systems – Special Constraints & Requirements , Commercial Mobile Operating Systems, Software Development Kit: iOS, Android, BlackBerry, Windows Phone, MCommerce – Structure – Pros Cons, Mobile Payment System, Security Issues	8	15

Text Book:

1. Jochen Schiller, —Mobile Communications, PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, —Fundamentals of Mobile Computing, PHI Learning Pvt.Ltd, New Delhi – 2012.

Reference Books:

1. Dharma Prakash Agarwal, Qing and An Zeng, "Introduction to Wireless and Mobile Systems", Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing, Springer, 2003.
4. C.K.Toth, —AdHoc Mobile Wireless Networks, First Edition, Pearson Education, 2002.
5. Android Developers: <http://developer.android.com/index.html>
6. Apple Developer: <https://developer.apple.com/>
7. Windows Phone Deventer: <http://developer.windowsphone.com>
8. BlackBerry Developer: <http://developer.blackberry.com>

List of Experiments:

Note: The experiment list provide beneath is for reference only. The course teacher may change/ formulate it as per his/ her methodology and requirement

- 1) Write a program to simulate Fixed Time Division Multiplexing. Take 12 stations. Every station has time slice of 417 microseconds. Delay should be 10ms. Every time the station gets turn, it shows message.
- 2) Write a program that identifies the bluetooth devices in the wireless range.
- 3) Write a program that prints the signal strength of Wifi connection of the given computer.
- 4) Prepare a wireless ad hoc network and show its working.
- 5) Write a program to find hamming distance. For example Hamming distance $d(v_1, v_2) = 3$ if $v_1 = 011011$, $v_2 = 110001$.
- 6) Write a program to perform infrared communication.
- 7) Write a program to perform Bluetooth file transfer.
- 8) Develop an android app which displays “Hello, welcome to Android Lab” message.
- 9) Develop an android app which displays a form to get following information from user.
 - Username
 - Password
 - Email Address
 - Phone Number
 - Country
 - State
 - State
 - Gender
 - Interests
 - Birth Date
 - Birth Time

Form should be followed by a Button with label “Submit”. When user clicks the button, a message should be displayed to user describing the information entered.

Utilize suitable UI controls (i.e. widgets). [When user enters country in Auto Complete Text View, list of states should be displayed in Spinner automatically.]

10) Using Android, Create a login Activity. It asks “username” and “password” from user. If username and password are valid, it displays Welcome message using new activity.

11) Develop calculator Android Application

Course Learning Outcomes (CLO):

CLO	Course Learning Outcome	Bloom’s Taxonomy Level
CLO1	Explain the basics of mobile communication systems, multiplexing, and MAC protocols.	2. Understanding, 3. Applying
CLO2	Analyze cellular networks including GSM/UMTS architecture, mobility management & wireless security.	2. Understanding, 4. Analyzing
CLO3	Select and compare routing protocols for MANET/VANET and demonstrate security issues in mobile networks.	3. Applying, 4. Analyzing, 5. Evaluating
CLO4	Explain & apply transport and application protocols such as Mobile TCP and WAP architecture.	2. Understanding, 3. Applying
CLO5	Develop a basic mobile application by integrating OS platform tools and ensure usability/security aspects.	3. Applying, 6. Creating, 5. Evaluating

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	M	H	M	L	M	-	-	-	L	L	-	M	H	M	L	-
CLO2	M	H	M	M	H	L	-	-	L	M	-	M	M	H	M	L
CLO3	H	H	H	M	H	L	-	-	M	M	-	H	H	H	H	M
CLO4	M	M	M	M	M	L	-	-	M	M	-	M	M	M	M	L
CLO5	M	M	M	H	H	M	-	-	M	H	M	H	H	H	H	H

H: High, M: Medium, L: Low

Branch Name:	B.Sc. (IT/DS/CS)
Program Code:	ET110/ET111/ET112
Semester/Year:	Semester - V/ Third Year
Subject Title:	Entrepreneurship Skills
Subject Code:	15-SEC310-3C
Pre-requisite:	Data analysis, technical skills, Communication, Critical thinking

Course Objective: Entrepreneur creates new business establishments or transforms old business establishments thus they work as engines of growth and play an important role in the development of economy. Our fast-growing economy provides ample opportunities for engineers to become successful entrepreneur. As entrepreneurship requires distinct skill set which could not be developed while teaching technical subjects a separate course has been introduced for the same. This course aims at developing competencies in students for becoming a successful entrepreneur.

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	
00	00	04	02	-	-	25	25	50

Subject Contents			
Sr. No	Topic	Total Hours	Weight (%)
1	Entrepreneurship Development - Concept & Scope: - Charms of becoming an intrapreneur/ entrepreneur. - Entrepreneurship: scope in local and global Market. Steps in setting up of a business. - Traits of successful intrapreneur/ entrepreneur.	8	15
2	Facility Planning: - Selection of Product/ Service, core competence, product life cycle, new product development process, mortality curve, creativity and innovation in product modification/development. - Process selection: Technology life cycle, forms and cost of transformation, factors affecting process selection. - Factors affecting selection of location for an industry. Importance of material handling and its relevance with facility location. - Calculate capacity of plant and its relation with economies of scale. Including flexibility in capacity	7	20
3	Support agencies for MSME: Categorization of MSME, ancillary industries	7	20

	- Support agencies for entrepreneurship guidance, training, registration. - Support agencies for technical consultation, technology transfer and quality control. - Support agencies for marketing and finance		
4	Managing critical resources: - Managing finance: Sources of financetypes, advantages and disadvantages, methods of cost control & importance, managing working capital. - Materials Management: MRP, JIT - Time management: art of managing time - Information system: Developing suitable information systems.	6	15
5	Project planning: - Preparation of business plan and techno economic feasibility study. - Breakeven point, return on investment and return on sales.	4	10
6	Managing enterprise - Identifying a USP, developing a marketing plan - Developing supply chain, planning for initial orders	4	10
7	Risk Management - Planning for calculated risk taking, initiation with low cost projects - Integrated futuristic planning, angel investors, and role of incubation centers	4	10

List of Reference Books:

1. Entrepreneurship development and Management Author: Dr. R.K. Singal · Publisher: S.K. Kataria & Sons · Edition: 3rd 2016.
2. Entrepreneurial Development S S Khanka S. Chand Publishing, 2006 - Business & Economics.
3. Developing Entrepreneurship: A Handbook, T. Venkateswara Rao, Publisher: Learning Systems, 1978 Original from the University of California Digitized 13 Feb 2009.
4. Entrepreneurship and Venture Management. Front Cover. Clifford M. Baumbach, Joseph Mancuso. Prentice-Hall, 1975
5. Planning an Industrial unit J. N. Vyas 2000.
6. Manual for the preparation of industrial - feasibility studies UNIDO 1991
7. New project opportunities GITCO. GITCO LTD Gujarat Industrial and Technical Consultancy Organization Ltd. A MULTIDISCIPLINARY CONSULTANCY ORGANIZATION <https://www.gitco.co.in/>.
8. Corporate creativity: the winning edge by Pradip N. Khandwalla. New Delhi: Tata McGraw-Hill Publishing Co. Ltd., 2003.
9. EDI STUDY MATERIAL EDI, BHAT, Ahmedabad Website : <http://www.ediindia.org>

List of Learning Websites

1. <http://www.ediindia.org>
2. <http://smallb.in/>
3. <http://www.msme.gov.in>
4. <http://nimsme.org>
5. <http://www.nsic.co.in>

List of suggested student Practical activities:

Following is the list of proposed activities, students should prepare a portfolio of the completed activities for future use:

1. Develop two products from household waste (attach photographs).
2. Download product development and innovative films from internet.
3. Prepare a collage for “Traits of successful entrepreneurs.”
4. Invite entrepreneurs, industry officials, bankers for interaction.
5. Identify your hobbies and interests and convert them into business idea.
6. Convert your project work into business.
7. Choose any advertisement and analyze its good and bad points.
8. Decide any product and analyze its good and bad features.
9. Select any product and prepare its cost sheet.
10. Choose any product and study its supply chain
11. Choose a product and design a unique selling proposition, brand name, logo, advertisement (print, radio, and television), jingle, packing, packaging, and label for it.

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

CLO	Description	Bloom’s Taxonomy Level
CLO1	Students will pick up about Foundation of Entrepreneurship Development and its theories.	1 Remembering 2. Understanding
CLO2	Students will explore entrepreneurial skills and management function of a company with special reference to SME sector.	2 Understanding 3 Applying 4 Analyze 5 Evaluate
CLO3	Students will identify the type of entrepreneur and the steps involved in an entrepreneurial venture.	2 Understanding 3 Applying 4 Analyze
CLO4	Students will understand various steps involved in starting a venture and to explore marketing methods & new trends in entrepreneurship.	2 Understanding 3 Applying 5 Evaluate

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	L	M	M	M	M	M							M	L	M	L
CLO2	L	M	M	L	M	M							M	M	M	M
CLO3	M	M	H	M	L	M							L	M	M	M
CLO4	M	L	M	H	M	H							M	M	M	M

H: High, M: Medium, L: Low