Faculty of Science & Technology
Savitribai Phule Pune University
Pune, Maharashtra, India

Curriculum for
Final Year of Information Technology
(2019 Course)
(With effect from AY 2022-23)

INDEX

	Savitribai Phule Pune University Final Year of Information Technology (2019 Course) (With effect from Academic Year 2022-23)													
	Semester VII													
Course Code	Course Name	Teaching Scheme(Hours/week)			Examination Scheme and Marks						Credit Scheme			
		Lecture	Practical	Tutorial	Mid-Sem	End-Sem	Termwork	Practical	Oral	Total	Lecture	Practical	Tutorial	Total
414441	Information Storage and Retrieval	03	-	-	30	70	-	-	-	100	3	-	-	3
414442	Software Project Management	03	-	-	30	70	-	-	-	100	3	-	-	3
414443	Deep Learning	03	-	-	30	70	-	-	-	100	3	-	-	3
414444	Elective III	03	-	-	30	70	-	-	-	100	3	-	-	3
414445	Elective IV	03	-	-	30	70	-	-	-	100	3	-	-	3
414446	Lab Practice III	-	04	-	-	-	25	-	25	50	-	2	-	2
414447	Lab Practice IV	-	02	-	-	-	25	25	-	50	-	1	-	1
414448	Project Stage-I	-	-	02	-	-	50	-	-	50	-	-	2	2
414449	Audit Course7													
	Total Credit										15	03	02	20
	Total	15	06	02	150	350	100	25	25	650	15	03	02	20

Elective III:	Elective IV:
• Mobile Computing • High Performance Computing • Multimedia Technology • Smart Computing	• Bioinformatics • Introduction to DevOps • Computer Vision • Wireless Communications
Lab Practice-III:	Lab Practice-IV:
It is based on subjects: • Information Storage and Retrieval	It is based on subjects: • Deep Learning

Audit Courses 7:
- 414449A: Copyrights and Patents
- 414449B: Stress Management by Yoga
- 414449C: English for Research Paper Writing

Savitribai Phule Pune University, Pune		
Final Year Information Technology (2019 Course)		
414441: Information and Storage Retrieval		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 03 hrs/week	**03 Credits**	**Mid_Semester: 30 Marks** **End_Semester: 70 Marks**

Prerequisite Courses,

1. Data Structures and Files.
2. Database management systems.

Companion Course, if any: Lab Practice III

Course Objectives:

1. To understand the concepts of information retrieval.
2. To understand the role of clustering in information retrieval.
3. To learn different indexing structures and searching techniques.
4. To evaluate the performance of the IR system and understand user interfaces for searching.
5. To understand information sharing on the web.
6. To understand the various applications of information retrieval giving emphasis to multimedia and distributed IR, web Search.

Course Outcomes:

On completion of the course, students will be able to

CO1. Understand the concept of Information retrieval and to apply clustering in information retrieval.

CO2. Use an indexing approach for retrieval of text and multimedia data.

CO3. Evaluate performance of information retrieval systems.

CO4. Apply the concepts of multimedia and distributed information retrieval.

CO5. Use appropriate tools in analyzing the web information

CO6. Simulate the working of a search engine and recommender system.

COURSE CONTENTS		
Unit I	**Introduction to Information Retrieval**	**(06 hrs)**

Basic Concepts of IR, Data Retrieval & Information Retrieval, Text mining and IR relation, IR system block diagram, **Automatic Text Analysis:** Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighting, Probabilistic Indexing, Automatic Classification. Measures of Association, Different Matching Coefficients, Cluster Hypothesis, **Clustering Techniques: Rocchio's** Algorithm, Single pass algorithm, Single Link algorithm.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**Indexing and Searching Techniques**	**(06 hrs)**

Indexing: Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing.

Searching Techniques: Boolean Search, sequential search, Serial search, cluster-based retrieval, Query languages, Types of queries, Patterns matching, structural queries.

IR Models: Basic concepts, Boolean Model, Vector Model, Probabilistic Model.

Mapping of Course Outcomes for Unit II	CO2

Unit III	Evaluation and Visualization of Information Retrieval System	(06 hrs)
Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user-oriented measures. **Visualization in Information System:** Starting points, Query Specification, document context, User relevance judgment, Interface support for search process.		

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Distributed and Multimedia IR**	**(06 hrs)**
Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, **Multimedia IR:** Introduction, Data Modeling, Query Language, Background-Spatial Access Method, A Generic Multimedia Indexing Approach, One Dimensional Time Series, Two-Dimensionalcolor Images, Automatic Feature Extraction, Trends and Research Issue.		

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Web Searching**	**(06 hrs)**
Introduction, Challenges, Web Characteristics, **Search Engines:** Centralized Architecture, Distributed Architecture, User Interfaces, Ranking, Crawling the web, Indices, Browsing, Meta-searchers, Searching using Hyperlinks, Trends and Research Issues, **Introduction to Web Scraping:** Python for web scraping, Request, HTML parsing, Beautiful Soup.		

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Advanced Information Retrieval**	**(06hrs)**
XML Retrieval: Basic XML concepts, Challenges in XML retrieval, Vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. **Recommendation system:** Collaborative Filtering and Content Based Recommendation of Documents and Products. Introduction to Semantic Web.		

Mapping of Course Outcomes for Unit VI	CO6	
Textbooks:		

1. Ricardo Baeza-Yates, Berthier Riberio–Neto, Modern Information Retrieval, Pearson Education, ISBN: 81-297-0274-6.
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk), Second Edition ISBN:978-408709293.
3. Ryan Mitchell, Web Scraping with Python, O'reilly, second Edition, ISBN: 9781491985571.
4. Ricci F, Rokach L, Shapira B, Kantor P, Recommender Systems Handbook, Springer, ISBN:978-0-387-85819-7.
5. Norbert Fuhr, MouniaLalmas, Saadia Malik, Gabriella Kazai, Advances in XML Information Retrieval and Evaluation, Springer New York Publisher.

Savitribai Phule Pune University, Pune
Final Year Information Technology (2019 Course)
414442: Software Project Management

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory (TH): 3 hrs/week	**03 Credits**	**Mid_Semester:30 Marks** **End_Semester:70 Marks**

Prerequisite Courses: **Software Engineering**

Course Objectives:

1. To discuss the fundamentals of Software Project Management
2. To explain Project Design and Project Evaluation.
3. To acquire skill in Activity Planning and to deal with Risk Management
4. To provide platform to understand through different tools about Project Tracking, Monitoring & Control.
5. To discuss Staff Selection Process and the issues related to Staff Management.
6. To provide exposure to modern tools used for Software Project Management.

Course Outcomes:

 On completion of the course, students will be able to–

CO1. Apply the practices and methods for successful Software Project Management

CO2. Create Design and Evaluate Project

CO3. Analyze Project Schedule and calculate Risk Management with help of tools.

CO4. Demonstrate different tools used for Project Tracking, Monitoring & Control.

CO5. Identify Staff Selection Process and the issues related to Staff Management.

CO6. Discuss and use modern tools for Software Project Management.

COURSE CONTENTS

Unit I	**Introduction to Software Project Management**	**(6hrs.)**

Introduction to Software Project Management: Why is Software Project Management important? What is a Project? Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some Ways of Categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success, and Failure, what is Management? Management Control, Traditional versus Modern Project Management Practices.
Case study: Online Shopping System.

Mapping of Course Outcomes for Unit I	CO1

Unit II	**Project Design and Evaluation**	**(6 hrs.)**

Project Design: Overview of UML diagrams: Use case, Class, Activity, State, Sequence, Deployment
Project Evaluation: What is Project Evaluation? Importance of Project Evaluation, Cost Benefit Evaluation Techniques
Process Evaluation and Improvement: The Process Improvement Process: The Process Improvement Cycle, Process Measurement: The GQM Paradigm, Process Analysis: Techniques of Process Analysis, Process change: The Process Change Process
Case study: Online Shopping System, Perform Cost-Benefit Analysis using Microsoft Excel

Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Activity Planning & Risk Management**	**(6 hrs.)**

Objectives of Activity planning – Project schedules – Activities – Sequencing and Scheduling, Network Planning Models – Formulating Network Model – Forward Pass & Backward Pass Techniques.
Risk Management- Introduction, Risk Management, Risk Assessment, Risk identification, Risk Prioritization, Risk Planning, Risk control, Risk Strategies, Evaluating Risk to the schedule
Study Risk Management Tools - SpiraPlan by Inflectra, Risk Management Studio, GRC Cloud
Case study: Online Shopping System

Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Project Tracking, Monitoring & Control**	**(6hrs.)**

Introduction: Project Tracking and Control, Monitoring and Control Processes, Collection of Project data, Partial Completion Reporting.
Data Collection Methods: Phone vs. Online vs. In-Person Interviews, Visualizing Progress, Visual Project Management, Kanban Boards, Project Calendars, Cost Monitoring, Four Steps in Project Cost Management, Earned Value Analysis, Project Tracking, Effective Approach to Track Projects,
Status Report: Four features of a Good Status Report, Change Control, Different factors of Change Control Process, Change Process Flow-Diagram, Software Configuration Management, Tasks in SCM Process, Participant of SCM Process.
Software Configuration Management Tools: Git, Team Foundation Server, Ansible, Managing Contracts, The Stages of Contract Management, Challenges of Contract Management, Benefits of Contract Management, Types of Contracts in Software Project Management
Case study: Online Shopping System, track different versions of a software using Git tool

Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Managing People and Organizing Teams**	**(6 hrs.)**

Understanding Behavior-Organizational Behavior- Selecting the Right Person for the Job-Instruction in the Best Methods-Motivation-The Oldham-Hackman Job Characteristics Model- Stress-Health and Safety- Ethical and Professional Concerns-Becoming a team-Decision Making-Organization and Team Structures-Coordination Dependencies-Dispersed and Virtual Teams-Communication Genres and plans-Leadership.
Case study: Team Buildingin Project Management with reference to academic project work.

Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Applications of Software Project Management in Industry**	**(6 hrs.)**

Agile Project Management with Azure DevOps: An Overview of Application Lifecycle Management & Azure DevOps, Traceability, Visibility, Collaboration, and Extensibility. Difference between Microsoft TFS and Azure DevOps.

Metrics in Agile Practice: Introduction to Metrics inAgile Practice, Metrics for Project Management, Agile Project Management in Azure DevOps and TFS.

Case study: Online Shopping System.

Mapping of Course Outcomes for Unit VI	CO6

Textbooks:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – FifthEdition, Tata McGraw Hill, New Delhi. - *(for Unit 1, 3, 5)*

2. A Guide to the Project Management Book of Knowledge-Seventh Edition. *(For Unit 4)*

3. Walker Royce, "Software Project Management" a unified approach. Addison Wesley ISBN 0-20130958-0. *(For Unit 6)*

Reference Books:

1. JackMarchewka," Information Technology-Project Management", Wiley Student Version, 4th Edition, 2013.

2. Lan Somerville, Software Engineering, Fifth Edition, Addison Wesley Publications, 1996. *(For Unit 2)*

3. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN:9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527. *(For Unit 2)*

4. James P Lewis, "Project Planning, Scheduling & Control", McGraw Hill, 5th Edition, 2011.

5. PankajJalote," Software Project Management in Practice", Pearson Education, 2002.

6. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.

7. Joachim Rossberg "Agile Project Management with Azure DevOps" Apress. *(For Unit 6)*

8. Robert K. Wyzocki, Rudd McGary, Effective Project Management, WILEYDreamtech India Pvt. Ltd., 2000.

Books / E Learning References:

1. https://www.inflectra.com/SpiraPlan/(for Unit 3)

2. https://www.techtarget.com/searchsecurity/definition/governance-risk-management-and-compliance-GRC(for Unit 3)

3. https://www.softwaretestinghelp.com/risk-management-tools/#3_Risk_Management_Studio (For Unit 3)

4. NPTEL: https://nptel.ac.in/courses/106101061/29

5. https://onlinecourses.nptel.ac.in/noc17_mg01/preview

6. Coursera: https://www.coursera.org/learn/uva-darden-project-management

7. http://managementhelp.org/evaluation/program-evaluation-guide.htm.

8. https://nptel.ac.in/courses/106105218 (NPTEL)

9. Virtual Labs:- Software Engineering-   **1) http://vlabs.iitkgp.ernet.in/se/3/**
  2) http://vlabs.iitkgp.ernet.in/se/5/   **3) http://vlabs.iitkgp.ernet.in/se/6/**
  4) http://vlabs.iitkgp.ernet.in/se/7/

Savitribai Phule Pune University, Pune		
Final Year Information Technology (2019 Course)		
414443: Deep Learning		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory (TH): 3 hrs/week	**03 Credits**	**Mid_Semester : 30 Marks** **End_Semester : 70 Marks**

Prerequisite Courses:1. Machine Learning 2. Mathematics

Companion Course: Artificial Intelligence Soft computing

Course Objectives:

1. To introduce the theoretical foundations, algorithms, methodologies, and application of neural networks and deep learning.
2. To design and develop an application-specific deep learning model.
3. To provide the practical knowledge handling and analyzing real world applications.

Course Outcomes:

On completion of the course, students will be able to–

CO1. Understand the theoretical foundations, algorithms, and methodologies of Deep Learning.
CO2. Apply the concepts of Convolution Neural Networks and use of popular CNN architectures.
CO3. Compare Feed Forward Neural Network and Recurrent Neural Network and learn modeling the time dimension using RNN and LSTM.
CO4. Elaborate unsupervised deep learning algorithms like Autoencoders.
CO5. Explore Representation Learning and Transfer Learning techniques using variants of CNN architecture.
CO6. Evaluate the performance of deep learning algorithms and to provide solution for various real-world applications.

COURSE CONTENTS		
Unit I	**Fundamentals of Deep Learning**	**(06 hrs)**
What is Deep Learning?, Multilayer Perceptron ,Feed forward neural, Back propagation, Gradient descent, Vanishing gradient problem, **Activation Functions:** RELU, LRELU, ERELU, Optimization Algorithms, **Hyper parameters:** Layer size, Magnitude (momentum, learning rate),Regularization (dropout, drop connect, L1, L2)		
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Convolutional Neural Network:**	**(06 hrs)**
Introduction to CNN, Convolution Operation, Parameter Sharing, Equivariant Representation, Pooling, Variants of the Basic Convolution Function, The basic Architecture of CNN, Popular CNN Architecture – AlexNet.		
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Recurrent Neural Networks**	**(06 hrs)**

Recurrent Neural Networks: Types of Recurrent Neural Networks, Feed-Forward Neural Networks vs Recurrent Neural Networks, Long Short-Term Memory Networks (LSTM), Encoder Decoder architectures, Recursive Neural Networks		
Mapping of Course Outcomes for Unit III	**CO3**	
Unit IV	**Autoencoders**	**(06 hrs)**
Undercomplete Autoencoders, Regulraized Autoencoders-Sparse Autoencoders, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Autoencoders, Applications of Autoencoders.		
Mapping of Course Outcomes for Unit IV	**CO4**	
Unit V	**Representation Learning**	**(06 hrs)**
Greedy Layerwise Pre-training, Transfer Learning and Domain Adaption, Distributed Representation, Variants of CNN: DenseNet.		
Mapping of Course Outcomes for Unit V	**CO5**	
Unit VI	**Applications of Deep Learning**	**(06 hrs)**
Overview of Deep Learning Applications: Image Classification, Social N/w/ analysis, Speech Recognition, Recommender system, Natural Language Processing.		
Mapping of Course Outcomes for Unit VI	**CO6**	
Textbooks:		
1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017 2. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2017. 3. Nikhil Buduma, "Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms" O'Reilly		
Reference Books:		
1. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding. 2. Deep Neural Networks" Apress, 2018. 3. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012. 4. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017. 5. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017. 6. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.		
E Books / E Learning References :		
1. Michael Nielsen, "Neural Networks and Deep Learning", Online book, 2016 (http://neuralnetworksanddeeplearning.com/) 2. Deep Learning for Visual Computing https://onlinecourses.nptel.ac.in/noc22_ee54 3. Deep Learning - IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs22 4. Deep Learning - IIT Ropar https://onlinecourses.nptel.ac.in/noc22_cs35/ 5. Introduction to Deep Learning : https://www.coursera.org/learn/introduction-to-deep-learning-boulder 6. Deep Learning Specialization : https://www.coursera.org/specializations/deep-learning		

<table>
<tr><td colspan="3" align="center">**Savitribai Phule Pune University, Pune**
Final Year Information Technology (2019 Course)
414444: Elective – III (Mobile Computing)</td></tr>
<tr><td>**Teaching Scheme:**</td><td align="center">**Credit Scheme:**</td><td>**Examination Scheme:**</td></tr>
<tr><td>Theory (TH):3 hrs/week</td><td align="center">**03 Credits**</td><td>**Mid_Semester: 30 Marks**
End_Semester: 70 Marks</td></tr>
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Prerequisite Courses :

Companion Course:

Course Objectives:

1. To understand the basic concepts of mobile computing.

2. To learn the basics of mobile telecommunication system.

3. To understand the Generations of Mobile Communication Technologies.

4. To be familiar with the network layer protocols and Ad-Hoc networks.

5. To know the basis of transport and application layer protocols.

6. To gain knowledge about different mobile platforms and application development.

Course Outcomes:

On completion of the course, students will be able to–

CO1. understand the basic concepts of mobile computing, MAC and different multiplexing technics.

CO2. understand Protocols, Connection Establishment, Frequency Allocation, Routing of mobile telecommunication system like GSM, GPRS, UMTS.

CO3. understand the Generations of Mobile Communication Technologies

CO4. learn mobile IP , Adhoc – Network, Reactive Routing protocols, Multicast Routing.

CO5. obtaining knowledge of transport layer protocol TCP, File System, and different application layer protocols.

CO6. gain knowledge about different mobile platforms**,** operating Systems, Software Development Kit, Security Issues.

<table>
<tr><td colspan="3" align="center">**COURSE CONTENTS**</td></tr>
<tr><td>**Unit I**</td><td align="center">**Introduction**</td><td>**(06 hrs)**</td></tr>
<tr><td colspan="3">**Introduction to Mobile Computing:** Applications of Mobile Computing, A short history of wireless communication,

Medium Access Control: Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals.

SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access.

CDMA: Spread Aloha multiple access.</td></tr>
<tr><td>**Mapping of Course Outcomes for Unit I**</td><td colspan="2">**CO1**</td></tr>
</table>

Unit II	Mobile Telecommunication System	(06 hrs)

Introduction to Cellular Systems, **GSM:** Services &Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, **GPRS, UMTS:** Architecture, Handover, Security.

Mapping of Course Outcomes for Unit II	CO2

Unit III	Generations of Mobile Communication Technologies.	(06 hrs)

First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Fourth Generation 4G wireless networks, Fifth Generation 5G wireless networks

Mapping of Course Outcomes for Unit III	CO3

Unit IV	Mobile Network Layer	(06 hrs)

Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunnelling and Encapsulation, Optimizations, Reverse tunnelling,

IPv6:DHCP, **AdHoc networks:** Routing, Proactive protocol-DSDV, **Reactive Routing Protocols:** DSR, AODV, Hybrid routing –ZRP, **Multicast Routing:** ODMRP, Vehicular Ad Hoc networks (VANET) MANET Vs VANET Security.

Mapping of Course Outcomes for Unit IV	CO4

Unit V	Mobile Transport Layer	(06 hrs)

Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction oriented TCP.

Support for Mobility: File systems: Consistency, Examples.

World Wide Web: Hypertext transfer protocol, Hypertext markup language, some approaches that might help wireless access, System architectures

Wireless application protocol: Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Wireless markup language, WML script, Wireless telephony application, Examples Stacks with WAP, Mobile databases, Mobile agents.

Mapping of Course Outcomes for Unit V	CO5

Unit VI	Mobile Platforms and Applications	(06 hrs)

Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems.

Software Development Kit: Ios, Android, Blackberry, Windows Phone,

M Commerce, Structure, Pros &Cons, Mobile Payment System, Security Issues.

<table>
<tr><td colspan="3" align="center">**Savitribai Phule Pune University, Pune**
Final Year Information Technology (2019 Course)
414445: Elective – IV (Wireless Communication)</td></tr>
<tr><td>**Teaching Scheme:**</td><td>**Credit Scheme:**</td><td>**Examination Scheme:**</td></tr>
<tr><td>**Theory (TH): 3 hrs/week**</td><td>**03 credits**</td><td>**Mid_Semester: 30 Marks**
End_Semester: 70 Marks</td></tr>
<tr><td colspan="3">**Prerequisite Courses:** Basic Computer Networks, Computer Networks and Security, Mobile Computing</td></tr>
<tr><td colspan="3">**Companion Course :**NA</td></tr>
<tr><td colspan="3">**Course Objectives:**

1.To learn fundamental knowledge of wireless communication and generation of cellular network.

2. To understand basic fundamentals of cellular system and LTE Technology.

3. To study various multiple access techniques to access the shared channel.

4.To learn various protocols and applications in wireless communication system.

5. To understand security issues, challenges and tools in wireless communication system.

6. To study recent trends and technologies in wireless communication.</td></tr>
<tr><td colspan="3">**Course Outcomes:**
On completion of the course, students will be able to–

CO1: Articulate the fundamental concept of cellular system.

CO2: Analyse the fundamentals of cellular systems.

CO3: Illustrate multiple access technique for effective utilization of spectrum.

CO4: Design and analyse the WAP Programming Model in networking environment.

CO5: Learn and understand security issues, challenges and tools in wireless communication.

CO6: Explore the emerging trends and applications in wireless communication.</td></tr>
<tr><td colspan="3" align="center">**COURSE CONTENTS**</td></tr>
<tr><td align="center">**Unit I**</td><td align="center">**Introduction to Wireless Communication**</td><td align="center">**(6hrs)**</td></tr>
<tr><td colspan="3">Evolution of mobile communications, Types of Wireless Communication: Satellite Communication, Microwave Communication, Infrared, Generation of Cellular network, 2G/3G/4G/5G/6G.</td></tr>
<tr><td align="center">**Unit II**</td><td align="center">**Fundamentals of Cellular and LTE Technology**</td><td align="center">**(6hrs)**</td></tr>
<tr><td colspan="3">Cellular system, hexagonal geometry cell and concept of frequency reuse, Need of LTE Long Term Evolution (LTE) Technology fundamentals: Architecture features. **4G:** LTE communication protocol: Protocol model, Air Interface Transport Protocols, Fixed Network Transport Protocols, User Plane Protocols , Signalling Protocols</td></tr>
<tr><td align="center">**Unit III**</td><td align="center">**Multiple Access Techniques**</td><td align="center">**(6hrs)**</td></tr>
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Overview of TDMA (Time Division Multiple Access), and CDMA (Code Division Multiple Access), SDMA (Space Division Multiple Access), IDMA (Interleave Division Multiple Access).

Latest access technologies: MIMO (Multiple Input Multiple Output), OFDM (Orthogonal Frequency Division Multiplexing).

Unit IV	Wireless Communication Protocols	(6 hrs)

Wireless Application Protocol, The WAP Programming Model, WAP Architecture, Traditional WAP Networking Environment, Wi-Fi Direct, Li-Fi, NFC, SigFox, Z-Wave, LoRaWAN, Thread (based on IEEE 802.15.4), RT Wi-Fi, RTCP, RTSP, SPEED.

Unit V	Security in Wireless Communication	(6 hrs)

Security Issue and challenges in GSM, 1G, 2G, 3G, 4G.

Multimedia security in 5G and 6G, post-quantum cryptography, Molecular communication, visible light communication (VLC), and distributed ledger (DL). UMTS Security, Bluetooth Security, WEP, WPA2.

Wireless Security Tools: Kismet, URH (Universal Radio Hacker).

Unit VI	Recent Trends and Applications in Wireless Technology	(6 hrs)

5G NR (New Redio): Working, Benefits.

Holographic MIMO Surfaces for 6G Wireless Networks, Simultaneous Transmission and Reflection (STAR) for 360° Coverage, Quantum technology for 5G/6G Wireless Networks.

Applications of Wireless Technology.

Textbooks:

1. Wireless Communications, T.L. Singal, McGraw Hill Education.
2. Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers.
3. Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
4. Principles of Modern Wireless Communication Systems Theory and Practice, 1st Edition, Aditya Jagannatham.
5. 5G Outlook–Innovations and Applications,RamjeePrasad,River Publishers Series in Communications.
6. Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press