TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Electronics and Communication Engineering

Sixth Semester

Program: B.Tech. in ECE	**Year, Semester:** 3rd, 6th.
Course Title: Antenna Lab	**Subject Code:**TIU-UEC-L309
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. **To provide hands-on experience in testing different types of antennas** for various applications, allowing students to apply theoretical concepts in practical scenarios.
2. **To develop proficiency in using measurement equipment**to analyze antenna parameters such as radiation patterns, gain, enabling students to interpret results and optimize antenna performance.

COURSE OUTCOME:

On completion of the course, the student will be able:

CO-1	Interpret radiation patterns of different types of antennas using Antenna trainer kit.	K3
CO-2	Analyze antenna radiation patterns along with beamwidth calculation..	K4
CO-3	Test a range of antennas like dipole antennas, microstrip antennas etc. demonstrating hands-on skills..	K3
CO-4	Implement comprehensive laboratory reports that include procedure, measurement data, and result analysis..	K3
CO-5	Understand the performance and design parameters of antennas in practical applications.	K2
CO-6	Compare the performance of different antennas for various communication systems.	K4

COURSE CONTENT:

MODULE 1:	**HALF-WAVE FOLDED DIPOLE ANTENNA**	**6 Hours**
Testing of the half-wave folded dipole antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
MODULE 2:	**MICROSTRIP PATCH ANTENNA**	**6 Hours**
Testing of the microstrip patch antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
MODULE 3:	**SLOT ANTENNA**	**6 Hours**
Testing of the slot antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
MODULE 4:	**CIRCULAR LOOP ANTENNA**	**6 Hours**
Testing of the circular slot antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
MODULE 5:	**YAGI UDA ANTENNA**	**6 Hours**
Testing of the yagiuda antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
MODULE 6:	**HELICAL ANTENNA**	**6 Hours**
Testing of the helical antenna. Measurement of key parameters such as radiation pattern, beamwidth, gain etc.		
TOTAL LAB HOURS		**36 Hours**

Books:

1. "Introduction to Electrodynamics" by David J. Griffiths
2. "Antenna Theory: Analysis and Design" by Constantine A. Balanis
3. "Electromagnetic Waves and Antennas" by Sophocles J. Orfanidis
4. "Microwave Engineering" by David M. Pozar
5. "Electromagnetic Field Theory Fundamentals" by Bhag Guru and HüseyinHiziroglu

Department of Electronics &Communication Engineering

Program: B.Tech. in ECE	**Year, Semester:** 3r^{d}, 6th
Course Title: Analog Communication Laboratory	**Subject Code:** TIU-UEC-L311
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Student should understand and develop fundamentalunderstanding ofcommunication systems.
2. To learn basic concepts of analog communication systems.
3. Understands the comparison of different analog and pulse modulation schemes.
4. To illustrate the practical implementation of communication techniques for sending information from transmitter to receiver.
5. To develop MATLAB programming skills to simulate concept of communication
6. systems.

COURSE OUTCOME:

On completion of the course, the student will be able:

CO-1	Ability to **Understand** the operations of analog and pulse modulation & demodulation techniques.	K2
CO-2	**Apply** appropriate modulation and demodulation techniques (e.g., AM, FM, DSB-SC, SSB-SC) to simulate real-world communication systems in the laboratory setting.	K3
CO-3	Acquire knowledge on MATLAB or any other simulation programming skills to **Create** & Simulate analog and pulse modulation and demodulation techniques.	K3
CO-4	**Evaluate** & Design of communication circuits such as AM, SSB-SC, DSB-SC, FM, PAM, PWM & PPM.	K4
CO-5	**Analyze** various aspects of analog and pulse communications modulation & demodulation techniques, sampling theorem verification and study of spectrum analyzer, frequency synthesizer, AGC &PLL.	K4
CO-6	Synthesize a comprehensive solution for a real-world analog communication problem by integrating pre-emphasis, de-emphasis, phase-locked loops (PLLs), and modulation techniques.	K5

COURSE CONTENT:

MODULE 1:	Amplitude Modulation	**12 Hours**
Study the operation, waveform analysis, and efficiency of a half-wave rectifier circuit.		
MODULE 2:	Angle Modulation	**9 Hours**
Analyze the performance, output waveform, and efficiency of a full-wave rectifier circuit.		
MODULE 3:	Pre-emphasis, De-emphasis, and PLL Systems	**9 Hours**
Examine the voltage-current characteristics of a Light Emitting Diode (LED) under different conditions.		
MODULE 4:	Pulse Modulation Techniques	**12 Hours**
Study the input and output characteristics of a Bipolar Junction Transistor (BJT) in different regions of operation.		
TOTAL LAB HOURS		**42 Hours**

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Mobile Communication	**Subject Code:** TIU-UEC-E302
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Course Objectives:

Enable the student to:

1. To understand the basic structural layout of a mobile communication system.
2. To gain a first hand knowledge of the propagation mechanism involved in in these. Moreover based on the propagation mechanism and the physical and demographic layout of the area where the mobile communication system is planned and laid out.
3. knowledge of fading mechanism in different situations can be gained .
4. Knowledge about the multiple access schemes used in transmission from both base station and mobile station and the receiver structure in both the cases also can be gained .
5. Knowledge about the actual mobile communication system like GSM ,GPRS , IS-95 etc.in different generations also can be acquired.

COURSE OUTCOME :

On completion of the course, the student will be able to:

COs	Outcomes	Level
7.	**Understand Mobile Communication Fundamentals** – Explain the principles of mobile communication, including frequency reuse, handoff strategies, and network architecture.	K2
8.	**Analyze Wireless Propagation and Channel Characteristics** – Describe signal propagation, path loss models, fading, and interference in mobile environments.	K2
9.	**Explore Mobile Network Technologies** – Compare and contrast different generations of mobile networks (2G, 3G, 4G, 5G) and their protocols.	K3
10.	**Evaluate Modulation and Multiple Access Techniques** – Understand modulation schemes (AM, FM, QPSK) and multiple access techniques like TDMA, FDMA, CDMA, and OFDMA.	K3

11.	**Design and Optimize Mobile Communication Systems** – Apply network planning techniques, resource allocation strategies, and power management principles to enhance mobile communication.	K4
12.	**Understand Emerging Trends in Mobile Communication** – Discuss advancements such as IoT, 5G, mobile edge computing, and security challenges in wireless networks.	K4

COURSE CONTENT :

MODULE 1:		**6Hours**
Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.		
MODULE 2:		**12 Hours**
Signal propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small-scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.		
MODULE 3:		**4 Hours**
Capacity of flat and frequency selective channels. Antennas- Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays.		
MODULE 4:		**6Hours**
Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.		
MODULE 5:		**6Hours**
Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.		
MODULE 6:		**6 Hours**
MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.		
TOTAL LECTURES		**40 Hours**

Books:

Text Books:

1. T. S. Rappaport, “Wireless Communications Principles and Practice”, 2nd edition, Prentice Hall, 2002
2. G. L. Stüber, “Principles of Mobile Communications”, 3rd edition, Springer, 2013.
3. M. K. Simon and M. -S. Alouni, “Digital Communications over Fading Channels”, Wiley, 2002.
4. M. Plätzold, “Mobile Fading Channels”, Wiley, 2002.
5. A. J. Goldsmith, “Wireless Communications”, Cambridge, 2005

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Information Theory	**Subject Code:** TIU-UEC-T302B
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. understand the concepts of fundamental limit of information transfer through communication channel
2. understand source coding techniques for data compression
3. understand how probabilistic nature of communication channel and noise impacts data transmission
4. understand channel coding techniques and their capabilities

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	**Understand** the concepts of information and entropy and **apply** these concepts to find out entropy of different probability distributions	K3
CO-2:	**Understand** the concepts of mutual information	K2
CO-3:	**Understand** the concepts of source coding	K2
CO-4:	**Understand** the concepts of channel capacity and **evaluate** channel capacity of different channels.	K5
CO-5:	**Analyze** the characteristics of Gaussian channel and its capacity.	K4
CO-6:	**Understand** the concepts of linear block codes	K2

COURSE CONTENT :

MODULE 1:	**ENTROPY AND INFORMATION**	**14 Hours**
Basics of information theory, entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources		
MODULE 2:	**CHANNEL CAPACITY**	**16 Hours**
Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.		

MODULE 3:	**SOURCE AND CHANNEL CODING**	**10 Hours**
Techniques of coding and decoding; Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.		
TOTAL LECTURES		**40 Hours****

Books:

1. Elements of Information Theory, T.M. Cover and J.A. Thomas, Wiley Student Edition
2. Information theory, Coding and Cryptography, Ranjan Bose, TMH
3. Error Control Coding, Shu Lin and D J Costello Jr, Prentice Hall
4. Information and Coding, N Abramson, McGraw Hill.
5. David Mackay, "Information Theory, Interference & Learning Algorithms", Cambridge University Press, 1st Edition, 2002.

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Program: B. Tech. in ECE	**Year, Semester:** 3ed Yr., 6h Sem.
Course Title: Digital Communication	**Subject Code:** TIU-UEC-T312
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

5. Understand the functional block diagram of Digital communication system.
6. To study various source and waveform coding techniques.
7. To study various line coding techniques.
8. To study baseband transmission model of digital communication.
9. To study various digital modulation schemes.
10. To understand a mathematical model of digital communication system for bit error rate analysis.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	**Understand** the mathematical background of digital communication Systems.	Understand
CO-2:	**Understand** and comparevariouswaveform coding schemes for their bandwidth and signal to noise ratio.	Understand
CO-3:	**Understand** various line coding schemes and **Analyze** their power spectral density.	Understand, Analyze
CO-4:	Design of optimum receiver for baseband signal reception and **Analyze**its performance in the presence of ISI and noise	Analyze

CO-5:	**Analyze** and comparedifferent digital modulation schemes for their spectral efficiency, bandwidth and bit error performance.	Analyze
CO-6:	**Understand** the basics of information theory and coding.	Understand

COURSE CONTENT :

MODULE 1:	**INFORMATION THEORY AND CODING**	**8 Hours**
Concepts of information and entropy, Source coding, Coding theorem, fixed length codes, variable length codes, Entropy coding, Shannon Fano, Huffman codes, Shannon's capacity theorem.		
MODULE 2:	**WAVEFORM CODING AND BASEBAND SHAPING**	**10 Hours**
Quantization of signals, Waveform Coding techniques: PCM, DPCM, ADPCM, DM, ADM. Line coding techniques: Binary and multilevel line codes, Digital signals and their spectra.		
MODULE 3:	**BASEBAND TRANSMISSION AND RECEPTION**	**9 Hours**
Baseband transmission, intersymbol interference, noise, eye pattern, BER analysis, Optimum filtering, equalization techniques, Clock recovery.		
MODULE 4:	**DIGITAL MODULATION AND DEMODULATION**	**13 Hours**
Digital modulation schemes: Binary modulation schemes- ASK, PSK, FSK, DPSK; M-ary modulation schemes: QPSK, pi/4 QPSK, QAM: generation and demodulation schemes, carrier recovery techniques, BER, analysis of digital modulation systems, spectral efficiency of digital modulation schemes.		
TOTAL LECTURES		**40 Hours****

Books:

1. S. Haykin, "Digital Communications", John Wiley.
2. S. Haykin& M. Moher, "Introduction to Analog & Digital Communications", John Wiley.
3. S. Haykin, "Communication Systems", John Wiley.
4. S. Haykin, "Digital Communication Systems", John Wiley.
5. B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford University Press
6. R. Singh & S. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hill
7. R. N. Mutagi, "Digital Communication", Oxford

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE (BEC)	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Digital Signal Processing	**Subject Code:** TIU-UEC-T314
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

11. understand the digital signals and mathematical operations that are applicable to such signals
12. understand how continuous time signal from nature is handled in discrete domain
13. understand the characterization of response of a digital system
14. how the digital filterscan modify the signals and how to design such filters

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Applythe knowledge of discrete signals to represent signals mathematically in discrete time and frequency domain	K3
CO-2:	Understand the basic mathematical operations applicable to discrete signal/systems, like time shift, folding, convolution, correlation.	K2
CO-3:	Analyzethe properties of LTI systems, and explain frequency response of LTI systems for discrete signal inputs	K4
CO-4:	Evaluatethe importance of sampling and quantization in digital signal processing	K5
CO-5:	Understand the concepts of DFT and analyze why it is important for frequency analysis of digital filters and discrete time systems in general.	K2
CO-6:	Evaluate the role of digital filters in discrete systems and analyze the characteristics of an ideal filter and design of different types of digital filters for various applications	K5

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**17 Hours**
Limitation of analog signal processing, advantage of digital signal processing, different type of discrete signal and system, concept of linearity, causality ,stability of the system, frequency domain representation and Fourier transform.		
MODULE 2:	**PROCESSING OF CONTINUOUS TIME SIGNAL**	**5 Hours**
Sampling and discrete time processing of continuous time signal,Decimation and Interpolation.		
MODULE 3:	**DICRETE FOURIER TRANSFORM**	**6 Hours**
DFT and its properties, linear filtering methods based on DFT, Filtering of long data sequence, Fast Fourier Transform algorithm using decimation in time and decimation in frequency technique.		
MODULE 4:	**FILTER DESIGN**	**13 Hours**
Design of digital IIR filter using different technique for butterworth and chebyshev filter, Design of FIR filter: different window technique and optimum approximation		

MODULE 5:	DIGITAL SIGNAL PROCESSOR	2 Hours
Architecture and various features of TMS/ADSP, series of digital signal processor; Instruction set and few application of TMS 320CXX.		
TOTAL LECTURES		**43 Hours****

Books:

6. J. G. Proakis& D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson
7. S. K. Mitra, "Digital Signal Processing: A Computer Based Approach", McGraw Hill
8. T. J. Cavicchi, "Digital Signal Processing", John Wiley
9. A. V. Oppenheim & R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall
10. L. R. Rabiner & B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall
11. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall
12. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, "Digital Signal Processing", Wiley
13. P. Ramesh Babu, "Digital Signal Processing", Scitech
14. S. Salivahanan, "Digital Signal Processing", McGraw Hill
15. Ashok Ambardar, "Digital Signal Processing", Cengage
16. A. Anand Kumar, "Digital Signal Processing", Prentice Hall of India

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Computer Networking	**Subject Code:** TIU-UEC-T306
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

COB	Objectives
1.	Explain basic concepts such as network types, topologies, protocols, and communication models (OSI and TCP/IP).
2.	Describe and compare networking models, routing protocols (RIP, OSPF, BGP), switching techniques, and addressing schemes (IPv4, IPv6).
3.	Configure network devices (routers, switches, firewalls) using tools like Cisco Packet Tracer or real-world hardware.
4.	Identify cybersecurity threats, encryption techniques, firewalls, and intrusion detection/prevention systems.
5.	Diagnose and troubleshoot network issues using tools like Wireshark, ping, and traceroute.

6.	Discuss advancements in cloud networking, SDN (Software-Defined Networking), IoT networking.

COURSE OUTCOME:

On completion of the course, the student will be able to:

COs	Outcomes	Level
1.	Be conversant with network devices and parameters, link and port parameters. Analyze the requirements for a layered computer network and select the most appropriate network topology.	K2
2.	Understand different types of switching and random multiple access techniques.	K2
3.	Adopt static and various dynamic routing techniques as per requirement.	K3
4.	Know the header formats for various networking protocols operating in OSI Layers 2, 3 and 4. Understand IPv4 addressing techniques and Design subnets with variable subnet masks.	K3
5.	Comprehend Error control, multi-layer Flow control and Congestion control and be cognizant of various associated methodologies.	K4

COURSE CONTENT:

MODULE 1:	**Introduction to Computer Networks**	**10 Hours**
Introduction to networks and layered architecture. Data communication concepts, transmission media and topology, multiplexing.		
MODULE 2:		**10 Hours**
Circuit switching and packet switching, data link layer, layer 2 switches and ATM switches, SONET/SDH.		
MODULE 3:		**10 Hours**
Medium access control. CSMA CD, TDMA, FDMA, CDMA. Network layer and addressing, IP version 4 and 6.		
MODULE 4:		**10Hours**
Routing algorithms.Transmission layer, TCP and UDP. Congestion control techniques. WAN, ATM. Internetworking.Wirelesscommunications.Network management and security.		
TOTAL LECTURES		**40 Hours**

Books:

Text Books:

1. "Computer Networks" by Andrew S. Tanenbaum et. al, Sixth Edition, Pearson

2. "Data Networks" by Dimitri Bertsekas and Robert Gallager, Second Edition, Pearson
3. "Computer Networking: A Top-down approach" by James Kurose and Keith Ross, Sixth Edition, Pearson.

Department of Electronics & Communication Engineering

Program: B. Tech. in ECE	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title:VLSI Design	**Subject Code:** TIU- UEC- T310
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. To introduce about fundamentals of VLSI Design and understand the basic design flow.
2. Student should understand about fundamentals of IC Fabrication Technique.
3. To know about the VLSI Design Frontend and Backend process and also developed the new design.
4. To give understanding of various types of Low power circuit Design for a particular application.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO-1:	Ability to **recognizing** different VLSI design flow and Design hierarchy.	K1
CO-2:	**Understand** the utilization of VLSI Fabrication technique, various Logic Design in Digital domain.	K2
CO-3:	**Design and analyze** of Sequential Circuits, Low-power VLSI Circuits and Semiconductor Memories.	K4
CO-4:	Able to Test the circuits to **clarify** the fault models.	K2
CO-5:	**Develop** HDL-based designs and implement them on FPGA/ASIC platforms	K3
CO-6:	**Apply** VLSI design methodologies for real-world applications	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**6Hours**
Design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging styles, design automation principles;		
MODULE 2:	**Fabrication Technology**	**6 Hours**

Basic steps of fabrication, bipolar, CMOS and Bi-CMOS fabrication processes, layout design rules; MOS and Bi-CMOS characteristics and circuits: MOS transistor characteristics, MOS switch and inverter, Bi-CMOS inverter, latch-up in CMOS inverter, super-buffers, propagation delay models, switching delay in logic circuits, CMOS analog amplifier;		
MODULE 3:	**Logic Design**	**6 Hours**
switch logic, gate restoring logic, various logic families and logic gates, PLA; Dynamic Circuits: Basic concept, noise considerations, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, clocking schemes;		
MODULE 4:	**Sequential Circuits**	**6 Hours**
Basic regenerative circuits, bistable circuit elements, CMOS SR latch, clocked latch and flip-flops;		
MODULE 5:	**Low-power Circuits**	**6 Hours**
low-power design through voltage scaling, estimation and optimization of switching activity, reduction of switched capacitance, adiabatic logic circuits; Subsystem Design: design of arithmetic building blocks like adders, multipliers, shifters, area- speed-power tradeoff;		
MODULE 6:	**Semiconductor Memories**	**6 Hours**
SRAM, DRAM, non-volatile memories; Bipolar ECL Inverter: Features of ECL gate, robustness and noise immunity, logic design in ECL, single- ended and differential ECL gates;		
MODULE 7:	**Testability of VLSI**	**6 Hours**
Fault models, scan-based techniques, BIST, test vector generation; Physical Design: Brief ideas on partitioning, placement, routing and compaction.		
TOTAL LECTURES		**42 Hours****

Books:

TEXT BOOKS:

1. S.-M. Kang and Y. Leblebici, “CMOS Digital Integrated Circuits and Design”, Tata McGraw Hill
2. P. E. Allen and D. R. Holberg, “CMOS Analog Circuit Design”, Oxford

REFERENCE BOOKS:

3. N. H. E. Weste and D. M. Harris, “CMOS VLSI design: A Circuits and Systems Perspective”, 4th Edition, Pearson Education India, 2011.
4. C. Mead and L. Conway, “Introduction to VLSI Systems”, Addison Wesley, 1979.
5. J. Rabaey, “Digital Integrated Circuits: A Design Perspective”, Prentice Hall India, 1997.

6. P. Douglas, “VHDL: programming by example”, McGraw Hill, 2013. Robotics :Control ,Sensing , Vision and Intelligence , K.S Fu , R.C Gonzalez and C.S.G Lee , Wiley India

Department of Electronics and Communication Engineering

Program: B. Tech. in ECE	**Year, Semester:** 3rdYr., 6TH Sem
Course Title: Database Management System (DBMS)	**Subject Code:** TIU-UEC-S302
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

COB	Objectives
1.	Learn fundamental concepts of data management, including data storage, retrieval, and organization.
2.	Gain knowledge of database structures, normalization, and schema design for efficient data handling.
3.	Apply data management techniques to analyze information and support business decision-making.
4.	Use database management systems (DBMS) and query languages like SQL to manage and manipulate data effectively.

COURSE OUTCOME:

On completion of the course, the student will be able to:

COs	Outcomes	Level
1.	For a given query write relational algebra expressions for that query and optimize the developed expressions.	K2
2.	For a given specification of the requirement design the databases using E R method and normalization.	K2
3.	For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.	K3
4.	For a given query optimize its execution using Query optimization algorithms.	K3
5.	For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.	K4

6.	Implement the isolation property, including locking, time stamping based on concurrency control and serializability of scheduling.	K4

COURSE CONTENT:

MODULE 1:	**Introduction**	**6 Hours**
General introduction to database systems, Concept of file System and Disadvantages, Database-DBMS distinction, Role of DBA, Approaches to building a database, Data models, Database management system, Three-schema architecture of a database, Data Independency, Integrity constraints.		
MODULE 2:	**Relational Data Model:**	**6 Hours**
Concept of relations, Schema-instance distinction, Keys, Referential integrity and foreign keys. Relational Algebra Operators: Selection, Projection, Union, Intersection, Set difference, Cross product, Rename, Assignment, Various types of joins, Division, Example queries. Tuple Relational Calculus, Domain Relational Calculus.		
MODULE 3:	**SQL**	**6 Hours**
Introduction, Data definition in SQL, Table, key and foreign key definitions, Update behaviors, querying in SQL, Basic select- from- where block and its semantics, Nested queries-correlated and uncorrelated, Notion of aggregation, Aggregation functions group by and having clauses, Embedded SQL.		
MODULE 4:	**Database Design Concepts (part-1) - Dependencies and Normal forms**	**6 Hours**
Importance of a good schema design, Problems encountered with bad schema designs, Motivation for normal forms, dependency theory – functional dependencies, Armstrong's axioms for FD's, Closure of a set of FDs, Minimal covers, Definitions of 1NF, 2NF, 3NF and BCNF, Decompositions and desirable properties of them, Algorithms for 3NF and BCNF normalization, multi-valued dependencies and 4NF, Join dependencies and definition of 5NF, DKNF.		
MODULE 5:	**Database Design Concepts (part-2) -ER Model:**	**8 Hours**
Conceptual data modelling-motivation, Entities, Entity types, Various types of attributes, Relationships, Relationship types, E/R diagram notation, High-level conceptual modelling, ER Modelling concepts, ER Diagrams, Cardinality constraints Enhanced ER Model: Higher-order relationships, Enhanced ER Model(EER), Weak-entity types, Subclasses and inheritance, Specialization and Generalization, Modelling of UNION types using categories.		
MODULE 6:	**Data Storage and Indexes:**	**4 Hours**
File organizations, Primary, Secondary index structures, Various index structures - hash-based, Dynamic hashing techniques, Multi-level indexes, B+ trees.		
MODULE 7:	**Transaction Processing and Concurrency Control**	**6 Hours**

Transaction Fundamentals: OLTP environments, Concurrency issues, need for transactions, Necessary properties of transactions (ACID properties), Transaction states, serializability, Serial schedules, Conflict serializability, View serializability, Recoverable and non-recoverable schedules, Cascading rollbacks, Cascadeless schedules. Concurrency control: Serialized and non-serialized schedules, Testing for serializability, Locking, Lock compatibility matrix, Locking and serializability, Deadlocks and starvation, Two-phase locking (2PL) protocol, Conservative, strict and rigorous 2PL, 2PL with lock conversions, Timestamp-ordering based protocol, Multi-versioning protocol, Multi-granularity locking, Deadlock prevention protocols, Wait-die and wound-wait schemes, Time-out based schemes, Deadlock recovery, Nested transactions		
MODULE 8:	**Database Recovery Techniques:**	**3 Hours**
Recovery concepts, Deferred updates technique, Immediate update technique, Shadow paging		
TOTAL LECTURES		**45 Hours**

Books:

Text Books:

1. Ramez Elmasri and Shamkant Navathe, Fundamentals of Database Systems, Publisher -Pearson Education, 5th Edition.
2. Avi Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts,Tata McGraw – Hill Education.

Reference Books:

1. Microsoft SQL Server 2019 documentation: Databases - SQL Server | Microsoft Docs
2. Microsoft Azure SQL documentation: Azure SQL documentation - Azure SQL | Microsoft Docs
3. Microsoft Azure Cosmos DB documentation: Introduction to Azure Cosmos DB |Microsoft Docs
4. Articles on Microsoft Azure and SQL Server: Sucharita Das, Author at SQL Server Central
5. Transaction Processing in SQL Server: https://youtu.be/vO4OgihpAGw