Progressive Education Society's

Modern College of Engineering

Department of Electronics & Telecommunication Engineering

Curriculum Booklet
Third Year
2019-Pattern
Semester -I

Vision of Institute

"To create a collaborative academic environment to foster professional excellence and ethical values"

Mission of the Institute

1. To develop outstanding engineers & professionals with high ethical standards capable of creating and managing global enterprises.
2. To foster innovation and research by providing a stimulating learning environment.
3. To ensure equitable development of students of all ability levels and backgrounds.
4. To be responsive to changes in technology, socio-economic levels and environmental conditions.
5. To foster and maintain mutually beneficial partnerships with alumni and industry.

Vision of Department

To impart holistic Education in Electronics and Telecommunication Engineering to create engineers equipped to meet the challenges of a dynamic, global environment

Mission of Department

1. To impart quality Education in the field of Electronics, Communication and Signal processing, by providing a comprehensive learning experience.
2. To provide avenues to encourage students to continue education in diverse fields.
3. To develop competent Engineers, well-versed in multi-disciplinary fields.
4. To inculcate ethical and professional values in our students to endow society with responsible citizens.

Program Educational Objectives

The graduates of Electronics and Telecommunication Engineering Department of P.E. S's MCOE will

1. Apply design and development skills related to E&TC Engineering to solve real life problems
2. Pursue careers as Entrepreneurs, Engineers or Managers in Private/Government sectors or continue their education in the same or multi-disciplinary fields.
3. Practice ethical standards, adhere to social responsibilities and lead teams of professionals in the global environment.

Program Specific Outcomes

At the time of graduation, the students of the ENTC department of PES's MCOE, will be able to

1. Apply the Knowledge in E&TC engineering to understand, evaluate, design, or implement the electronics, communication, embedded or information systems or sub- systems using conventional or modern tools/techniques
2. Take up jobs in Government or private sectors, undertake research, create jobs or pursue further studies in any of the fields of E&TC, in India or Abroad.
3. Incorporate ethical & social responsibility to complete projects in the E&TC and allied fields and use effective written and oral communication skills to present the work.

Program Outcome

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of

the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11.Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12.Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Structure

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019
Course
(With effect from Academic Year 2021-22)

Semester-I

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304181	Digital Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
304182	Electromagnetic FieldTheory	03	-	01	30	70	25	-	-	125	03	-	01	04
304183	Database Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304184	Microcontrollers	03	-	-	30	70	-	-	-	100	03	-	-	03
304185	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304186	Digital Communicatio	-	02	-	-	-	-	50	-	50	-	01	-	01

	n Lab													
304187	Database Managemen tLab	-	02	-	-	-	-	-	25	25	-	01	-	01
304188	Microcontroller Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304189	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304191A	Mandatory Audit Course 5 &	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**15**	**10**	**01**	**150**	**350**	**50**	**125**	**25**	**700**	**-**		**-**	**-**
Total Credit											**15**	**05**	**01**	**21**

Elective -I

1) Digital Signal Processing
2) Electronic Measurements
3) Fundamentals of JAVA Programming
4) Computer Networks

1. Name of the Course – Digital Communication

Weekly Work Load (in Hrs.)	Lecture	Tutorial	Practical
	3 Lectures / Week		2 Hrs. / Week

Online / In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30 M	70 M	50 M	-	-	150 M	04

1.1 Syllabus

Unit I: Random Processes & Noise (7 Hrs.)
Random Processes: Introduction, Mathematical definition of a random process, Stationary processes, Transmission of a random process through a LTI filter, Power spectral density.
Mathematical Representation of Noise: Some Sources of Noise, Frequency-domain Representation, Quadrature Components of Noise, Representation of Noise using Orthonormal Coordinates.

Unit II: Digital Modulation-I (7 Hrs.)
Baseband Signal Receiver: Probability of Error, Optimal Receiver Design. **Digital Modulation:** Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).

Unit III: Digital Modulation-II (7 Hrs.)
Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Inter-channel and Inter-symbol Interference, some Issues in transmission and reception, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems.

Unit IV: Spread Spectrum Modulation (6 Hrs.)
Use of Spread Spectrum, Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum, Frequency Hopping (FH) Spread Spectrum, **Pseudorandom (PN) Sequences:** Generation and Characteristics, Synchronization in Spread Spectrum Systems

Unit V: Information Theoretic Approach to Communication System (7 Hrs.)
Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, Discrete memory less channel, Mutual information, Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem.

Unit VI: Error-Control Coding (6 Hrs.)
Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding, Introduction to Turbo Codes & LDPC Codes.

1.2 Course Objectives

- To introduce the statistical theory for understanding various signals and processes in a communication system.
- To explain various digital modulation techniques used in digital communication systems and their performance in presence of noise.
- To elaborate the concept of spread spectrum communication system.
- To introduce the concept of information theory & coding techniques.

1.3 Course Outcomes

At the end of the course the Student will be able to:

- Apply the statistical theory for describing various signals and processes in a communication system. **(Unit I) (BTL: 3).**
- Explain various digital modulation techniques and their performance in presence of noise. **(Unit II, III). (BTL: 2).**
- Describe the digital communication system with spread spectrum modulation. **(Unit IV) (BTL: 2).**
- Apply information theoretic approach to analyze a communication system. **(Unit V) (BTL: 3).**
- Use error control coding techniques to improve performance of a digital communication system. **(Unit VI) (BTL: 3).**

1.4 Text Books:

1. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill, 4th Edition,

2. B.P. Lathi, Zhi Ding , "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

1.5 Reference Books:

1. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition

2. Wayne Tomasi, “Electronic Communications System”, Pearson Education, 5th Edition
3. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Tata McGraw Hill Publication, 5th Edition
4. Simon Haykin, “Communication Systems”, John Wiley & Sons, 4th Edition
5. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, 4th Edition.
6. R. P. Singh, S. P. Sapre, “Communication Systems”, Tata McGraw Hill Publication.
7. Sanjay Sharma, “Communication Systems”, Catson Publications.
8. T. L. Singal, “Digital Communication”, McGraw Hill Publication.

1.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

- NPTEL Course on “Digital Communications”
- Link of the Course: https://nptel.ac.in/courses/108/102/108102096/
- www.nptelvideos.in
- www.freevideolectures.com

1.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Random Processes: Introduction, Mathematical definition of a random process, Stationary processes, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density Mathematical Representation of Noise: Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise, Quadrature Components of Noise, Representation of Noise using Orthonormal Coordinates.	T1, R1, R5, R7, R8	7L
2	II	Baseband Signal Receiver: Probability of Error, Optimal Receiver Design. Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).	T1, T2, R1, R4, R7, R8	7L
3	III	Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature	T1, T2, R1, R4, R7, R8	7L

		Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping: to reduce ISI, ICI, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems.		
4	IV	Spread Spectrum Techniques: DSSS, FHSS, Code Division Multiple access Frequency **Pseudorandom (PN) Sequences:** Generation and Characteristics, Synchronization in Spread Spectrum Systems	T1, T2, R4, R7, R8	6L
5	V	Introduction to information theory, Entropy, Mutual Information, Channel capacity, Differential entropy, Information theory theorems, Source Coding, Discrete memory less channel	R1, R4, R6, R7	7L
6	VI	Linear Block Codes: Coding and syndrome decoding, Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding, Introduction to Turbo Codes & LDPC Codes.	R1, R4	6L

1.8 Unit wise Lecture Plan

1.8 a. Unit No.-I- Random Processes & Noise

Pre-requisites: - Signals & Systems, Analog Communication

Objectives: -

- To introduce the statistical theory for understanding various signals and processes in a communication system.

Outcomes: -

- Apply the statistical theory for describing various signals and processes in a communication system.

Lecture No.	Details of the Topic to be covered	References
1	Mathematical definition of random and stationary process	T1, R1, R5, R7, R8
2	Mean, Correlation and covariance function, auto correlation function- definition and properties	
3	Ergodic process, conditions for ergodicity	

4	Transmission of random process through a LTI filter	
5	Power spectral density, definition, derivation, properties, Gaussian process- properties	
6	Noise- Narrow band noise, representation in in-phase and quadrature components	
7	Problems on unit I	
8	Mathematical definition of random and stationary process	
9	Mean, Correlation and covariance function, auto correlation function- definition and properties	
10	Ergodic process, conditions for ergodicity	

Question Bank: Theory

Q. 1	Show that if a wide sense stationary process x (t) is passed through a LTI filter with impulse response h(t) then its output has constant mean square value. **PI Mapped : 2.1.3**
Q. 2	Represent and discuss on the time domain and the frequency domain approach of sampling theorem. **PI Mapped : 1.4.1**
Q. 3	State the properties of auto correlation function. Show that when wide sense stationary process passed through a LTI filter with impulse response h(t) produces constant mean square value. **PI Mapped : 2.1.3**
Q. 4	State the properties of in-phase and quadrature phase components of narrow band noise and explain the process of generation with PSD. **PI Mapped : 2.1.3**
Q. 5	What is power spectral density? Derive the expression of PSD when a random process is transmitted through a LTI filter. **PI Mapped : 2.1.3**

Q. 6	Explain the terms time average and ensemble average of random variables supported by relevant expressions. **PI Mapped : 1.1.1**

Q. 7	Show that PSD forms the Fourier transform pair with autocorrelation function. **PI Mapped : 1.4.1**

Q. 8	Define following terms with respect to random process a) Ensemble b) Sample function c) Ensemble Average d) Random Variable. E) Time averages. **PI Mapped : 1.4.1**

Question Bank: Tutorial (PO1: 1.1.1, PO2: 1.4.1, 2.1.3)

Q. 1	Consider the random process X (t)= Acos(ώt+θ) where ώ and θ are constants and A is a random variable. Determine whether X(t) is a wide sense stationary process. **PI Mapped : 2.1.3**

Q. 2	A wide sense stationary processes X(t) is applied to the input of an LTI system with impulse response $h(t)=3e^{-2t}$ u(t).Find the mean value of output Y(t) of system if E[X(t)]=2. **PI Mapped : 2.1.3**

Q. 3	What are the conditions for a random process to be wide sense stationary? **PI Mapped : 2.1.3**

Q. 4	If X (t) = Acos $(2\pi f_c t+\phi)$ is random process with ϕ as a random variable uniformly distributed over $(0, 2\pi)$.Prove that x(t) is ergodic in mean. **PI Mapped : 2.1.3**

Q. 5	State the properties of power spectral density. **PI Mapped : 1.4.1**

Q. 6	What is a Wide Sense Stationary Process? When A WSS R.P. X(t) is applied to input of LTI system with impulse response h(t) = 3e–2t u(t), Find the mean value of system if E [X(t)] = 2 and its autocorrelation. **PI Mapped : 2.1.3**

Q. 7	Let x(t) be a zero mean ,stationary ,Gaussian process with autocorrelation function Rx(τ).This process applied a square law device ,which is defined by input-output

	relation $Y(t)=X^2(t)$ where Y(t) is the output .Show that the mean of Y(t) is R(0). **PI Mapped : 1.1.1**

Q. 8	Consider the random process $s(t) = \cos(\omega_0 t + \varphi)$ where φ is a random variable with probability density $F(\varphi)=1/2\pi \quad -\pi \leq \varphi \leq \pi = 0$ elsewhere. Show that the first and second moments of s(t) are independent of time. **PI Mapped : 1.1.1**

1.8 b. Unit No.-II- Digital Modulation-I

Pre-requisites:- Signals & Systems, Analog Communication, M III, Digital Electronics

Objectives:-

- To explain various digital modulation techniques used in digital communication systems and their performance in presence of noise.

Outcomes:-

- Explain various digital modulation techniques and their performance in presence of noise.

Lecture No.	Details of the Topic to be covered	References
1	Baseband Signal Receiver: Probability of Error, Optimal Receiver Design.	T1, T2, R1, R4, R7, R8
2	Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK),	
3	Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Frequency Shift Keying (BFSK), .	
4	Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Phase Shift Keying	

	(QPSK),	
5	Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for M-ary Phase Shift Keying (MPSK)	

Question Bank: Theory

Q.1	Derive the error probability of Matched Filter. **PI Mapped : 2.1.2**
Q. 2	Derive an expression for error probability of BPSK using Matched Filter. **PI Mapped : 2.1.2**
Q. 3	Explain Gram Schmitt procedure for orthogonalization. **PI Mapped : 2.1.2**
Q. 5	State various properties of Matched filter and explain its impulse response in detail. **PI Mapped : 1.4.1**
Q. 6	Derive an expression for signal to noise ratio and error probability of matched filter in presence of white Gaussian noise. **PI Mapped : 2.1.2**
Q. 7	What is Correlator? Compare its performance with Matched filter mathematically and relevant diagrams. **PI Mapped : 2.2.4**
Q. 8	Derive the expression for signal to noise ratio of integrate and dump receiver. **PI Mapped : 2.1.2**
Q. 9	Derive expression for error probability of optimum filter. **PI Mapped : 2.1.2**
Q. 10	What is equalizer? Explain Adaptive equalizers. **PI Mapped : 1.4.1**
Q. 11	What is Inter symbol Interference? Explain the ideal solution to control ISI. **PI Mapped : 1.4.1**

Q. 12	Explain LPC encoder & decoder with the help of block diagram. **PI Mapped : 2.3.1**

Q. 13	Compare BPSK, BFSK, QPSK, M-ary FSK, M-ary PSK. **PI Mapped : 2.2.4**

Q. 14	Draw signal space representation for BPSK, QPSK, BFSK, M-ary FSK, M-ary PSK? **PI Mapped : 2.4.4**

Q. 15	Draw block diagram of BPSK and QPSK transmitter and receiver and explain. **PI Mapped : 2.3.1**

Q.16	In the BPSK signal detector, the local oscillator has fixed phase error of 20 dB. The phase error deteriorates the SNR at the output by the factor of a. $Cos20^0$ b. Cos^220^0 c. $Cos70^0$ d. Cos^270^0. **PI Mapped : 2.4.4**

Q.17	In a digital communication system employing FSK the 0 & 1 bits are represented by sine waves of 10 kHz & 25 kHz respectively. These waveforms will be orthogonal for a bit interval of a. 45 □s b. 200 □s c. 50 □s d. 250 □s. **PI Mapped : 2.4.4**

Q.18	Coherent demodulation of FSK signal can be affected using a. Correlation receiver b. Band pass filters & envelop detectors c. Matched filter d. Discriminator detection **PI Mapped : 2.4.4**

Q. 19	Find the error probability for coherent FSK when i) frequency offset is small ii) frequencies used is orthogonal iii) Also find error probability for non-coherent detection. **PI Mapped : 2.4.4**

Q. 20	Describe BFSK transmitter and receiver with help of block diagram. Draw the spectrum of BFSK and state the bandwidth requirement **PI Mapped : 2.3.1**

Q. 21	Draw the Diagram of the geometric representation of a) Orthogonal and non-orthogonal BFSK. State the Euclidean distance of above mentioned systems by explaining the importance of Euclidean distance. **PI Mapped : 2.3.1**

Question Bank: Tutorial

Q. 1	A polar binary signal Pi(t) is +1 or -1 pulse during interval (0,T). AGWN noise with power spectral density 10^{-5}W. 1KHz is added to the signal. Determine the energy per bit with bit error probability of Pe <= 10^{-4} using matched filter. **PI Mapped : 2.1.2**
Q. 2	Find the error probability of BPSK SIGNAL .The received signal is detected coherently by a matched filter with amplitude 10mv,bit rate 1Mbps and carrier frequency 100MHz.The signal is corrupted with white noise of PSD No12=10^{-11} W1KHz. For erfc(1.56) = 0.02737, erfc(1.58) = 0.02545, erfc(1.6) = 0.02365, erfc (1.62) = 0.02196. **PI Mapped : 2.1.2**
Q. 3	A binary data is transmitted at a rate of 10Mbps over a channel whose BW is 8MHz. Find the signal energy per bit at receiver input for Pe<=10^{-4}, assume No/2=10^{-10}Watt/Hz. **PI Mapped : 2.1.2**
Q. 4	Binary data is transmitted using PSK at a rate 3 Mbps over RF link having bandwidth 10 MHz. Find signal power required at receiver input so that error probability is less than or equal to 10-4. Assume noise PSD to be 10-10 watt/Hz. **PI Mapped : 2.1.2**
Q. 5	Find the bit error probability for a BPSK system with bit rate of 1Mbps. The received waveforms S1(t)=A$\cos\omega_c t$ and S2(t)= -A$\cos\omega_c t$ are coherently detected with a matched filter. The value of A is 10mV. Assume that noise power special density N0/2 = 10–11 W/Hz and that signal power and energy per bit are normalized relative to 1Ω load. Given : **X erfc(x)** 1.56 0.02737 1.58 0.02545 1.6 0.02365 1.62 0.02196 **PI Mapped : 2.1.2**

Q. 6	A received signal has amplitude of +_ 2V held for a time T. The signal is corrupted by white gaussian noise having PSD of $10^{-4}V^2$/Hz. If the signal is processed by integrate and dump receiver, what should be minimum time T during which signal must be sustained so that the Pe is not exceeding 10^{-4}. **PI Mapped : 2.4.4**

Q. 7	A system transmits binary data at the rate of 2.5×106 bits per second. During the course of transmission, white Gaussian noise of zero mean and power spectral density 10–20 W/Hz is added to the signal. In the absence of noise, the amplitude of the received sinusoidal wave for digit 1 or 0 is 1 mV. Determine the average probability of symbol error for the following system configuration i) BFSK ii) QPSK iii) BPSK. **PI Mapped : 2.1.2**

Q. 8	Given that amplitude of input at coherent optimal receiver is 10mV and freq 1MHz. The signal is corrupted with white noise of PSD 10^-9W/Hz. The data rate is 10^4 bits/sec. Find the error probability. [erfc(1.01)=0.1531, erfc(1.11)=0.1164, erfc(1.22)=0.0844, erfc(1.33)=0.0599] **PI Mapped : 2.1.2**

Q. 9	Binary data is transmitted using PSK at a rate 3 Mbps over RF link having bandwidth 10 MHz. Find signal power required at receiver input so that error probability is less than or equal to 10^{-4}. Assume noise PSD to be 10-10 watt/Hz. **PI Mapped : 2.1.2**

1.8c. Unit No.-III- Digital Modulation-II

Pre-requisites: - Signals & Systems, M III

Objectives: -

To explain various digital modulation techniques used in digital communication systems and their performance in presence of noise.

Outcomes: -

Explain various digital modulation techniques and their performance in presence of noise.

Lecture No.	Details of the Topic to be covered	References
1	Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK),	T1, T2, R1, R4, R7, R8
2	Generation, Reception, Signal Space Representation and Probability of Error Calculation for M-ary FSK (MFSK), Minimum Shift Keying (MSK)	
3	Pulse Shaping to reduce Inter-channel and Inter-symbol Interference	
4	Some Issues in transmission and reception,	
5	Orthogonal Frequency Division Multiplexing (OFDM),	
6	Comparison of digital modulation systems.	
7	Problems on unit III	

Question Bank: Theory

Q. 1	Sketch the waveforms of MSK for the given bit stream 11001001. **PI Mapped : 2.3.1**
Q. 2	Explain M-ary PSK transmitter with suitable block diagram. What are advantages of M-ary PSK over M-ary FSK. **PI Mapped : 2.3.1**
Q. 3	Draw signal space representation of 16-QAM system and comment on Euclidean distance and probability of error of 16-QAM. **PI Mapped : 2.4.4**
Q. 4	Find the spectral efficiency of OFDM if BPSK modulation is used. **PI Mapped : 2.4.4**
Q. 5	With the help neat block diagram explain M-ary FSK system with spectral characteristics and signal space representation. **PI Mapped : 2.3.1**

Q. 6	Explain digital OFDM system implementation using FFT transforms. **PI Mapped : 2.3.1**

Q. 7	Explain Simple Analog OFDM system **PI Mapped : 1.4.1**

Q. 8	Compare QPSK and MSK. Explain phase continuity of MSK. **PI Mapped : 2.2.4**

Q. 9	What is Inter symbol Interference? Explain the ideal solution to control ISI. **PI Mapped : 1.4.1**

Question Bank: Tutorial

Q. 1	If the digital message input data rate is 24 kbps and average energy per bit is 0.05 units. Find BW and euclidean distance for BPSK, 8-PSK, MSK and 16-QAM. **PI Mapped : 2.1.2**

Q. 2	Consider binary data transmission at the rate of 56 kbps using base band binary pulse amplitude modulation that is designed to have raised cosine spectrum. The transmission bandwidth required for a roll off factor of 0.25 is: ___ **PI Mapped : 2.1.2**

Q. 3	A terrestrial microwave radio system uses 256 QAM digital modulation scheme. Estimate the number of bits/symbol used. **PI Mapped : 2.1.2**

1.8d. Unit No.-IV- Spread Spectrum Modulation

Pre-requisites:- Signals & Systems, M III

Objectives:-

To elaborate the concept of a spread spectrum communication system.

Outcomes:-

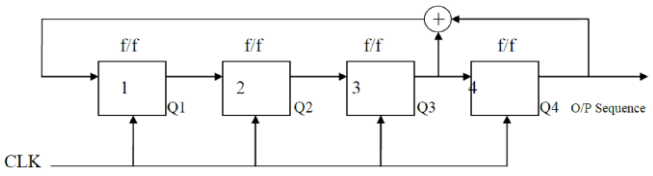
Describe the digital communication system with spread spectrum modulation.

Lecture No.	Details of the Topic to be covered	References
1	Use of Spread Spectrum	T1, T2, R4, R7, R8
2	Direct Sequence (DS) Spread Spectrum, Spread Spectrum	
3	Code Division Multiple Access (CDMA)	
4	Ranging Using DS Spread Spectrum	
5	Frequency Hopping (FH) Spread Spectrum	
6	Pseudorandom (PN) Sequences: Generation and Characteristics	
7	Synchronization in Spread Spectrum Systems	
8	Correlation receiver	

Question Bank: Theory

Q. 1 What is PN sequence? State the properties of PN sequence with the help of 4 bit shift register. **PI Mapped : 1.4.1**

Q. 2 For the shift register given in problem, demonstrate the balance property of PN sequence. Also calculate & plot auto-correlation function of the PN sequence produced by this shift register.



PI Mapped : 2.1.3

Q. 3 Consider a slow hop spread spectrum system with binary FSK, two symbols per frequency hop, and a PN sequence generator with outputs with the binary message of 0 1 1 0 1 1 0 1 1 0 0 0. The message is transmitted using the following PN sequence with k=3:{010,110,101,100,000,101,011,001,001,111,011,001}, plot the output frequencies for the input message. **PI Mapped : 2.1.3**

Q. 5	Explain in brief: Processing gain, Jamming Margin in DSSS, fast frequency hopping and slow frequency hopping. **PI Mapped : 1.4.1**

Q. 6	Design a 4-bit PN sequence generator and verify the properties of maximum length sequence. Assume that initial state is 1000. **PI Mapped : 2.4.4**

Q. 7	Explain in detail DSSS-BPSK transmitter and receiver. **PI Mapped : 1.4.1**

Q. 8	How is FHSS advantageous over DS-SS? **PI Mapped : 2.2.4**

Q. 8	Explain CDMA in detail. **PI Mapped : 1.4.1**

Q. 8	Compare slow and fast frequency hopping. **PI Mapped : 2.2.4**

Question Bank: Tutorial

Q. 1	Represent variation of the frequency of a fast hop spread spectrum system with BFSK, having following parameters. Numbers of MFSK tones $M=2^K=4$, length of PN segment per hop K=3, total number of frequency hops $2^K=8$ for binary message 01111110 001001111010. **PI Mapped : 2.1.3**

Q. 2	A spread spectrum has following parameters- Information bit duration T_b=4.095 msec PN chip duration T_c=1usec. Find the processing gain. What is the number of shift register required? Also find jamming margin if E_b/N_o=10 for the BPSK scheme. **PI Mapped : 2.4.4**

Q. 3	Consider a slow hop spread spectrum system with BFSK, two symbols per frequency hop and PN sequence generator with output with binary message of 011011011000.The message is transmitted using the following PN sequences with k=3;{010,110,101,100,000,101,011,001,111,011,001}Plot the output. **PI Mapped : 2.1.3**

Q. 4	A slow FH/MFSK has following parameters:

	Number of bits per MFSK SYMBOLS=4 Number of MFSK symbol per hop=5 Calculate the processing gain of system. **PI Mapped : 2.1.3**
Q. 5	A BFSK FHSS system has the information rate of 3 kbps and is operating in a jamming environment where entire channel is being jammed with a power level 5 times greater than the received signal. Without the jammer, the SNR$(S/N)_R$=60 db and $N_o=10^{-21}$ W/Hz. If required $P_e=10^{-7}$ determine minimum processing gain and corresponding transmission BW. **PI Mapped : 2.1.3**
Q. 6	A DS-SS BPSK has a processing gain of 500. What is interference margin against continuous tone interferences if desired error probability is 10^{-5}. **PI Mapped : 2.4.4**
Q. 7	A PN sequence is generated using a feedback shift register of length 4. Find the generated output sequence if the initial contents of the shift register is 1000. If the chip rate is 10^7 chip / sec, calculate the chip and PN sequence duration period of output sequence. Assume suitable configuration. **PI Mapped : 2.1.2**
Q. 8	The power spectrum of DS-SS signal shows that at f=0 power is 1mW and spectrum goes through zero at 20.47 MHz away from carrier of 1000Mhz. If spacing between spectral lines is 0.1MHz. Determine required power, the chip rate and no. of shift register used to generate PN sequence. **PI Mapped : 2.1.2**
Q. 9	Consider a slow hop SS System with BFSK that transmits two symbols per frequency hop and has a PN generator with k=3 output for a binary message sequence 011011011000 .Draw the spectral output (output freq. vs data input). Determine the processing gain. If $Wx=r_b=3000$ and find the bit error probability in process of white noise if $No=10^{-12}$W/Hz, $S_R=5.4*10^{-3}$W. **PI Mapped : 2.1.2**
Q10	Consider a fast hop spread spectrum system with binary FSK, 2 hops / symbol and a PN sequence generator with outputs with a binary message 010010010000. The message is transmitted using following PN sequence {010, 110, 101, 100, 000, 101, 011, 001, 001, 111, 011, 001, 110, 101, 101, 001, 110, 001, 011, 111, 100, 000, 110, 110}. Plot the output frequency for the input message. **PI Mapped : 2.1.2**

Q. 11	The information bit duration is DS-BPSK spread spectrum communication system is 10 μS while the chipping rate is 1 MHz. Assuming an average error probability is 10–6 for proper detection of message signal, calculate the Jamming margin. (Ref. Table 1) **Table 1** **Z Q (Z)** 2.5 0.0062100 2.8 0.0025600 3.0 0.0013500 3.2 0.0006900 3.4 0.0003400 3.6 0.0001690 3.68 0.0001660 3.8 0.0000700 4.0 0.0000300 4.3 0.0000100 4.7 0.0000010 5.2 0.0000001 **PI Mapped : 2.1.2**
Q. 12	A DS SS BPSK system has f_b= 3 Kbps N_o= 10^{-10}w/Hz and is receiving signal with pe =10^{-7} in presence of single tone jammer whose received power is 10 times larger than original signal. Calculate the jamming margin and draw anti jam characteristics. **PI Mapped : 2.1.2**
Q. 13	In a DSSS-BPSK system, the feedback shift register used to generate the PN sequence of length 15. The system is required to have an average probability of symbol error as 10–5. **8** Calculate : i) Processing gain ii) Antijam Margin Given :

x	erfc(x)
3.01	0.00002074
3.02	0.00001947
3.03	0.00001827
3.04	0.00001714 **PI Mapped : 2.1.2**

1.8 e. Unit No.-V- Information Theoretic Approach to Communication System

Pre-requisites:- Signals & Systems, M III

Objectives:-

To introduce the concept of information theory & coding techniques.

Outcomes:-

Apply information theoretic approach to analyze a communication system.

Lecture No.	Details of the Topic to be covered	References
1	Introduction to information theory	R1, R4, R6, R7
2	Entropy and its properties	
3	Source coding theorem, Huffman coding, Shannon-Fano coding	
4	Discrete memory less channel, Mutual information, Channel capacity	
5	Channel coding theorem	
6	Differential entropy and mutual Information for continuous ensembles	
7	Information Capacity theorem	

Question Bank: Theory

Q. 1	Write a short note on 1. Source coding theorem 2. Channel Coding theorem 3. Information Capacity theorem. **PI Mapped : 1.4.1**
Q. 2	State and explain all the three Shannon's theorem of Information Theory. **PI Mapped : 1.4.1**
Q. 3	What is entropy? Show that the entropy is maximum, when all the messaging is equi-probable. Assume m=3. **PI Mapped : 2.1.3**
Q. 4	What is Mutual Information? Explain the properties of mutual information. **PI Mapped : 1.1.1**
Q. 5	Define and compare the following:- a) Noiseless Channel b) Noisy Channel c) Binary Symmetric Channel d) Errorless Channel/ Lossless Channel **PI Mapped : 2.2.4**
Q. 6	Prove that for a finite variance σ^2, the Gaussian random variable has the largest differential entropy attainable by any random variable. What is H(X) for a uniformly distributed random variable X over the interval [0, a]. **PI Mapped : 2.2.2**
Q. 7	For a source transmitting two independent messages m1 and m2 having probabilities of [P] and [1-P] respectively. Prove that the entropy is maximum when both the messages are equally likely. Also plot the variation of entropy (H) as a function of probability [P]. **PI Mapped : 2.2.3**
Q. 8	Calculate the capacity of a Binary Symmetric Channel. **PI Mapped : 2.1.3**
Q. 9	A channel has following channel matrix $P(Y/X) = [1-P \; P \; 0 \; 0 \; P \; 1-P]$

	i. Draw the channel diagram If the source has equally likely outputs, compute the probabilities associated with the channel outputs for P=0.2 **PI Mapped : 2.2.3**

Q. 9	For Gaussian random variable having variance σ^2, show that the differential entropy is given by $\left\{\frac{1}{2}[2\pi e\sigma^2]\right\}$ **PI Mapped : 2.1.3**

Q. 10	Define the following:- a) Kraft Inequality Theorem b) Information Rate **PI Mapped : 1.4.1**

Question Bank: Tutorial

Q. 1	A discrete source emits one of five symbols once every millisecond. The symbol probabilities are $\frac{1}{2},\frac{1}{4},\frac{1}{8},\frac{1}{16},\frac{1}{16}$ respectively. Find the source entropy and Information Rate. **PI Mapped : 2.1.3**

Q. 2	Consider a Discrete Memory-less Source with probabilities {0.20, 0.20, 0.15, 0.10, 0.10, 0.05, 0.05}. Determine the Huffman code for this source. **PI Mapped : 2.1.3**

Q. 3	Consider a Discrete Memory-less Source with probabilities {0.20, 0.20, 0.15, 0.10, 0.10, 0.05,0.05}. Find the Shannon Fano code for this source. **PI Mapped : 2.1.3**

Q. 4	For the given string 'ZANAPENA' generated by source (DMS) find the code words using Huffman Algorithm and efficiency of the code. **PI Mapped : 2.1.3**

Q. 5	A discrete memory less source has five symbols X_1, X_2, X_3, X_4 and X_5 with probabilities $P(X_1)=0.4$, $P(X_2)=0.19$, $P(X_3)=0.16$, $P(X_4)=0.15$, $P(X_5)=0.1$. Construct the Shannon Fano code and calculate the code efficiency and redundancy. **PI Mapped : 2.1.3**

Q. 6	A Discrete Memory less Source has 3 symbols S1, S2, S3 with probabilities 0.4, 0.35, 0.2 respectively. Determine the Huffman code for first and second order extension. Calculate the average code word length and efficiency of the code. **PI Mapped : 2.1.3**

Q. 7	Consider a channel with a noise characteristic as P(Y/X) given by P(Y/X) = [0.6 0.2 0.2 0.2 0.6 0.2 0.2 0.2 0.6] And $P(X_1)$ =1/8, $P(X_2)$ =1/8, $P(X_3)$ =6/8. Find entropy of source, receiver, joint entropy of system, the mutual information and conditional entropies. **PI Mapped : 2.1.3**
Q. 8	A zero memory source emits six messages (m_1, m_2, m_3, m_4, m_5, m_6) with probabilities (0.30, 0.25, 0.15, 0.12, 0.10, 0.08) respectively. Find:- i. Huffman code ii. Determine its average word length iii. Find entropy of the source Determine its efficiency and redundancy. **PI Mapped : 2.1.3**
Q. 9	A zero memory source emits six messages (N, I, R, K, A, T) with probabilities (0.30, 0.10, 0.02, 0.15, 0.40, 0.03). Given that 'A' is coded as '0'. Find i. Entropy of source ii. Determine Shannon Fano code and Tabulate them What is the original symbol sequence of Shannon Fano coded signal (110011110111111110100). **PI Mapped : 2.1.3**
Q. 10	Consider a DMS 'X' with two symbols x_1 & x_2 with probabilities $P(x_1)$ =0.9 & $P(x_2)$ =0.1. Find the efficiency and redundancy of this code and its second order extension. **PI Mapped : 2.1.3**
Q. 11	Show that the self-information is always positive. Also calculate H(X),H(Y),H(X,Y),H(X/Y),H(Y/X),I(X;Y) for a channel with three inputs X_1,X_2,X_3. Three outputs Y_1,Y_2 and Y_3 with noise matrix as given as P[Y/X]=[0.9,0.1,0:0,0.8,0.2:0,0.3,0.7]. Calculate where $P(X_1)$ =0.3, $P(X_2)$ =1/4, $P(X_3)$ =0.9/2. **PI Mapped : 2.1.3**

Q. 12	A voice single in a PCM system is Quantized in 16 levels with following probabilities P1-P4 =0.1, P5-P8 =0.05, P9-P12 =0.075, P13-P16 =0.025. Calculate Entropy, Joint Entropy and Information Rate if f_m = 3kHz **PI Mapped : 2.1.3**
Q. 13	State Shannon's first theorem? Obtain the efficiency of a Shannon Fano code for a zero memory source that emits six messages (A,E,H,N,G,S) with probabilities of {0.19,0.15,0.02,0.16,0.4,0.08} respectively. Given that A coded as '0'. **PI Mapped : 2.1.3**
Q. 14	A discrete memory less source consists of three symbols x1,x2, x3 with probabilities 0.55,0.25 and 0.2 respectively. Determine minimum variance Huffman codes for the source for following two alternatives: a) Considering symbol by symbol occurrence. b) Considering second order block extension of the source. Determine the code efficiency for two alternatives and comment on efficiency. **PI Mapped : 2.1.3**
Q. 15	A discrete source emits messages x_1 and x_2 with probabilities 3/4 and ¼ with binary symmetric channels, find H(X), H(Y), H(X,Y), H(X/Y), H(Y/X), I(X;Y) if probability p=1/3 draw channel diagram. **PI Mapped : 2.1.3**

1.8 a. Unit No.-VI-Error-Control Coding

Pre-requisites:- Signals & Systems, Digital Electronics

Objectives:-

To introduce the concept of information theory & coding techniques.

Outcomes:-

Use error control coding techniques to improve performance of a digital communication system.

Lecture No.	Details of the Topic to be covered	References
1	Linear Block Codes: Coding	R1, R4

2	Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding	
3	Cyclic Codes: Coding & Decoding	
4	Convolutional Codes: Coding & Decoding	
5	Introduction to Turbo Codes	
6	LDPC Codes	

Question Bank: Theory

Q. 1	What are single parity check codes? Write about decoding performance of these codes. **PI Mapped : 1.4.1**
Q. 2	Write a note on:- i. Repitition code ii. Dual code iii. Hamming code iv. Golay code v. Single parity check code vi. Interleaved code vii. Shannon channel capacity theorem viii. Systematic code **PI Mapped : 1.4.1**
Q. 3	Design a LBC with minimum distance of three and a message block size of eight bits. **PI Mapped : 2.4.1**
Q. 4	How can LDPC codes be represented graphically? Give step by step procedure for LDPC decoding using bit flipping algorithm. **PI Mapped : 2.4.1**
Q. 5	Explain the following terms:- i. Rate distortion theory ii. Data compression **PI Mapped : 1.4.1**
Q. 6	A voice grade telephone channel has the bandwidth of 3.4 kHz. If the signal to noise ratio on the channel is 30 dB, determine the capacity of the channel. If the above

	channel is to be used to transmit 48 kbps generated data, determine the minimum SNR required **PI Mapped : 2.4.1**
Q. 7	Write a short note on single parity check codes **PI Mapped : 1.4.1**
Q. 8	State the information capacity theorem and show that the Shannon's limit for AWGN channel is -1.6 dB **PI Mapped : 1.4.1**
Q. 9	Define:- i. Shannon Limit ii. Shannon's third theorem iii. Hamming code **PI Mapped : 1.4.1**
Q. 10	Draw and explain block diagram of turbo encoder and decoder. **PI Mapped : 1.4.1**
Q. 11	Enlist the advantages and applications of turbo codes. **PI Mapped : 2.4.4**
Q. 12	Interleaving exploits time diversity without adding any overhead bits in wireless digital cellular communication systems. Comment on this statement with illustration of suitable interleaving technique. **PI Mapped : 2.4.4**
Q. 13	Distinguish between block interleaving and convolutional interleaving and which one is more useful in wireless communication systems. **PI Mapped : 2.2.4**

Question Bank: Tutorial

Q. 1	Consider a (7,4) LBC whose Generator matrix is given by $G = [1\ 0\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 0\ 0\ 1\ 1\ 1\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 0\ 0\ 0\ 1\ 0\ 1\ 1]$ i. Find all code words ii. Find parity check matrix iii. What is the minimum distance of this code? iv. How many errors can the code detect? v. Is this a linear code? Justify **PI Mapped : 1.1.1**

Q. 2 For a Gaussian channel

$$C = B1 + \left(\frac{E_b}{N_o}\right)\left(\frac{C}{B}\right)$$

Find Shannon Limit

Draw the bandwidth efficiency diagram with $\left(\frac{E_b}{N_o}\right)$ dB on horizontal axis and $\left(\frac{R_b}{B}\right)$ on vertical axis. Mark different regions and Shannon Limit on the graph. **PI Mapped : 2.4.4**

Q. 3 For (6, 3) Linear Block Code following generator matrix is used G= {1 0 0 1 1 0; 0 1 0 0 1 1; 0 0 1 1 1 1}.

a) Find error correction and detection capability of the code.

b) Is this a perfect code justify. **PI Mapped : 1.1.1**

Q. 4 For a (6,3) systematic linear block code, the three parity check bits C_4, C_5 and C_6 are formed from the following equations:-

$C_4 = d_1 \oplus d_3$,

$C_5 = d_1 \oplus d_2 \oplus d_3$,

$C_6 = d_1 \oplus d_2$,

i. Write down the generator matrix G
ii. Construct all possible code words
iii. Suppose that the received word is 010111 **PI Mapped : 1.1.1**

Q. 5 For a systematic linear block code, the three parity check bits C_4, C_5 and C_6 are given by:-

$C_4 = d_1 \oplus d_2 \oplus d_3$,

$C_5 = d_1 \oplus d_2$,

$C_6 = d_1 \oplus d_3$,

i. Construct Generator matrix
ii. Find out all possible code words
iii. Determine error correction capability
iv. Prepare a suitable decoding table
v. Decode the received words 101100 &000110 **PI Mapped : 2.4.4**

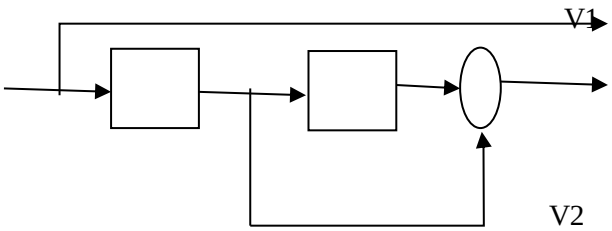
Q. 6	Find the parity check matrix for decoding Linear Block code if generator matrix is given as $G = [1\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ \ 1\ 1\ 0\ 0\ 1\ 1\ 1\ 0\ 1]$ **PI Mapped : 1.4.1**
Q. 7	For a (4, 2) Linear Block code, the generator matrix is given as $G = [\ 1\ 0\ 1\ 0\ 1\ 0\ \ 1\ 1\ ]$ Find all code words that can be generated. Comment on error correction capability of the code. **PI Mapped : 1.1.1**
Q. 8	For a (6,3) linear block code, following generator matrix is used $G = [1\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 1\ \ 1\ 1\ 0\ 0\ 1\ 1\ 1\ 1\ 1]$ i. Find error correction and detection capability of the code ii. Is this a perfect code? Justify. **PI Mapped : 2.4.4**
Q. 9	Obtain the code words for (6,3) LBC which has the generator matrix of G = [1 1 0 1 0 0 : 0 1 1 0 1 0 : 1 0 1 0 0 1] If the code word C= 1 0 1 1 1 0 is transmitted and Received code word is r = 0 0 1 1 1 0 Obtain the correct code word, by use of syndrome **PI Mapped : 1.4.1**
Q. 10	The parity check bits of a (7,4) block code are generated by:- $C_5 = d_1 \oplus d_2 \oplus d_3,$ $C_6 = d_1 \oplus d_2 \oplus d_3,$ $C_7 = d_2 \oplus d_3 \oplus d_4,$ Where d1, d2, d3,d4 are the message digits i. Find the generated matrix and parity check matrix for this code ii. Find the minimum weight of this code. iii. Find error detecting capability of this code **PI Mapped : 2.4.4**

Q. 11	Using generator polynomial $g(x) = x^3+x+1$. Generate systematic cyclic code for the following message. a) 1 0 1 1 b) 1 0 1 0 **PI Mapped : 1.1.1**

Q. 12	Draw the encoding and decoding circuit for cyclic code whose generator polynomial is $g(x) = x^4 + x^2 + 1$ **PI Mapped : 1.1.1**

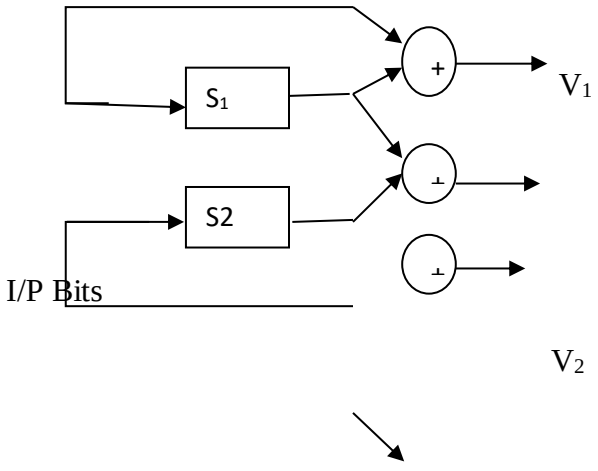
Q. 13	For a (7, 4) cyclic code, generator polynomial $g(x) = x^3+ x+1$ is used. Draw the circuit for generating syndrome. Find the syndrome for received code word 0 0 1 1 0 0 0. **PI Mapped : 1.1.1**

Q. 14 Draw the trellis diagram for the following encoder **PI Mapped: 1.4.1**



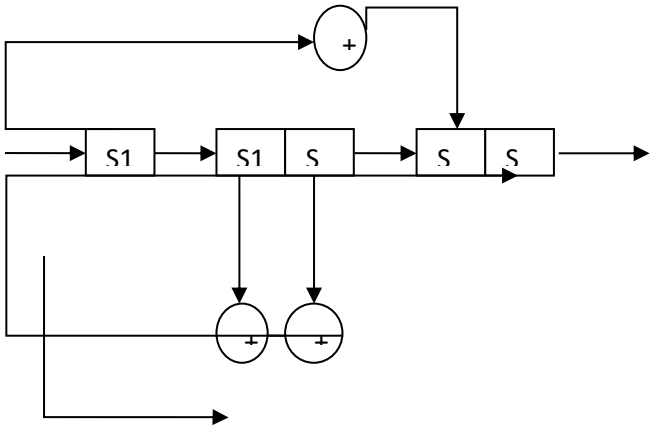
Q. 15	Explain with example polynomial description of convolutional codes. **PI Mapped : 1.4.1**

Q. 16	For the following convolutional encoder; find the coded output if input message is 10110000



PI Mapped : 2.4.1

Q. 17	For the convolutional encoder shown below sketch the state diagram & Trellis diagram. Find the output data sequence 1010111



PI Mapped : 2.4.4

Q. 18	The (1/2, 3) convolution encoder has generating vectors as g1= (100), g2 =(110) and sketch the encoder and Trellis diagram. And decode the following sequences using Viterbi algorithm 11100000101. **PI Mapped : 2.4.1**

Q. 19	A voice grade channel of the telephone network has a bandwidth of 3.4 kHz. Calculate the information capacity of the telephone channel for SNR of 30 dB. **PI Mapped : 1.4.1**

1.9 List of Practical

Sr. No.	Name of Experiment	Setup	CO's
Group A			
1	Study of BPSK transmitter & receiver using suitable hardware setup/kit.	Kit, DSO, Patch Cords, Probes	CO1-1.4.1
2	Study of BFSK transmitter & receiver using suitable hardware setup/kit.	Kit, DSO, Patch Cords, Probes	CO1-1.4.1
Group B			
3	Study of DSSS transmitter and receiver using suitable hardware setup/kit.	Kit, DSO, Patch Cords, Probes	CO2-1.4.1
4	Study of FHSS transmitter and receiver using suitable hardware setup/kit.	Kit, DSO, Patch Cords, Probes	CO2-1.4.1
Group C			
5	Simulation study of Performance of M-ary PSK.	PC with Scilab installed	CO1-1.4.1, 5.1.2
6	Simulation study of Performance of M-ary QAM.	PC with Scilab installed	CO1-1.4.1, 5.1.2
7	Simulation Study of CDMA technique.	PC with Scilab installed	CO2-1.4.1, 5.1.2
8	Simulation study of random processes. Find various statistical parameters of the random process.	PC with Scilab installed	CO3-1.1.1, 5.1.2
Group D			
9	Simulation study of Source Coding technique. (Huffman Coding)	PC with Scilab installed	CO4-1.1.1, 1.4.1, 5.1.2
10	Simulation Study of Linear Block codes.	PC with Scilab installed	CO4-1.1.1, 1.4.1, 5.1.2
11	Simulation Study of Convolutional codes	PC with Scilab installed	CO4-1.1.1, 1.4.1, 5.1.2

Oral Questions

Sr. No.	Oral Questions	CO Mapped
Q. 1	Draw block diagram of BPSK transmitter and receiver and explain	
Q. 2	Define band-pass transmission, Base band transmission	
Q. 3	What is coherent detection?	
Q.4	Compare BPSK, BFSK, QPSK, M-ary FSK, M-ary PSK	
Q.5	In which binary modulation error propagation is fast?	
Q.6	In which technique errors occur in pairs?	
Q.7	Draw signal space representation for BPSK, QPSK, BFSK, M-ary FSK, M-ary PSK?	
Q.8	Draw spectrum of BPSK, QPSK, BFSK	
Q.9	What is bandwidth requirement BPSK, QPSK, BFSK, M-ary FSK, M-ary PSK, DPSK.	**CO2**
Q.10	Explain ISI	
Q.11	How to avoid ISI?	
Q.12	Write probability of error of BPSK, QPSK, FSK	
Q.13	What is Pe of integrate and dump filter?	
Q.14	What is significance of the matched filter?	
Q.15	Define bit error rate and Symbol error rate	
Q.16	What is significance E_b/N_0 ratio?	
Q.17	Whether correlator and matched filter are same	
Q.18	Where matched filter is used?	
Q.19	State need for Spread Spectrum techniques.	
Q.20	Compare DSSS with FHSS.	
Q.21	Compare Slow frequency hop and fast frequency hop.	
Q.22	What is maximal length sequence?	
Q.23	Explain the properties of PN sequence.	
Q.24	How do you gain security in Spread Spectrum?	
Q.25	What are application, advantages and disadvantages of spread spectrum?	**CO3**
Q.26	Which one will you prefer and why out of 1. DSSS & FHSS 2. SFH and FFH	
Q.27	Whether DSSS is wide band system or narrow band system?	
Q.28	Generate 3 bit PN sequence.	
Q.29	Define jamming margin, Processing gain	
Q.30	State Shannon's 3 theorems.	
Q.31	Compare source and channel coding.	**CO4**
Q.32	State source and channel coding techniques.	
Q.33	What is LBC? State properties of LBC.	
Q.34	What is generator polynomial?	**CO5**
Q.35	Define Hamming weight and hamming distance.	
Q.36	Write formula for error detection and error correction	

Q.37	How syndrome decoding takes place in LBC and Cyclic code?	
Q.38	State properties of cyclic code	
Q.39	What is systematic code?	
Q.40	Draw cyclic code encoder	
Q.41	Draw syndrome generator	
Q.42	State steps for generation of cyclic code	
Q.43	How modulo addition and multiplication is done	
Q.44	What is difference between convolution and block code?	
Q.45	Define constrain length?	
Q.46	Draw encoder for given problem	
Q.47	Which blocks are involved in generation of convolution	
Q.48	What are different decoding methods of convolution code?	
Q.49	What is Turbo code?	
Q.50	How interleaver works?	
Q.51	What is LDPC?	
Q.52	What is code rate?	
Q.53	Size of generator matrix, parity check matrix, identity matrix	
Q.54	What is n, k and n-k?	
Q.55	Define random variable, Random process	**CO1**
Q. 56	Differentiate RV and RP	
Q. 57	Classify RP	
Q. 58	Define Time average and ensemble average	
Q. 59	Define ergodic process, stationary process, wide sense stationary process with example	

2. Name of the Course – Electromagnetic Field Theory (304182)

Weekly Work Load(in Hrs)	**Lecture**	**Tutorial**	**Practical**
	3	**1**	**0**

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	0	0	25	125	3+1=4

2.1 Syllabus

Unit I: Electrostatics **8L**

Review of 3D Coordinate Geometry, Vector Calculus, Physical significance of Gradient, Divergence, Curl, Electric field intensity(E), Displacement Flux Density(D), Gauss's law, Electric potential(V), Potential Gradient, E/D/V due to uniform sources (point charge, infinite line charge, infinite surface charge) , Maxwell Equations for Electrostatics, Current, Current Density, physical interpretation.

Application Case Study: Electrostatic Discharge, Cathode Ray Oscilloscope.

Unit II: Electrostatics – II **6L**

Lorentz force, magnetic field intensity (H), Magnetic Flux Density(B), – Biot–Savart's Law – Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Maxwell Equations for Magneto Statics, physical interpretation.

Application Case Study: Lightning, Magnetic Resonance Imaging (MRI).

Unit III: Boundary Conditions **6L**

Electric Dipole, Dielectric Polarization, Properties of Conductors, Dielectric Materials, Boundary conditions (dielectric-dielectric, conductor –dielectric), significance and applications of Poisson's and Laplace's equations - Capacitance, Energy density.

Magnetization, magnetic materials, Boundary conditions for Magnetic Fields, Magnetic force, Torque.

Application Case Study: RF MEMS, Magnetic Levitation, Electromagnetic Pump.

Unit IV: Time Varying Electromagnetic Fields: Maxwell Equations **6L**

Scalar and Vector Magnetic Potential, Poisson's and Laplace Equations, Faraday's law, Translational and motional emf, Displacement current density, Continuity Equation, Time varying Maxwell's equations - point form, integral form, Power and Poynting theorem, concept of Retarded magnetic vector potential,

Application Case Study: Memristor, Electric Motors, Generators

Unit V: Uniform Plane Waves **6L**

Maxwell's equation using phasor notations, Electromagnetic wave equations (Helmholtz equation), Relation between E and H, depth of penetration, concept of polarization, Reflection by perfect conductor- normal incidence, reflection by perfect dielectric- normal incidence, Snell's law.

Application Case Study: Comparison of Circuit Theory at low frequency and Field theory at High frequencies, Antenna Radiation Mechanism, Propagation of EM energy.

Unit VI: Transmission Line Theory **6L**

Line parameters, skin effect, general solution, physical significance of the equations, wavelength, velocity of propagation, the distortion less line, Reflection on a line not terminated in Z0, reflection coefficient, open and short circuited lines, reflection coefficient and reflection loss, standing waves; nodes; standing wave ratio, Input impedance of dissipation less line, Smith Chart and its applications in solving the transmission line parameters.

Application Case Study: Coaxial Cable, Twisted Pair, Microwave Waveguides

2.2 Course Objectives

- To introduce electrostatics, magneto statics and time varying fields.
- To solve electromagnetic problems using Maxwell's equations.
- To introduce the transmission line and its parameters
- To impart knowledge of electromagnetic waves
- To elaborate application of Electromagnetics

2.3 Course Outcomes

At the end of the course the student will be able to:

- **CO1. Explain** the basic mathematical concepts related to electromagnetic vector fields. (Unit 1) (**BTL:2)**
- **CO2. Apply** the principles of Electrostatic or Magneto static to solve the problems related to Electromagnetic field. (Unit 1,2,3) **(BTL:3)**
- **CO3. Use** the concepts Maxwell 's equations to explain time varying electromagnetic field. (Unit 4) **(BTL:3)**
- **CO4. Explain** the behaviour of uniform plane wave in different medium (Unit 5) (**BTL:2)**
- **CO5. Analyze** the transmission line parameters (Unit 6) (**BTL:2)**
- **CO6. Illustrate** application of Electromagnetics (Unit 1-6) (**BTL:3**)

2.4 Text Books:

T1	Mathew N. O. Sadiku, Principles of Electromagnetics', 4th Edition,Oxford University Press Inc, 2009.
T2	William H. Hayt and John A. Buck, Engineering Electromagnetics', Tata McGraw Hill, 8th Revised edition, 2011.

2.5 Reference Books:

	Kraus and Fleish, Electromagnetics with Applications', McGraw Hill International Editions, 5th edition, 2010
R2	Jordan and Balmain, Electromagnetic Waves and Radiating Systems, PHI, 1964.

2.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

R1	**Referred Book other than Mention in Syllabus:** 1. Microwave Engineering by David M. Pozar **2.** RF circuit design by Ludwig & Bretchko
R2	**Reference Web Links:** 1. Video lectures on transmission lines by R.K.Shevgaonkar

2.7 Teaching Plan

Unit No.	Topics to be covered	Book Referred	Total Lecture Planned	CO Mapped	PI Mapped
1	Review of 3D Coordinate Geometry, Vector Calculus, Physical significance of Gradient, Divergence, Curl, Electric field intensity(E), Displacement Flux Density(D), Gauss's law, Electric potential(V), Potential Gradient, E/D/V due to uniform sources (point charge, infinite line charge, infinite surface charge) , Maxwell Equations for Electrostatics, Current, Current Density, physical interpretation. **Application Case Study:** Electrostatic Discharge, Cathode Ray Oscilloscope.	T1, T2	10	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3 1.4.1-2 2.1.3-2
2	Lorentz force, magnetic field intensity (H), Magnetic Flux Density(B), – Biot–Savart's Law – Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current,	T1, T2	8	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3 1.4.1-2 2.1.3-2

	Maxwell Equations for Magneto Statics, physical interpretation. **Application Case Study:** Lightning, Magnetic Resonance Imaging (MRI).				
3	Electric Dipole, Dielectric Polarization, Properties of Conductors, Dielectric Materials, Boundary conditions (dielectric-dielectric, conductor – dielectric), significance and applications of Poisson‘s and Laplace‘s equations - Capacitance, Energy density. Magnetization, magnetic materials, Boundary conditions for Magnetic Fields, Magnetic force, Torque. **Application Case Study:** RF MEMS, Magnetic Levitation, Electromagnetic Pump.	T1, T2	8	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3 1.4.1-2 2.1.3-2
4	Scalar and Vector Magnetic Potential, Poisson’s and Laplace Equations, Faraday‘s law, Translational and motional emf, Displacement current density, Continuity Equation, Time varying Maxwell‘s equations - point form, integral form, Power and Poynting theorem, concept of Retarded magnetic vector potential, **Application Case Study:** Memristor, Electric Motors, Generators.	T1, T2	7	CO3, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3 1.4.1-2 2.1.2-2 2.1.3-2

5	Maxwell's equation using phasor notations, Electromagnetic wave equations (Helmholtz equation), Relation between E and H, depth of penetration, concept of polarization, Reflection by perfect conductor-normal incidence, reflection by perfect dielectric- normal incidence, Snell's law. **Application Case Study:** Comparison of Circuit Theory at low frequency and Field theory at High frequencies, Antenna Radiation Mechanism, Propagation of EM energy.	T1, T2	7	CO4, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3 1.4.1-2 2.1.2-2 2.1.3-2
6	Line parameters, skin effect, general solution, physical significance of the equations, wavelength, velocity of propagation, the distortion less line, Reflection on a line not terminated in Z0, reflection coefficient, open and short-circuited lines, reflection coefficient and reflection loss, standing waves; nodes; standing wave ratio, Input impedance of dissipation less line, Smith Chart and its applications in solving the transmission line parameters. **Application Case Study:** Coaxial Cable, Twisted Pair, Microwave Waveguides	T1,T2	8	CO5, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3 1.4.1-2 2.1.2-2 2.1.3-2

2.8 Unit wise Lecture Plan

2.8 a. Unit No. I: Electrostatics

Pre-requisites:- Vector Analysis, Charges, Flux, Line of forces, Potential, Current

Objectives: -

- To introduce electrostatics concepts in electromagnetics
- To explain students various laws in the field of static electricity.

Outcomes: -Students will be able to

- Identify the problem and will be able to apply appropriate laws of electrostatic to solve the problem.

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Vectors, coordinate systems, conversion of coordinate systems, vector operators, differential operators, integrals	T1, T2	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3 1.4.1-2 2.1.3-2
2	Differential elements- line, surface, volume, curl divergence, gradient.			
3	Coulomb's law and examples, Electric field intensity, EFI due to point charge with numerical, EFI due to line charge			
4	EFI due surface charge, volume, numerical on surface charge density			
5	Electric flux, electric flux density, Gauss's law and it's mathematical proof, Application of Gauss's law to find EFI at point charge			
6	Application of Gauss's law to find E and D due to line Charge, Application of Gauss's law to differential volume element			
7	Divergence Theorem, Potential difference, potential difference due to point charge, line charge derivations			
8	Relation between E and V, potential gradient, conservation of E			
9	Current, Current Density			
10	**Application Case Study:** Electrostatic Discharge, Cathode Ray Oscilloscope			

Question Bank: Theory

CO Mapped: CO1, CO2

Q 1 State and explain Coulomb's law.

Q 2 A charge $Q_A = -20\mu C$ is located at A (-6,4,7), and a charge $Q_B = 50\mu C$ is at B(5,8,-2) in free space. If distances are given in meters, find: (a) R ; (b) R_{AB} . Determine the vector force exerted on $Q_A$by Q_B if ε_0 =: (c)$10^{-9}/(36\pi)$F/m; (d) 8.854×10^{-12}F/m.

Ans.11$\hat{x}$ +4$\hat{y}$ -9$\hat{z}$ m; 14.76 m; 30.76$\hat{x}$ +11.184$\hat{y}$ -25.16$\hat{z}$ mN; 30.72$\hat{x}$ +11.169$\hat{y}$ -25.13$\hat{z}$ mN.

Q 3 Define electric field intensity $\bar{E}$. Derive the expression for the same using Coulomb's law of force.

Q 4 A charge of -0.3 μC is located at A(25,-30,15) (in cm), and a second charge of 0.5 μC is at B(-10,8,12) cm. Find $\bar{E}$ at: (a) the origin; (b) P(15,20,50)cm

Ans. 92.3 $\hat{x}$ -77.6 $\hat{y}$ -94.2 $\hat{z}$ kV/m; 11.9 $\hat{x}$ -0.519 $\hat{y}$ +12.4 $\hat{z}$ kV/m;

Q 5 Develop expression for $\bar{E}$ at a general point P due to uniform charge distribution along an infinite straight line with uniform charge densityρ_L .

Q 6 Infinite uniform line charges of 5 nC/m lie along the (positive and negative) x and y axes in free space. Find $\bar{E}$ at: (a) (0, 0, 4); (b) P_B(0, 3, 4).

Ans.45 $\hat{z}$ V/m; 10.8$\hat{y}$ +36.9$\hat{z}$ V/m;

Q 7 A line charge density ρ_L is uniformly distributed over a length 2a with center as origin along x axis. Find $\bar{E}$ at a point P which is on the z axis at a distance d.

Q 8 Find the electric field intensity $\bar{E}$ at a point P on positive x axis due to infinite sheet of charge with surface charge density ρ_S along x=0 plane.

Q 9 Two parallel conducting plates with surface charge density ρ_S and - ρ_S are placed symmetrical from the origin along x=0 plane. The distance between the plates is 2a. Find

$\bar{E}$ at: (a) $-a < x < a$;(b) $x < -a$;(c) $x > a$.

Q 10 Three infinite uniform sheets of charge are located in free space as follows: 3 nC/m^2 at $z = -4$, 6 nC/m^2 at z = 1and -8 nC/m^2 at z = 4. Find $\bar{E}$ at a point: (a) (2, 5,-5); (b) (4, 2,-3); (c) P_C(-1,-5, 2); (d) P_D(-2, 4, 5).

Ans.-56.5 $\hat{z}$; 283 $\hat{z}$; 961 $\hat{z}$; 56.5 $\hat{z}$ all V/m.

Q 11 Derive the expression for $\bar{E}$ at a point P on the axis of a charged circular ring, carrying a charge uniformly along its circumference with a density ρL .

Q 12 Define electric flux density and state its vector form.

Q 13 Given a 60 μC point charge located at the origin, find the total electric flux passing through: (a) that portion of the sphere r = 26 cm bounded by $0 < \theta < \frac{\pi}{2}$ and $0 < \emptyset < \frac{\pi}{2}$;

(b) The closed surface defined by ρ = 26 cm and z = ±26 cm ; (c) the plain z = 26 cm.

Ans. 7.5 μC; 60 μC; 30 μC.

Q 14 Obtain D due to point charge Q placed at origin. Hence obtain the relation between $\bar{D}$ And $\bar{E}$.

Q 15 State and explain the Gauss's law.

Q 16 What is Gaussian surface? What conditions it should satisfy?

Q 17 State and prove Gauss's law.

Q 18 Given the electric flux density, $\bar{D}$ = $0.3r^2\hat{r}nC/m_2$ in free space: (a) find $\bar{E}$ at point (= 2, θ = 25°, $\emptyset$ = 90°) ; (b) find the total charge within the sphere r = 3; (c) find the total electric flux leaving the sphere r = 4.

Ans.135.5 r̂ V/m;305 nC; 965 nC

Q 19 Obtain the expression for $\overline{D}$ and $\overline{E}$ due to infinite line charge using Gauss's law.

Q 20 Obtain $\overline{D}$ in all the regions of a coaxial cable of length L, using Gauss's law.

Q 21 Obtain $\overline{D}$ for infinite sheet of charge using Gauss'slaw.

Q 22 A point charge of 0.25 μC is located at r = 0, and uniform surface charge densities are located as follows: 2 mC/m^2 at r = 1 cm, and −0.6 mC/m^2 at r = 1.8 cm. Calculate $\overline{D}$ at: (a) r = 0.5 cm; (b) r = 1.5 cm; (c) r = 2.5 cm; (d) What uniform surface charge density should be established at r = 3 cm to cause to cause $\overline{D}$ = 0 at r = 3.5 cm?

Ans. 796 r̂$\mu C/m^2$; 977 r̂$\mu C/m^2$; 40.8 r̂$\mu C/m^2$; -28.3 r̂$\mu C/m^2$

Q 23 In each of the following parts, find a numerical value for div $\overline{D}$ at the point specified: (a) $\overline{D}$ = 2$(xyz - y^2)$ $\hat{x}$ +($x^2z - 2xy$) $\hat{y}$ + x^2y $\hat{z}$ $C/m2$ at PA (2, 3,-1);

(b) $\overline{D}$ = 2$\rho z^2 sin2\emptyset$ ˆ+ $\rho z^2 sin2\emptyset$ $\hat{\emptyset}$ + 2$\rho^2 z$ $sin2\emptyset$ $\hat{z}$ C/m^2at $PB(\rho = 2, \emptyset = 110°, z = -1)$;

(c) $\overline{D}$ = 2$rsin\theta cos\emptyset$ r̂ + $rcos\theta cos\emptyset$ $\hat{\theta}$ − $rsin\emptyset$ $\hat{\emptyset}$ C/m^2 at (r = 1.5, θ = 30°, $\emptyset$ =50°.

Ans. -10; 9.06; 1.29

Q 24 Derive the expression to show that the divergence of flux density is equal to volume charge density.

Q 25 In free space, let $\overline{D}$ = 8$xyz^4\hat{x}$ + 4$x^2z^4\hat{y}$ + 16$x^2yz^3\hat{z}$ pC/m^2. (a) Find the total electric flux passing through the rectangular surface z = 2 , 0 < x < 2 , 1 < y < 3 , in the z direction. (b) Find $\overline{E}$ at (2, −1, 3). (c) Find an approximate value for the total charge contained in an incremental sphere located at P(2, −1, 3) and having a volume of $10^{-12}m^3$.

Ans.1365pC; −146.4 $\hat{x}$ + 146.4 $\hat{y}$ − 195.2 $\hat{z}$ V/m; -2.38×10^{-21}C

Q 26 State and prove the divergence theorem.

Q 27 Given the field $\bar{D} = 6\rho \sin 0.5\emptyset\ \hat{\rho} + 1.5\rho cos0.5\emptyset\ \hat{\emptyset}\ \ C/m^2$, evaluate both sides of the divergence theorem for the region bounded by $\rho = 2$, $\emptyset = 0$, $\emptyset = \pi$, $z = 0$, $z = 5$.

Ans. 225; 225

Q 28. Define a work done and obtain the line integral to calculate the work done in moving a point charge Q in an electric field $\bar{E}$.

Q 29 Given the electric field $\bar{E} = \frac{1}{Z^2}(8xyz\ \hat{x} + 4x^2z\ \hat{y} - 4x^2y\ \hat{z})\ V/m$, find the differential amount of work done in moving a 6-nC charge a distance of 2μm, starting at $P(2, -2, 3)$ and proceeding in the direction $\hat{L}$ =: (a) $-\frac{6}{7}\hat{x} + \frac{3}{7}\hat{y} + \frac{2}{7}\hat{z}$

(b) $\frac{6}{7}\hat{x} - \frac{3}{7}\hat{y} - \frac{2}{7}\hat{z}$ (c) $\frac{3}{7}\hat{x} + \frac{6}{7}\hat{y}$

Ans. -149.3 fJ; 149.3 fJ; 0

Q 30 Calculate the work done in moving a 4-C charge from (1, 0, 0) to $A(0, 2, 0)$ along the path $y = 2 - 2x$, $z = 0$ in the field $\bar{E}$ =: (a) $5x\ V/m$; (b) $5xx + 5yy\ V/m$.

Ans. 20J; 10J; -30J

Q 31 Explain the conservation property of an electric field.

Q32 Derive the expression for potential due to point charge.

Q 33 A 15-nC point charge is at the origin in free space. Calculate V_1 if point P_1 is located at $P_1(-2, 3, -1)$ and: (a) $V = 0\ at$ 6, 5, 4 ; (b) $V = 0\ at$ infinity; (c) $V = 5\ V\ at$ 2, 0, 4 .

Ans. 20.67 V; 36.0 V; 10.89 V

Q 34 Find the potential V on z axis at a distance z from origin when uniform line charge ρ_L in the form of a ring of radius a is placed in the z=0 plane.

8 Two concentric cylindrical conductors are arranged to form a coaxial transmission line.

Prove that the potential difference between the conductors is given by,

$V = \frac{\rho_L}{2\pi\varepsilon} ln \frac{b}{a}$V $\qquad\qquad a \leq r \leq b$

Where a=radius of inner cylinder, b= radius of outer cylinder, ρ_L=charge per unit length of the inner conductor.

Q 35 Write the expression for potential at point P on x axis because of a finite length line charge of length 2L centered at origin along y axis

Q 36 Derive the expression for potential due to infinite length line charge on z axis and point P is on x axis.

Q 37 If we take zero reference for the potential at infinity, find the potential at (0, 0, 2) caused by this charge configuration in free space: (a) 12 nC/m on the line ρ = 2.5 m, z = 0; (b) point charge of 18 nC at (1, 2, -1); (c) 12 nC/m on the line y = 2.5, z = 0.

Ans. 529 V; 43.2 V; 67.4 V

Q 38 What is potential gradient

Q 39 Derive the relation between $\bar{E}$ and V.

Q 40 Given the potential field in cylindrical coordinates, $V = \frac{100}{z^2+1}\ \rho cos\emptyset$ V, and point P at ρ = 3 m, $\emptyset$ = 60°, z = 2 m, find values at P for : (a) V; (b) $\bar{E}$; (c) E; (d)$\frac{dV}{dN}$; (e) N ;(f) ρ_v in free space.

Ans. 30 V; $-10\hat{\rho} + 17.3\hat{\emptyset} + 24\hat{z}\ V/m$; 31.2 V/m; 31.2 V/m; $0.32\hat{\rho}$ -0.55$\hat{\emptyset}$ -0.77$\hat{z}$; -234pC/m^3.

Question Bank: Tutorial

CO Mapped: CO1, CO2

Q. 1 Let a point charge 41 nC be located at (**4**, −**2**, **7**) and a charge 45 nC at

$\boldsymbol{P}_2$(−**3**, **4**, −**2**). The electric field $\bar{E}$ at (**1**, **2**, **3**) will be?

Q. 2 A uniform line charge of 16 nC/m is located along the line defined by $\boldsymbol{y}$ = −**2**, $\boldsymbol{z}$ =

5. If $\varepsilon = \varepsilon 0$:

(a) Find $\bar{E}$ at (**1**, **2**, **3**);

(b) Find $\bar{E}$ at that point in $\boldsymbol{z}$ = **0** plane where the direction of $\boldsymbol{E}$ is given by $\frac{1}{3}$ ŷ - $\frac{2}{3}$ $\hat{z}$.

Q. 3 A coaxial cable of length 50 cm has inner radius of 1 mm & outer radius of 4 mm. The space between the two conductors is assumed to be filled with air. The total charge on the inner conductor is 30 nC. Find:

(a) Find charge density on each conductor.

(b) Find $\bar{E}$

Q. 4 A charge is distributed along z – axis between ±**6** m with uniform charge density 25 nC/m. Calculate $\bar{E}$ at $\boldsymbol{pt}$ (**2**, **0**, **0**) in free space.

Q. 5 Three infinite uniform sheets of charge are located in free space as follows: 3 nC/m^2 at $z = -4$, 6 nC/m^2 at z = 1and -8 nC/m^2 at z = 4. Find $\bar{E}$ at a point: (a) P(2, 5,-5); (b) P(4, 2,-3); (c) P_C(-1,-5, 2); (d) P_D(-2, 4, 5).

Q. 6 The cylindrical surfaces ρ = 1, 2, & 3 cm carry uniform surface charge densities of 20, -8,

& 5 nC/m^2, respectively.

(a) How much electric flux passes through the closed surface = 5 cm, $0 < z < 1$?

(b) Find $\overline{D}$ at (1, 2, 3)cm.

Q. 7 A point charge of 0.25 μC is located at r = 0, and uniform surface charge densities are located as follows: $2mC/m2\ at\ r$ = 1 $cm, -0.6mC/m2\ at\ r$ = 1.8 cm. Calculate $\overline{D}$ at:

(a)r = 0.5 cm (b) = 1.5 cm (c) r = 2.5 cm (d) What uniform surface charge density should be established at r = 3 cm to cause D = 0 $at\ r$ = 3.5 cm ?

Q. 8 If $\overline{D} = 20xy2\,z + 1\,x + 20x2y\,z + 1\,y + 10x2y2z\ C/m2$, calculate volume charge density at P(0.3, 0.4, 0.5)

Q. 9 $\overline{D}$ = $(2xy)\hat{x} + (3yz)\hat{y} + (4zx)\hat{z}\ C/m^2$. Find charge enclosed by $-1 \le x \le 2$, $0 \le z \le$ 4 & y = 3 $plane$.

Q. 10 Given the field $\overline{D}$ = 6ρ sin $0.5\emptyset\ \hat{\rho} + 1.5\rho cos0.5\emptyset\ \hat{\emptyset} C/m^2$ evaluate both sides of the divergence theorem for the region bounded by ρ = 2, $\emptyset$ = 0, $\emptyset = \pi$, z = 0, z = 5.

Q. 11 A uniform surface charge density of $\boldsymbol{20\ nC/m^2}$ is present on the spherical surface $\boldsymbol{r = 0.6\ cm}$ in free space. (a) Find the absolute potential at ($\boldsymbol{r = 1\ cm}$, $\boldsymbol{\theta = 25°}$, $\emptyset$ = $\boldsymbol{50°}$) (b) Find $\boldsymbol{V_A}$, given points $\boldsymbol{A}$ $\boldsymbol{r = 2\ cm}$, $\boldsymbol{\theta = 30°}$, $\emptyset = \boldsymbol{60°}$ & B(r = 3 cm, θ = 45°, $\emptyset$ = 90°).

Q. 12 Given a surface charge density of $\boldsymbol{80\ nC/m^2}$ on the plane $\boldsymbol{x = 2}$, a line charge density of 30 nC/m on the line $\boldsymbol{x = 1}$, $\boldsymbol{y = 2}$ and a 1 μC point charge at $(\boldsymbol{-1}, \boldsymbol{-1}, \boldsymbol{2})$. Find $\boldsymbol{V_{AB}}$ for points $\boldsymbol{A}$ $\boldsymbol{3}$, $\boldsymbol{4}$, $\boldsymbol{0\ and\ B}$($\boldsymbol{4}$, $\boldsymbol{0}$, $\boldsymbol{1}$).

Q. 13 Point charges +3 μC & -3 μC are located at $\boldsymbol{0}$, $\boldsymbol{0}$, $\boldsymbol{1\ mm}$& $\boldsymbol{0}$, $\boldsymbol{0}$, $\boldsymbol{-1\ mm}$ respectively in

free space. Find: (a) dipole moment $\bar{p}$; (b) $\bar{E}$ at $\boldsymbol{P}(\boldsymbol{r} = \mathbf{2}, \boldsymbol{\theta} = \mathbf{40}°, \emptyset = \mathbf{50}°)$.

Q. 14 An electric dipole located at the origin in free space has the moment $\boldsymbol{p} = \mathbf{3}\hat{\boldsymbol{x}} - \mathbf{2}\boldsymbol{y}\hat{} +$

$\boldsymbol{z}\hat{}\ \boldsymbol{nC}.\ \boldsymbol{m}$, then find $\boldsymbol{V}\ \boldsymbol{at}\ \boldsymbol{P}(\mathbf{2}, \mathbf{3}, \mathbf{4})$.

Q. 15 Calculate the numerical values for $\boldsymbol{V}$ &$\boldsymbol{\rho_v}$ at a point P in free space if:

(a) $\boldsymbol{V} = \frac{4xyz}{x^2+1}$ $\boldsymbol{at}\ (\mathbf{1}, \mathbf{2}, \mathbf{3})$

(b) $\boldsymbol{V} = \mathbf{5}\boldsymbol{\rho}^{\mathbf{2}}\boldsymbol{cos}\mathbf{2}\emptyset$, $\boldsymbol{at}\ (\boldsymbol{\rho} = \mathbf{3}, \emptyset = \frac{\pi}{2}, \boldsymbol{z} = \mathbf{2})$

(c) $\boldsymbol{V} = \frac{2cos\emptyset}{r^2}$, $\boldsymbol{at}\ (\boldsymbol{r} = \mathbf{0.\ 5}, \boldsymbol{\theta} = \mathbf{45}°, \emptyset = \mathbf{60}°)$.

2.8 b. Unit No. II: Magnetostatics

Pre-requisites: - Curl, Magnetic Flux, Magnetic Forces,

Objectives: -

- To introduce concepts of Magnetostatics in electromagnetics and to explain various laws.

Outcomes: -Students will be able to:

- Identify the steady magnetic field, distinguish between the electric and magnetic fields
- Apply various laws of Magnetostatics to solve the problems.
- Solve problems on magnetic boundary conditions.

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Biot-Savart‟s Law, Magnetic field intensity due to infinite long conductor, field of finite length conductor, Problem	T1, T2	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3

2	Ampere's circuital law with proof, Application of Ampere's circuital law to infinite long conductor, coaxial cable, infinite sheet			1.4.1-2 2.1.3-2
3	Problems, curl, $\nabla \times \bar{H} = \bar{J}$ proof, Stokes Theorem, Magnetic flux and magnetic flux density			
4	To find magnetic flux between conductors of coaxial cables, problem, scalar and vector magnetic potential, magnetic forces, problem,			
5	Force on differential current element, magnetic dipole, classification of magnetic materials,			
6	**Application Case Study:** Lightning, Magnetic Resonance Imaging (MRI).			

Question Bank: Theory

CO Mapped: CO1, CO2

Q 1 State and explain the Biot-Savart law with mathematical expression

Q 2 Using Biot-Savart law, find $\bar{H}$ due to infinitely long straight filament current of I amperes.

Q 3 A current filament carrying 15A in the $\hat{z}$ direction lies along the entire z axis. Find $\bar{H}$ in rectangular coordinates at: (a) $P_A(\sqrt{20}, 0, 4)$; (b) $P_B(2, -4, 4)$.

Ans. $0.53\hat{y}$ A/m; $0.477\hat{x} + 0.239\hat{y}$ A/m

Q 4 Using Biot-Savart law, find $\bar{H}$ due to straight conductor of finite length, carrying current of I amperes.

Q 5 Obtain the expression for $\bar{H}$ at the center of a circular conductor carrying current I, using Biot-Savart law.

Q 6 State and prove Ampere's circuital law.

Q 7 Obtain $\overline{H}$ due to infinitely long straight conductor carrying current , using Ampere's circuital law.

Q 8 Obtain $\overline{H}$ due to co-axial cable carrying current I, using Ampere's circuital law.

Q 9 Obtain $\overline{H}$ due to infinite sheet of current using Ampere's circuital law.

Q 10 Express the value of $\overline{H}$ in rectangular components at (0, 0.2, 0) in the field of: (a) a current filament, 2.5 A in the $\hat{z}$ direction at $x = 0.1$, $y = 0.3$; (b) a coax, centered on the z axis, with $a = 0.3$, $b = 0.5$, $c = 0.6$, $I = 2.5$ A in the $\hat{z}$ direction in the center conductor; (c) three current sheets, $2.7\hat{x}$ A/m at $y = 0.1$, $-1.4\hat{x}$ A/m at $y = 0.15$ and $-1.3\hat{x}$ A/m at $y = 0.25$.

Ans. $1.989\hat{x} - 1.989\hat{y}$ A/m; $-0.884\hat{x}$ A/m; $1.3\hat{z}$ A/m

Q 11 Using the concept of curl, obtain the point form of Ampere's circuital law.

Q 12 Calculate the value of vector current density: (a) in rectangular coordinates at $P(2,3,4)$ if $\overline{H} = x^2 z\,\hat{y} - y^2 x\,\hat{z}$; (b) in cylindrical coordinates at $P_B(1.5,90°, 0.5)$ if $\overline{H} = \frac{2}{\rho}(cos0.2\emptyset)\rho$; (c) in spherical coordinates at $P_C(12,30°, 20°)$ if $\overline{H} = \frac{1}{sin\theta}\,\widehat{\theta}$

Ans. $-\mathbf{16}\hat{x} + 9\hat{y} + 16\hat{z}\ A/m^2$; $0.055\hat{z}\ A/m^2$; $\widehat{\emptyset}\ A/m^2$

Q 13 State and explain Stoke"s theorem with its mathematical expression.

Q 14 State and prove the Stoke"s theorem.

Q 15 Evaluate both sides of Stoke"s theorem for the field $H = 6xy\ x - 3y_2 y$ A/m and the rectangular path around the region, $2 \le x \le 5$, $-1 \le y \le 1$, $z = 0$. Let the positive

direction of $d\,S$ be z .

Ans. -126A; -126A

Q 16 A solid conductor of circular cross section is made of a homogeneous nonmagnetic material. If the radius a = 1 mm, the conductor axis lies on the z axis, and the total current in the z direction is 20 A, find: (a) $H_\emptyset\ at\ \rho$ = 0.5 mm; (b) $B_\emptyset\ at\ \rho$ = 0.8 mm; (c) the total magnetic flux per unit length inside the conductor; (d) the total flux for ρ < 0.5 mm; (e) the total magnetic flux outside the conductor.

Ans. 1592 A/m; 3.2 mT; $2\frac{\mu Wb}{m}$; 0.5 μWb; ∞

Q 17 State and explain law of conservation of magnetic flux.

Q 18 Show that the divergence of magnetic flux density is always zero.

Q 19 Obtain the expression for a flux through a co-axial cable carrying direct current I.

Q 20 Explain the relationship between magnetic flux and magnetic flux density.

Q 21 Derive the relationship between the magnetic flux density B and vector magnetic potential A

Q 22 State and explain in brief, scalar and vector magnetic potential.

Q 23 Explain vector magnetic potential A and show that $\nabla.\ \bar{B} = 0$

Q 24 Write short note on Lorentz force equation

Q 25 The point charge Q = 18 nC has a velocity of 5×10^6 m/s in the direction $\bar{v} = 0.6\hat{x} + 0.75\hat{y} + 0.3\hat{z}$. Calculate the magnitude of the force exerted on the charge by the field: (a) $\bar{B} = -3\hat{x} + 4\hat{y} + 6\hat{z}$ mT; (b) $\bar{E} = -3\hat{x} + 4\hat{y} + 6\hat{z}$ kV/m; (c) $\bar{B}\ and\ \bar{E}$ acting together.

Ans. 660 μN; 140 μN; 670 μN

Q 26 Classify different magnetic materials with suitable examples

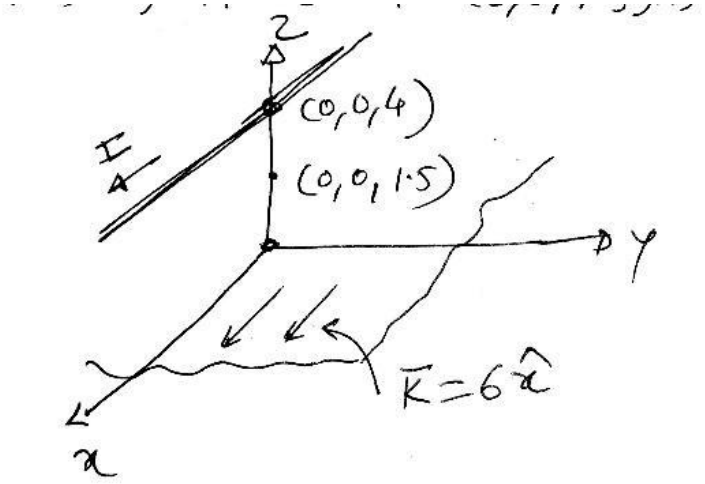
Question Bank: Tutorial

CO Mapped: CO1, CO2

Q. 1 (a) Find $\bar{H}$ in Cartesian components at $(\mathbf{2}, \mathbf{3}, \mathbf{4})$ if there is a current filament on the z-axis carrying 8 mA in the $\hat{\boldsymbol{z}}$ direction. (b) Repeat if the filament is located at $\boldsymbol{x} = -\mathbf{1}$, $\boldsymbol{y} = \mathbf{2}$. (c) Find $\bar{H}$ if both filaments are present.

Q. 2 Two semi-infinite filaments on the z-axis lie in the regions $-\infty < z < -a$ & $a < z < \infty$. Each carries a current in $\boldsymbol{I}$ in $\hat{\boldsymbol{z}}$ direction. (a) Calculate $\bar{H}$ as a function of $\boldsymbol{\rho}$ and $\emptyset$ at $\boldsymbol{z} = \mathbf{0}$. (b) What value of 'a' will cause the magnitude of $\boldsymbol{H}$ at $\boldsymbol{\rho} = \mathbf{1}$, $\boldsymbol{z} = \mathbf{0}$, to be half the value obtained for an infinite element?

Q. 3 A current sheet $\boldsymbol{K} = \mathbf{6}\,\hat{\boldsymbol{x}}\,\boldsymbol{A/m}$, lies in the $\boldsymbol{z} = \mathbf{0}$ plane & a current filament is located at $\boldsymbol{y} = \mathbf{0}$, $\boldsymbol{z} = \mathbf{4}\,\boldsymbol{m}$, as shown in the figure. Determine $\boldsymbol{I}$ and its direction if $\bar{H} = \mathbf{0}$ at (0, 0, 1.5)m



Q. 4 The plane $\boldsymbol{z} = \mathbf{0}$ & $z = 6$ carry current $\boldsymbol{K} = -\mathbf{20}\hat{\boldsymbol{x}}$ A/m & $\boldsymbol{K} = \mathbf{20}\hat{\boldsymbol{x}}$ A/m respectively. Determine

$\bar{H}$ & $\bar{B}$ ($\boldsymbol{\mu_r}$ = **1**) at (a) **1**, **1**, ; (b) (0, -3, 10).

Q. 5 Derive the expression for $\bar{H}$ due to: (a) infinite long conductor; (b) infinite length coaxial cable; (c) infinite sheet of current using Ampere"s Circuital Law.

Q. 6 A cylindrical conductor of radius $\mathbf{10^{-2}}\,\boldsymbol{m}$has an internal magnetic field $\bar{H}$ = **4. 77** × $\mathbf{104}\boldsymbol{r}\mathbf{2}-\boldsymbol{r}\mathbf{23}\times\mathbf{10}-\mathbf{2}\emptyset\boldsymbol{Am}$. Find the current flowing through conductor.

2.8 c. Unit No. III: Boundary Conditions

Pre-requisites:- Energy, capacitance, dipole, dielectric, conductor

Objectives: -

- To explain boundary conditions in electric field, properties of metallic conductors, and use of Laplace's equation to find capacitance.

Outcomes: -Students will be able to

- Explain the conductor properties, apply boundary conditions in electric field
- Determine the capacitance using Laplace's equation.

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Energy density in electrostatic fields, Potential Energy in terms of $\bar{E}$ and $\bar{D}$	T1, T2	CO1, CO2, CO6	1.1.1- 2 1.2.1- 3 1.3.1-3 1.4.1-2 2.1.3-2
2	Metallic conductor, conductor properties, boundary conditions for conductor-free space, boundary conditions for two different dielectric media			
3	Dielectrics, dipole moment, polarization of dielectric, relation between $\bar{E}$ and $\bar{D}$			
4	Capacitance, capacitance of parallel plate, Energy stored in capacitor			

5	Capacitance of coaxial cable, spherical capacitor, parallel plate capacitance multiple dielectrics			
6	Use dLaplace's equation to find the capacitance of parallel plate, coaxial cable, spherical capacitor			
7	Magnetization, magnetic materials, Boundary conditions for Magnetic Fields, Magnetic force, Torque.			
8	**Application Case Study:** RF MEMS, Magnetic Levitation, Electromagnetic Pump.			

Question Bank: Theory

CO Mapped: CO1, CO2

Q 1 Derive the expression for the energy stored per unit volume in an electric field

Q 2 Find the energy stored in free space for the region 2 mm < r < 3 mm, $0 < \theta < 90°$, $0 < \emptyset < 90°$, given the potential field V = : (a) $\frac{200}{r}$ V; (b) $\frac{300cos\theta}{r^2}$ V

Ans. 46.4 μJ; 36.7 J

Q 3 What is an electric dipole

Q 4 Derive the expression of $\bar{E}$ and V due to an electric dipole.

Q 5 What is dipole moment? Derive its expression.

Q 6 An electric dipole located at the origin in free space has a moment $p = 3\hat{x} - 2\hat{y} + \hat{z}$ nC.m

(a) Find $V\ at\ P(2, 3, 4)$. (b) Find $V\ at\ r = 2.5$, $\theta = 30°$, $\emptyset = 40°$.

Ans. 0.23 V; 1.97 V

Q 7 A dipole moment $p = 6\hat{z}$ nC.m is located at the origin in free space. (a) Find $V\ at$ ($r = 4$, θ=20°,$\emptyset$=0°) (b) Find $\bar{E}$ at P.

Ans. 3.17 V; 1.58 r + 0.29θ V/m.

Q 8 Derive the relation between J and ρ_v

Q 9 Current density is given in cylindrical coordinates as $J = -10^6 z^{1.5}\, \hat{z} A/m^2$ in the region $0 \le \rho \le 20\ \mu m$; for $\rho \ge 20\ \mu m$, $J = 0$. (a) Find the total current crossing the surface z = 0.1 m in the z direction. (b) If the charge velocity is $2 \times 10^6 \frac{m}{s}$ $at\ z = 0.1\ m$, find ρ_v there. (c) If the volume charge density at z = 0.15 m is −2000 C/m^3, find the charge velocity there.

Ans. −39.7 μA; −15.8 mC/m^3; 29.0 m/s

Q 10 Given the vector current density $J = 10\rho^2 z\ \hat{\rho} - 4\rho cos^2\emptyset\ \hat{\emptyset}\ mA/m^2$: (a) find the current density at P (ρ = 3, $\emptyset$ = 30°, z = 2); (b) determine the total current flowing outward through the circular band ρ = 3, 0 < $\emptyset$ < 2π, 2 < z < 2.8.

Ans. 180 $\hat{\rho} - 9\ \hat{\emptyset}\ \ mA/m^2$; 3.26 A

Q 11 What is convection current?

Q 12 Prove that convection current density is linearly proportional to the charge density and charge velocity

Q 13 Write the continuity equation and state its significance.

Q14 What is drift current? Obtain the expression of drift current density.

Q15State and explain the point form of Ohm‟s law

Q 16 State the properties of conductor

Q 17 Prove that electric field and electric field intensity are absent in an ideal conductor

Q 18 What is relaxation time? Derive expression for it.

Q 19 Explain the polarization in dielectrics

Q 20 Derive the mathematical expression for the polarization.

Q 21 Write a short note on properties of dielectrics.

Q 22 Derive the boundary conditions for the electric field at an interface between conductor and free space.

Q 23 Explain the capacitance and derive its basic expression.

Q 24 Derive the expression for the capacitance of a parallel plate capacitor with single dielectric

Q 25 Derive the equation of a capacitance of a co-axial cable.

Q 26 Derive the equation of a capacitance of a spherical capacitor

Q 27 Obtain an expression for an energy stored in a parallel plate capacitor.

Q 28 State the Laplace's equation with mathematical expression.

Q 29 Derive the Poisson"s and Laplace's equation from Gauss"s law.

Q 30 State the Laplace's equation in three coordinate systems.

Q 31 State and prove the uniqueness theorem.

Q 32 Using Laplace's equation derive the expression for the capacitance of :

a) Parallel plate capacitor

b) Co-axial cable

c) Spherical capacitor

Q 33 Find the relative permittivity of the dielectric material present in a parallel-plate capacitor if : (a) $S = 0.12\ m^2$, $d = 80\ \mu m$, $V_0 = 12\ V$, and the capacitor contains 1 μJ of energy; (b)

the stored energy density is 100 J/m^3, V_0 = 200 V and d = 45 μm; (c) E = 200 kV/m, ρ_s = 20 $\mu C/m^2$, and d = 100 μm

Ans. 1.05; 1.14; 11.3

Q 34 Derive the boundary condition at an interface between two magnetic medium with permeability μ_1 and μ_2.

Question Bank: Tutorial

CO Mapped: CO1, CO2

Q. 1 Using the Laplace's equation find the capacitance of coaxial cable.

Q. 2 Two perfect dielectrics have relative permittivity $\boldsymbol{\varepsilon_{r1}} = \mathbf{2}$ &$\boldsymbol{\varepsilon_{r2}} = \mathbf{8}$. The planar interface between them is the surface $\boldsymbol{x - y + 2z = 5}$. The origin lies in the region 1. If $\overline{E_1}$ = $\mathbf{100}\hat{\boldsymbol{x}} + \mathbf{200}\hat{\boldsymbol{y}} - \mathbf{50}\hat{\boldsymbol{z}}\ \boldsymbol{V/m}$ then find $\overline{E_2}$.

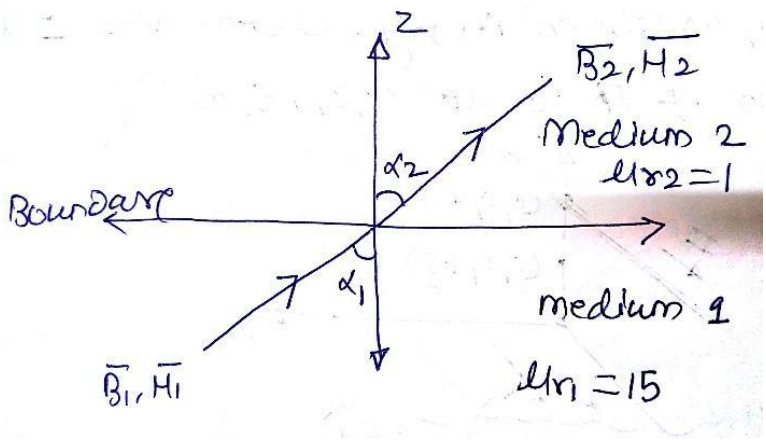
Q. 3 An electric field strength 1.2 V/m is entering a dielectric medium of $\boldsymbol{\varepsilon_R} = \mathbf{4}$ from air. The orientation of $\bar{E}$ in air is $\mathbf{65°}$ with respect to boundary. Determine the orientation of $\bar{E}$ in the dielectric and its strength in the dielectric.

Q. 4 Find the capacitance of the parallel plate capacitor, if the plates are of the area $\mathbf{1.5\ m^2}$, the distance between the plates is 2 mm, potential gradient is $\mathbf{10^5}$ V/m & $\boldsymbol{\rho_s}$ $\boldsymbol{as}$ $\mathbf{2.5}$ μC/m^2

Q. 5 A cylindrical capacitor has radius $\boldsymbol{a} = \mathbf{1}$ & b = 2.6 cm. If the space between the plates is filled with a non-homogeneous dielectric with $\boldsymbol{\varepsilon_r}$ =(10+r)/r , where $\boldsymbol{r}$ is in cms, find the capacitance per meter of the capacitor.

Q. 6 A spherical condenser has a capacity of 54 pF. It consists of two concentric spheres differing in radii by 4 cm & having air as dielectric. Find their radii.

Q. 7 In a region 1, as shown in the figure, $\overline{B_1} = \mathbf{1}.\mathbf{2}\hat{x} + \mathbf{0}.\mathbf{8}\hat{y} + \mathbf{0}.\mathbf{4}\hat{z}\,\boldsymbol{T}$. Determine $\overline{B_2}$ ***and*** $\overline{H_2}$ in other medium & also calculate the angles made by the fields with the normal.



Q 8 Let the permeability be 5 μH/m in region A where $x < 0$, and 20 μH/m in the region B where $x > 0$. If there is a surface current density $K = 150\,\hat{y} - 200\,\hat{z}$ A/m at $x = 0$, and if $\overline{H_A} = 300\hat{x} - 400\hat{y} + 500\hat{z}$ A/m, find: (a) $|\overline{H_{tA}}|$; (b) $|\overline{H_{NA}}|$; (c)$|\overline{H_{tB}}|$; (d) $|\overline{H_{NB}}|$.

Ans. 640 A/m; 300 A/m; 695 A/m; 75 A/m

Q 9 Given the potential field in free space, $V = 100 \sinh 5x \sin 5y$ V, and a point (0.1, 0.2, 0.3), find at P: (a) V; (b) $\bar{E}$; (c) $|\bar{E}|$; (d) ρ_s if it is known that P lies on a conductor surface.

Ans. 43.8 V; $-47\,\hat{x} - 140.8\,\hat{y}\,V/m$; 495 V/m; 4.38 nC/m^2

Q 10 Derive the electrostatic boundary conditions at an interface between two dielectrics.

Q 11 The region with $z < 0$ is characterized by $\varepsilon_{r2} = 2$ and $z > 0$ by $\varepsilon_{r1} = 5$. If $\overline{D_1} = 2\hat{x} +$

$5\hat{y} - 3\hat{z}\ nC/m^2$, find : (a) $\overline{D_2}$; (b) $\overline{D_{N2}}$; (c) $\overline{D_{tan\,2}}$; (d) energy density in each region (e)

The angle that $\overline{D_2}$ makes with z axis.

Ans. $0.8x + 2y - 3z\ nC/m^2$; $-z\ 0.8x + 2y\ nC/m^2$,0.4291 $\mu J/m^3$, 0.3851 $\mu J/m^3$

2.8 d. Unit No. IV:

Time Varying Electromagnetic Fields: Maxwell Equations

Pre-requisites:- All the laws from electrostatics and Magnetostatics from previous 3 units.

Objectives: -

- To introduce time varying fields and to solve electromagnetic problems using Maxwell's equations.

Outcomes: - Students will be able to:

- Explain the fundamentals of time varying electromagnetic fields
- Solve the electromagnetic problems with the use of Maxwell's equations
- Apply the knowledge of electromagnetics to derive uniform plane wave equation.

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Scalar and Vector Magnetic Potential	T1, T2	CO3, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3 1.4.1-2 2.1.2-2 2.1.3-2
2	Faraday's law, Translational and motional emf,			
3	Displacement current density, Continuity Equation			
4	Time varying Maxwell's equations - point form, integral form,			

5	Power and Poynting theorem,			
6	Concept of Retarded magnetic vector potential,			
7	**Application Case Study:** Memristor, Electric Motors, Generators			

Question Bank: Theory

CO Mapped: CO3

Q 1 State Faraday's law and Lenz's law

Q 2 Explain following: (a) Motional e.m.f. (b) Transformer e.m.f.

Q 3 With reference to the sliding bar shown in Figure 1, let d=7 cm, $\bar{B}$=0.3 $\hat{z}$ T, and $\bar{v}$=0.1$\hat{y}e20y$ m/s. Let y=0 at t=0. Find: (a) $v(t=0)$; (b) $y(t=0.1)$; (c) $v(t=0.1)$; (d) $V12\ at\ t$=0.1.

Ans. 0.1 m/s; 1.12 cm; 0.125 m/s; -2.63 mV

Q 4 What is the significance of displacement current?

Q 5 Explain the terms conduction current density and displacement current density.

Q 6 What is displacement current density? Show that it is a quantity introduced to retain the validity of continuity equation.

Q 7 Explain and write expressions for instantaneous, average and complex Poynting vector.

Q 8 Explain inconsistency of Ampere's law. How it is overcome by modifying equation of continuity?

Q 9 State and explain Maxwell's equations for static electric and magnetic fields in both integral and point form.

Q 10 State the Maxwell's equations in point form for static electric and strady magnetic fields. Explain how these are modified for the time varying fields.

Q 11 Obtain the expression for average Poynting vector.

Q 12 Derive the boundary conditions for time varying fields.

Q 13 Explain Poynting vector in point and integral form.

Q 14 Write a note on retarded potential.

Q 15 Write short note on : Retarded potential and its applications.

Q 16 Derive general wave equations. What are Helmholtz equations.

Q 17 State Poynting theorem. Derive the expression for the same. Also explain about Poynting vector.

Question Bank: Tutorial

CO Mapped: CO3

Q 1 Find the amplitude of the displacement current density: (a) adjacent to an automobile antenna where the magnetic field intensity of a FM signal is Hx=0.15cos [3.12(3×108t−y)] A/m; (b) in the air space at a point within a large power distribution transformer where $\bar{B}$=0.8cos [1.257×10−6(3×108t−x)]$\hat{y}$ T; (c) within large, oil-filled power capacitor where εr=5 and $\bar{E}$=0.9cos [1.257×10−6(3×108t−$z\sqrt{5}$)]$\hat{x}$ MV/m; (d) in a metallic conductor at 60 Hz, if ε=ε0,μ=μ0,σ=5.8×107 S/m, and $\bar{J}$=sin(377t−117.1z)$MA/m2$.

Ans. 0.468$Am2$;0.8$Am2$;0.015$Am2$;57.6$pAm2$.

Q 2 In non-magnetic material, $\bar{H}$=30cos (2π×108t−6x)$\hat{}$ A/m. Find the intrinsic impedance and the Poynting vector.

Q 3 Find time average Poynting vector for uniform plane wave where $\bar{E}$=($\hat{x}$+$j\hat{y}$)$ej(kt-\beta z)$ V/m and $\bar{H}$=$k\omega\mu(\hat{y}-j\hat{x})ej(kt-\beta z)$ A/m.

Q 4 The unit vector 0.64$\hat{x}$+0.6$\hat{y}$−0.48$\hat{z}$ is directed from region 2 ($\varepsilon r2$=2,$r2$=3,σ2=0) toward region 1 ($\varepsilon r1$=4,$\mu r1$=2,σ1=0). If $B\bar{1}$=($\hat{x}$−2$\hat{y}$+3$\hat{z}$)$sin300t$ T at point P in region 1 adjacent to boundary, find the amplitude at P of: (a) $BN\bar{1}$; (b) $Bt\bar{1}$; (c) $BN\bar{2}$; (d) $B\bar{2}$.

Ans. 2.00 T; 3.16 T; 2.00 T; 5.15 T

Q 5 Let μ=10−5Hm,=4×10−9Fm,σ=0,and ρv=0. Find k (including units) so that each of the following pairs of fields satisfies Maxwell's equations: (a) $\bar{D}$=6$\hat{x}$−2$y\hat{y}$+2$z\hat{z}$$nCm2$,$\bar{}$=$kx\hat{x}$+10$y\hat{y}$−25$z\hat{z}$ A/m; (b) $\bar{E}$=(20y−kt)$\hat{x}$ V/m, $\bar{H}$=(y+2×106t)$\hat{z}$ A/m.

Ans. 15 $Am2$; −2.5×108$Vm.s$

2.8 e. Unit No. V: Uniform Plane Waves

Pre-requisites: - All the laws from electrostatics and Magnetostatics from previous first four units.

Objectives: -

- To introduce the uniform plane wave equation using the electric and magnetic fields.

Outcomes: -

- Apply the knowledge of electromagnetics to derive uniform plane wave equation.

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Maxwell 's equation using phasor notations,	T1, T2, R2	CO4, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3 1.4.1-2 2.1.2-2 2.1.3-2
2	Electromagnetic wave equations (Helmholtz equation)			
3	Relation between E and H, depth of penetration,			
4	Concept of polarization, Snell's Law			
5	Reflection by perfect conductor-normal incidence,			
6	Reflection by perfect dielectric- normal incidence			
7	**Application Case Study:** Comparison of Circuit Theory at low frequency and Field theory at High frequencies, Antenna Radiation Mechanism, Propagation of EM energy.			

Question Bank: Theory

CO Mapped: CO4

Q1. A uniform plane wave has a wavelength of 2cm in free space and 1 cm in a perfect dielectric (σ = 0, $and\ \mu r \simeq 1$). Determine the relative permittivity of the dielectric.

Q2. A100-V/m plane wave of frequency 300MHz travels in the positive Z direction in a medium having ϵr = 9, μr = 1 and,σ=0. Write the complete time domain expression for field vectors.

Q3 The expression for the instantaneous electric field vector of a uniform plane wave propagating in negative x-direction in a medium is given by $E = y\ 2 \times 103 \exp 2\pi\ 9 \times 1015t + 6 \times 107x\ V/m$ what is (a) The phase velocity of propagation (b) Wavelength of wave (c) Refractive index of medium (d) The direction of the H field.

Q4 According to depth of penetration, what is the percentage proportion of attenuated wave w.r.t its original value?

Q5 The electric field of the incident wave is $\vec{E_i} = E_0 \cos(\omega t - \beta_z)\hat{a}_y$, where ω = 3 x 10^9p and β = 10 p. The electric field of the transmitted wave E_t is given by

Q6 What is the polarization of a wave with electric field vector $\vec{E} = E0e\ (\omega t - \beta z)\ (a\ x + a\ y)$

Question Bank: Tutorial

CO Mapped: CO4

Q1 The electric field of an electromagnetic wave propagating in the positive z – direction is given by $E = \hat{a}x \sin(\omega t - \beta z) + \hat{a}y \sin(\omega t - \beta z + \pi/2)$. Determine the polarization.

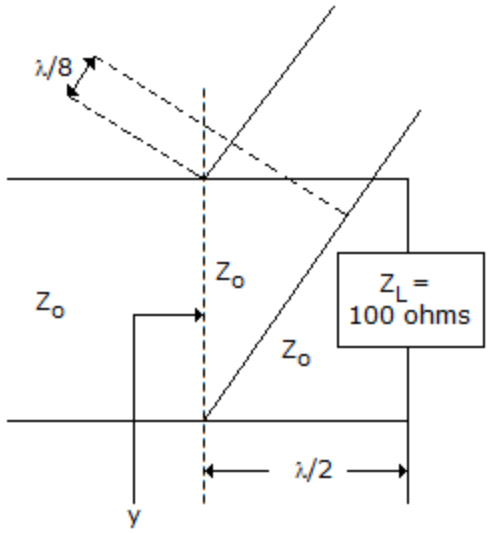
Q2 The electric field of a uniform plane electromagnetic wave in free space, along the positive X direction is given by $\vec{E} = 10(\hat{a}y + j\hat{a}z) - j25x$. Determine the frequency and polarization of the wave.

Q3 If the magnetic field component of a plane wave in a lossless dielectric is H = 50 sin (2π x 10^6 t – 6x) a_z mA/m , what will be the wave velocity?

Q4 A short circuited stub is shunt connected to a transmission line as shown in the figure is, if z_0 = 500 ohms, determine the admittance *y* seen at the function of the stub and the transmission line.

Q5 The depth of penetration of electromagnetic wave in a medium having conductivity σ at a frequency 1 KHz is 25 cm. Obtain the depth of penetration at a frequency of 4 KHz

Q6 The magnetic field intensity vector of a plane wave is given by $\vec{H}(x, y, z,) = 10 \sin(50000t + 0.004x + 30)\hat{a}y\ where\ \hat{a}y$ denotes the unit vector in y direction. Find the phase velocity.



Q7 The electric field of a uniform plane electromagnetic wave in free space, along the positive X direction is given by $\vec{E}$ = 10($\hat{a}y + j\hat{a}z$) $-j25x$. Determine the frequency and polarization of the wave.

2.8 f. Unit No.VI: Transmission Line Theory

Pre-requisites: - Transmission lines fundamentals.

Objectives: -

- To explain parameters like SWR, reflection coefficient, find the impedance transformation relation in term of reflection coefficient
- To explain the transmission line parameters using Smith chart
- To explain impedance matching techniques like stub matching, quarter wave transformer, etc.

Outcomes: -

- Analyze the transmission line problem, use the Smith chart to calculate transmission line parameters
- Use the Smith chart to solve stub matching problems

Lect. No.	Details of the Topic to be covered	References	CO Mapped	PI Mapped
1	Line parameters, skin effect, general solution, physical significance of the equations, wavelength	T1, T2, R1	CO5, CO6	1.1.1- 2 1.2.1 – 3 1.3.1-3

2	velocity of propagation, the distortion less line, Reflection on a line not terminated in Z0, reflection coefficient, open and short-circuited lines,			1.4.1-2 2.1.2-2 2.1.3-2
3	reflection factor and reflection loss, standing waves; nodes; standing wave ratio, Input impedance of dissipation less line			
4	Input impedance of open- and short-circuited lines			
5	Power and impedance measurement on lines			
6	Reflection losses on the unmatched Load			
7	Problems solving using Smith chart.			
8	**Application Case Study:** Coaxial Cable, Twisted Pair, Microwave Waveguides			

Question Bank: Theory

CO Mapped: CO5

Q 1 Explain briefly about the line constants of zero dissipation line. Derive expression for $Z0,,\alpha,\beta$.

Q 2 Derive the relationship between standing wave ratio and reflection coefficient

Q 3 Show that the reflection coefficient $|\Gamma|=|Vmax|-|Vmin||Vmax|+|Vmin|$

Q 4 Derive the expression for input impedance of a dissipation less line in terms of reflection coefficient.

Q 5 Discuss the theory of open and short circuited lines with voltage and current distribution diagrams and also get the input impedance expression

Q 6 Write short note on quarter wave transformer.

Q 7 Show that "the half wave line repeats its terminating impedance "

Q 8 Derive the expressions for the constant resistance and constant reactance circles in Smith circle diagram.

Q 9 Explain briefly properties of Smith chart.

Q 10 A load impedance ZL=30+j60 Ω is connected to a 50 Ω transmission line of 2 cm length and operated at 2 GHz. Using Smith chart find the input impedance Zin under the assumption that the phase velocity is 50 % of the

speed of the light.

Q 11 A load of ZL=100+j50 Ω terminates a 50 Ω line. What are the load admittance and input admittance if the line is 0.15λ long? Also find VSWR.

Question Bank: Tutorial

CO Mapped: CO5

Q. 1 A load impedance ZL=30+j60 Ω is connected to a 50 Ω transmission line of 2 cm length and operated at 2 GHz. Using Smith chart find the input impedance Zin under the assumption that the phase velocity is 50 % of the speed of the light.

Q. 2 A load of ZL=100+j50 Ω terminates a 50 Ω line. What are the load admittance and input admittance if the line is 0.15λ long? Also find VSWR.

Q. 3 A 75 Ω lossless transmission line is to be matched with a 100−j80 Ω load using single stub. Calculate the single stub length & its distance from load corresponding to frequency to frequency of 30 MHz using Smith chart.

Q 4 A 75 Ω lossless transmission line is to be matched with a 100−j80 Ω load using single stub. Calculate the single stub length & its distance from load corresponding to frequency to frequency of 30 MHz using Smith chart.

3.Name of the Course: Database Management-304183

Weekly Work Load(in Hours)	Lecture	Tutorial	Practical
	3	-	2

Online/ In-sem	End Sem Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	25	-	125	4

3.1 Syllabus

Unit I: Introduction to DBMS **7L**

Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, Data Abstraction and Database System Structure. Relational Model: Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus. Entity-Relationship model: Basic Concepts, Entity Set, Relationship Sets and Weak Entity Sets, Mapping Cardinalities, Keys, E-R diagrams, Design Issues, Extended E-R Features, Converting E-R & EER diagram into tables.

Unit II: **Relational Database Design** **6L**

Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, 4NF and BCNF.

Unit III: Basics of SQL **7L**

DDL, DML, DCL, Structure: Creation, Alteration, Defining constraints – Primary key, Foreign key, Unique key, Not null, Check, IN operator, Functions - Aggregate Functions, Built-in Functions – Numeric, Date, String Functions, Set operations, sub-queries, correlated subqueries, Use of group by, having, order by, join and its types, Exist, Any, All, view and its types. Transaction control commands: Commit, Rollback, Save-point PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers.

Unit IV: Database Transactions Management **7L**

Basic concepts of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlock handling and Time-stamp based Protocols.

Unit V: Parallel Databases **6L**

Introduction to Database Architectures: Multi-user DBMS Architectures, Case study- Oracle Architecture. Parallel Databases: Performance Parameters for Parallel Databases, Types of Parallel

Database Architecture, Evaluating Parallel Query in Parallel Databases and Virtualization on Multicore processors.

Unit VI: Distributed Databases **7L**

Distributed Databases: Distributed Database Management System, Factors Encouraging DDBMS, Advantages of Distributed Databases, Types of Distributed Databases, Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, and Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database.

3.2 Course Objectives

- To discuss fundamental concepts of database design.
- To illustrate fundamental concepts of relational database management.
- To demonstrate database manipulation using SQL Query for create, update and manage.
- To explain basic issues of transaction processing and concurrency control.
- To describe Parallel and Distributed Databases Architecture and their Applications.

3.3 Course Outcomes

- **CO1:** Explain fundamental concepts of database design and ER Model. (Unit –I) (BTL- 2, Understand)
- **CO2**: Design Relational Databases using Data Models. (Unit –II) (BTL- 3, Apply)
- **CO3**: Illustrate Database Queries using PL/SQL (Unit-III) (BTL- 3, Apply)
- **CO4**: Describe transaction management and Concurrency control concept (Unit-IV) (BTL-2 Understand)
- **CO5**: Discuss different Database Architectures. (Unit V & Unit VI) (BTL-2 Understand)

3.4 Textbooks

1. A. Silberschatz, H.F. Korth and S. Sudarshan , “Database System Concepts”, McGraw Hill, 6th Edition.
2. C.J. Date, A. Kannan, S. Swamynathan “An introduction to Database Systems”, Pearson, 8th Edition.

3.5 Reference

1. Martin Gruber, “Understanding SQL”, Sybex Publications.
2. Ivan Bayross, “SQL- PL/SQL”, BPB Publications, 4th Edition.
3. S.K. Singh, “Database Systems: Concepts, Design and Application”, Pearson, Education, 2nd Edition.

3.6 Reference Web Links/ Research Paper/ Referred Book other than Mentioned in Syllabus:

MOOC / NPTEL Courses:

1. **NPTEL Course “ Database Management System”:**
   https://nptel.ac.in/courses/106/106/106106220/

3.7 Teaching Plan

S.NO	Unit	Broad Topic to be covered	Total Lectures Planned	CO Mapped	PI Mapped
1	I	Introduction to DBMS	7L	CO1	1.3.1 2.1.1 2.1.2 2.1.3
2	II	Relational Database Design	6L	CO2	1.3.1 2.1.1 2.1.2 2.1.3 2.4.2
3	III	Basics of SQL	7L	CO3	1.3.1 2.1.1 2.1.2 2.1.3
4	IV	Database Transactions Management	7L	CO4	1.3.1 2.1.1 2.1.2 2.1.3
5	V	Parallel Databases	6L	CO5	1.3.1 2.1.1 2.1.2 2.1.3
6	VI	Distributed Databases	7L	CO5	1.3.1 2.1.1 2.1.2 2.1.3

HOUR WISE PLAN

Sr.	Content of the topic	References
	Unit I: **Introduction to DBMS**	T1
1.	Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications,	
2.	Data Abstraction and Database System Structure.	
3.	Relational Model: Structure of relational databases, Domains, Relations	
4.	Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus	
5.	Entity-Relationship model: Basic Concepts, Entity Set, Relationship Sets and Weak Entity Sets,	
6.	Entity-Relationship model: Mapping Cardinalities, Keys, E-R diagrams, Design Issues,	
7	Entity-Relationship model: Extended E-R Features, Converting E-R & EER diagram into tables.	
	Unit II: Relational Database Design	T1,R3
1.	Basic concepts, CODD's Rules, Relational Integrity: Domain, Atomic Domains	
2.	Referential Integrities, Enterprise Constraints,	
3.	Database Design: Features of Good Relational Designs, Normalization,	
4.	First Normal Form, Decomposition using Functional Dependencies,	
5.	Algorithms for Decomposition, 2NF, 3NF,	
6.	4NF and BCNF.	
	Unit III: Basics of SQL	**R1, R2**
1.	DDL, DML, DCL, Structure: Creation, Alteration, Defining constraints	
2	Primary key, Foreign key, Unique key, Not null, Check, IN operator,	
3	Functions - Aggregate Functions, Built-in Functions –Numeric, Date, String Functions,	
4	Set operations, sub-queries, correlated subqueries,	
5	Use of group by, having, order by, join and its types, Exist, Any, All, view and its types.	
6	Transaction control commands: Commit, Rollback, Save-point	
7	PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers.	
	Unit IV: Database Transactions Management	T1

1.	Basic concepts of a Transaction, Transaction Management, Properties of Transactions,	
2.	Concept of Schedule, Serial Schedule,	
3.	Serializability: Conflict and View, Cascaded Aborts,	
4.	Recoverable and Non recoverable Schedules,	
5.	Concurrency Control: Need, Locking Methods,	
6.	Deadlock handling and Time-stamp based Protocols.	
7.		
	Unit V: Parallel Databases	R3
1.	Introduction to Database Architectures: Multi-user DBMS Architectures,	
2	Case study- Oracle Architecture	
3.	Parallel Databases: Performance Parameters for Parallel Databases,	
4.	Types of Parallel Database Architecture,	
5	Evaluating Parallel Query in Parallel Databases	
6	Virtualization on Multicore processors.	
	Unit VI: Distributed Databases	R3
1.	Distributed Databases: Distributed Database Management System, Distributed Data Storage	
2.	Factors Encouraging DDBMS, Advantages of Distributed Databases,	
3.	Types of Distributed Databases, Architecture of Distributed Databases,	
4.	Distributed Database Design,	
5.	Distributed Transaction: Basics, Failure modes	
6.	Commit Protocols, Concurrency Control in Distributed Database.	
7.		

3.8. Unit wise Lecture Plan

3.8 a. Unit No.-I Introduction to DBMS

Pre-requisites: -

1. Data Structures, Object Oriented Programming

Objectives: -

1. To discuss fundamental concepts of database design.

Outcomes: -

CO1: Explain fundamental concepts of database design and ER Model. (Unit –I) (BTL- 2, Understand)

Program Indicators:

1.3.1 Apply fundamental engineering concepts to solve engineering problems
2.1.1 Articulate problem statements and identify objectives
2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1.	Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications,	T1
2.	Data Abstraction and Database System Structure.	
3.	Relational Model: Structure of relational databases, Domains, Relations	
4.	Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus	
5.	Entity-Relationship model: Basic Concepts, Entity Set, Relationship Sets and Weak Entity Sets,	
6.	Entity-Relationship model: Mapping Cardinalities, Keys, E-R diagrams, Design Issues,	
7.	Entity-Relationship model: Extended E-R Features, Converting E-R & EER diagram into tables.	

Unit -I Question Bank: Theory

Theory Questions-CO1

PI Mapped: 1.3.1,2.1.1,2.1.2,2.1.3

Q. 1	Explain advantages of DBMS over normal file system in detail.
Q. 2	Explain in detail different levels of abstraction.
Q. 3	Explain need of view.
Q. 4	Explain components and overall structure of DBMS.
Q. 5	What is relational model.
Q. 6	Write advantages of relational model.
Q. 7	Explain structure of relational databases.

Q. 8	Explain data structure of relational databases.
Q.9	What is relational algebra? List and explain fundamental and additional relational algebra operators.
Q. 10	Explain projection operation of relational algebra with example.
Q. 11	Explain selection operation of relational algebra with example.
Q. 12	Explain union operation of relational algebra with example.
Q. 13	Write note on extended operators of relational algebra with example.
Q. 14	Write a short note on tuple relational calculus
Q. 15	How does the concept of object in object oriented model differ from the concept of an entity in entity relation model.
Q.16	What is meant by mapping cardinality? Explain different types of cardinalities for a binary relation with example.
Q.17	Explain difference between primary key ,candidate key and super key.
Q.18	Explain extended ER features Specialization, Generalization and aggregation with example and diagarms.
Q.19	Explain how ER diagrams are converted into tables.
***HOT**	
Q. 20	**Draw an ER diagram for online book shop which consist of entity set,attribute, relationship, mapping cardinality and keys, it will maintain information about all customers ,books ,author , publisher, billing etc.**
Q. 21	**Construct an ER diagram for a car insurance company that has set of customers each of whom owns one or more cars. Each car has associated with it zero to any number of recorded accidents.**
Q. 22	**Construct an ER diagram for banking database system. Consider various entities such as account ,customer,branch, loan,Deposit,borrower, etc. Design Sepcialization and Generalization EER features.**

3.8 b. Unit No.-II Relational Database Design

Pre-requisites: -

1. Data Structures, Object Oriented Programming

Objectives: -

- 1. To illustrate fundamental concepts of relational database management.

Outcomes: -

- **CO2.: Design** Relational Databases using Data Models. (Unit –II) (BTL- 3, Apply)

Program indicators :

1.3.1 Apply fundamental engineering concepts to solve engineering problems
2.1.1 Articulate problem statements and identify objectives
2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models

Lecture No.	Details of the Topic to be covered	References
1.	Basic concepts, CODD's Rules, Relational Integrity: Domain, Atomic Domains	T1,T3
2.	Referential Integrities, Enterprise Constraints,	
3.	Database Design: Features of Good Relational Designs, Normalization,	
4.	First Normal Form, Decomposition using Functional Dependencies,	
5.	Algorithms for Decomposition, 2NF, 3NF,	
6.	4NF and BCNF.	

Question Bank:

Theory Questions-CO2

PI Mapped : 1.3.1, 2.1.1,2.1.2,2.1.3,2.4.2

Q. 1	Explain in details CODD's Rule.
Q. 2	How data integrity problem is handled with DBMS.
Q. 3	Explain the need of foreign key.
Q. 4	Differentiate between foreign key constraint and primary key constraint.
Q. 5	Explain basic elements of database design process.
Q. 6	Define database normalization. Explain all the normal forms with suitable example.
Q.7	Explain the concept of functional dependency and its types with suitable examples
Q. 8	Write short note on : multivalued dependency.

Q. 9	Describe concept of transitive dependency.
Q. 10	State and prove Armstrong's axioms for functional dependency.
Q. 11	What do we mean by "Decomposition"? what are the desirable properties of it? How can we implement them?
Q. 12	Explain 3NF with suitable example.
Q. 13	Define BCNF.
Q. 14	Differentiate between BCNF and 3NF. Also explain how it is stronger than 3NF.
Q.15	Explain why 4NF is more desirable than BCNF. Rewrite the definition of 4NF and BCNF using the notions of domain constraints and general constraints.
***HOT**	
Q. 16	Consider a relation scheme R = (A, B, C, D, E, H) on which the following 1 functional dependencies hold: {A–>B, BC–> D, E–>C, D–>A}. Write the candidate keys of R?
Q. 17	Show that: if $\alpha \rightarrow \beta$ and $\alpha \rightarrow \gamma$ then $\alpha \rightarrow \beta\gamma$
Q. 18	Relation R(A,B,C,D,E,F,G,H,I,J). Having following set of FD, Decompose it in 2NF and 3NF.

3.8 c. Unit No.-III- Basics of SQL

Pre-requisites: -

1. Data Structures, Object Oriented Programming

Objectives: -

- 1. To demonstrate database manipulation using SQL Query for create, update and manage.

Outcomes: -

- **CO3**: **Illustrate** Database Queries using PL/SQL (Unit-III) (BTL- 3, Apply)

Program Indicators :

1.3.1 Apply fundamental engineering concepts to solve engineering problems
2.1.1 Articulate problem statements and identify objectives
2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1.	DDL, DML, DCL, Structure: Creation, Alteration, Defining constraints	R1,R2
2.	Primary key, Foreign key, Unique key, Not null, Check, IN operator,	
3.	Functions - Aggregate Functions, Built-in Functions – Numeric, Date, String Functions,	
4.	Set operations, sub-queries, correlated subqueries,	
5.	Use of group by, having, order by, join and its types, Exist, Any, All, view and its types.	
6.	Transaction control commands: Commit, Rollback, Save-point	
7.	PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers.	

Unit -2 Question Bank:

Theory Questions-CO3

PI Mapped: 1.3.1,2.1.1,2.1.2,2.1.3

Q. 1	Explain role of SQL with example.
Q. 2	Explain data types in SQL.
Q. 3	Explain create,alter,drop,rename,truncate and desc commands with example.
Q. 4	List DML commands.
Q. 5	Explain constraints in RDBMS.
Q. 6	Why domain integrity is important in a database
Q. 7	Explain not null constraints with suitable example.
Q. 8	Describe entity relational constraints and referential integrity.
Q. 9	Write syntax of inser command ,demonstrate with suitable example.
Q.10	Describe how to delete data from table with an example.
Q. 11	Write note on DCL.
Q. 12	Write syntax of Grant privileges.
Q. 13	Write short note on revoking of privileges.
Q. 14	Explain select clause with syntax.

Q. 15	Explain order by clause with syntax.
Q.16	Explain where clause.
Q.17	Explain range searching operator “BETWEEN”
Q.18	Explain pattern matching operator “LIKE”
Q.19	Explain set operations with example.
Q.20	Explain SQL data types and literals.
Q 21	Explain index objects in SQL
Q22	Explain following string handling functions. Length(), upper(),lower(),replace(),concat()
Q23	Explain string function ltrim()
Q24	Explain following functions with example 1. Abs 2. Pow 3. Sqrt 4 round() 5. Month() year() now()
Q25	What are the different types of joins in SQL ? explain with suitable example.
Q26	Elaborate different types of subqueries
Q27	Explain view objects in SQL with examples
	***HOT**
Q. 28	**Consider following relations** **Instructor(ID,name,dept name)** **Student (ID,dept name,tot cred)** **Takes (ID,course-id,sec-id, semester,year)** **Course(course-id ,title,dept-name,credits)** **Dept (dept-id, dept-name)** **Design above relatin using SQL DDL statement ,primary and foreign key.**
Q.29	**Consider following relations** **Supplier (sid,sname,addr)** **Part(pid,Pname,color)** **Catalog (sid,pid,cost)** **Write SQL queries for following requirements** **1. Find name of all parts whose color is green** **2. Find name of suppliers who supply some red parts** **Find name of all parts whose cost is more than rs 25**

3.8 d. Unit No.-IV- Database Transactions Management

Pre-requisites:-

1. Data Structures, Object Oriented Programming

Objectives:-

- 1. To explain basic issues of transaction processing and concurrency control.

Outcomes: -

- **CO4**: **Describe** transaction management and Concurrency control concept (Unit-IV) (BTL-2 Understand)

Program Indicators:

1.3.1 Apply fundamental engineering concepts to solve engineering problems
2.1.1 Articulate problem statements and identify objectives
2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1.	Basic concepts of a Transaction, Transaction Management, Properties of Transactions,	**T1**
2.	Concept of Schedule, Serial Schedule,	
3.	Serializability: Conflict and View, Cascaded Aborts,	
4.	Recoverable and Non recoverable Schedules,	
5.	Concurrency Control: Need, Locking Methods,	
6.	Deadlock handling and Time-stamp based Protocols.	
7.	Deadlock handling and Time-stamp based Protocols.	

Question Bank: Theory

PI Mapped: 1.3.1,2.1.1,2.1.2,2.1.3

Q. 1	Explain read and write operations of Transactions
Q. 2	Explain states of Transaction.
Q. 3	What are ACID properties of a transactions.
Q. 4	Write an example of implement atomicity,consistency,isolation and durability.
Q. 5	Explain commit and roll back operations of transaction.
Q. 6	Write note on schedule.
Q. 7	Explain serial execution**.**
Q. 8	Explain concurrent execution.
Q. 9	Explain advantages of concurrent execution of transactions.
Q.10	Write a note on problems occurred in concurrent execution of transaction.
Q. 11	Explain the term : serializability.
Q. 12	Explain types of serializability.
Q. 13	Explain recoverability.
Q. 14	Explain concurrency control in distributed database.
Q. 15	Explain different types of Locking Methods.
Q. 16	Explain different two phase locking protocols in transaction management.
Q. 17	Explain the time stamp based concurrency control.
Q. 18	Explain the optimistic concurrency control.
Q.19	When deadlock occurs? How to prevent it? How to recover if deadlock occurs?
Q. 20	Write note on failure classification.
Q. 21	Explain storage structure in recovery system.

Q. 22	Write note on recovery and atomicity.
Q. 23	Explain log based recovery scheme
Q. 24	Write note on Check Points.
Q. 25	Write note on Shadow Paging
Q. 26	Describe the ARIES recovery algorithm with example.
	**HOT
Q.27	Suppose that there is a database system that never fails. Analyze whether a recovery manager required for this system?
Q.28	Analyze which of the following concurrency control protocols ensure both 2 conflict serializability and freedom from deadlock? Explain the following: App y 7 a. 2-phase locking b. Time-stamp ordering Consider the transactions T1, T2, and T3 and the schedules S1 and S2 given below. T1: r1(X);r1(Z);w1(X);w1(Z) T2: r2(Y);r2(Z);w2(Z) T3: r3(Y);r3(X);w3(Y) 3 S1: r1(X);r3(Y);r3(X);r2(Y);r2(Z); w3(Y);w2(Z);r1(Z);w1(X);w1(Z) S2: r1(X); r3(Y); r2(Y); r3(X); r1(Z); r2(Z); w3(Y); w1(X); w2(Z); w1(Z) Analyze which one of the schedules is conflict-serializable?

3.8 e. Unit No.-V Parallel Databases

Pre-requisites: -

1. Data Structures, Object Oriented Programming

Objectives: -

- 1. To describe Parallel and Distributed Databases Architecture and their Applications.

Outcomes: -

- **CO5**: **Discuss** different Database Architectures. (Unit V & Unit VI) (BTL-2 Understand)

Program Indicators:
1.3.1 Apply fundamental engineering concepts to solve engineering problems
2.1.1 Articulate problem statements and identify objectives
2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1.	Introduction to Database Architectures: Multi-user DBMS Architectures,	R3
2	Case study- Oracle Architecture	
3	Parallel Databases: Performance Parameters for Parallel Databases,	
4	Types of Parallel Database Architecture,	
5	Evaluating Parallel Query in Parallel Databases	
6	Virtualization on Multicore processors.	

Question Bank: Theory

PI Mapped: 1.3.1,2.1.1,2.1.2,2.1.3

Q. 1	Explain various multi-user DBMS architectures
Q. 2	Explain client server architecture with suitable database application.
Q. 3	Explain two -tier architecture
Q. 4	Explain three -tier architecture
Q. 5	Explain three-tier web architecture with diagram for online shopping database system.
Q. 6	Write short note on centralized database system.
Q. 7	Describe Oracle Database Architecture.
Q. 8	Explain speedup and scaleup attributes in parallel database architecture.
Q. 9	Explain different factors affecting the speedup and scale-up attributes.
Q.10	Explain parallel database architectures in detail.
Q. 11	Explain shared nothing parallel database system architecture.
Q. 12	Explain parallel query in parallel databases.
Q. 13	Write short note on : Virtualization on multicore processors.
	****HOT**

Q. 14	**Is a multiuser system necessarily a parallel system? Why or why not?**
Q. 15	**Is it wise to allow a user process to access the shared-memory area of a database system? Explain your answer.**
Q.16	**In a shared-memory architecture, why might the time to access a memory location vary depending on the memory location being accessed?**

3.8 f. Unit No.-VI Distributed Databases

Pre-requisites: -

1. Data Structures, Object Oriented Programming

Objectives: -

- 1. 1. To describe Parallel and Distributed Databases Architecture and their Applications.

Outcomes: -

- **CO5**: **Discuss** different Database Architectures. (Unit V & Unit VI) (BTL-2 Understand)

Program Indicators:

- 1.3.1 Apply fundamental engineering concepts to solve engineering problems
- 2.1.1 Articulate problem statements and identify objectives
- 2.1.2 Identify engineering systems, variables, and parameters to solve the problems
- 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1.	Distributed Databases: Distributed Database Management System, Distributed Data Storage	R3
2	Factors Encouraging DDBMS, Advantages of Distributed Databases,	
3.	Types of Distributed Databases, Architecture of Distributed Databases,	
4.	Distributed Database Design,	
5	Distributed Transaction: Basics, Failure modes	
6	Commit Protocols, Concurrency Control in Distributed Database.	

Question Bank:

Theory Questions-CO5

PI Mapped: 1.3.1,2.1.1,2.1.2,2.1.3

Q. 1	Write short on distributed database.
Q. 2	Enlist advantages and disadvantages of distributed database system architecture?
Q. 3	Compare homogeneous and heterogeneous distributed systems.
Q. 4	Explain homogeneous and heterogeneous distributed systems.
Q. 5	Explain distributed database system architectures.
Q. 6	Explain data replication and data fragmentation in distributed data storage.
Q. 7	Write note on : failure modes in distributed databases.
Q. 8	How concurrency problem can be resolved in distributed databases.
Q. 9	Explain Commit protocol in detail.
Q.10	Describe concurrency control in distributed databases.
	***HOT**
Q. 15	Why is it easier for a distributed file system such as GFS or HDFS to support replication than it is for a key-value store?
Q. 16	Explain parallel vs distributed technology.

Practical Session

Course Objectives:

1. To illustrate SQL Queries.
2. To demonstrate block of PL/SQL Commands.
3. To describe database connectivity using front end tool(PHP/Python/Java) and different navigation operations.
4. To explain process of software application development (mini project).

Course Outcomes:

At the end of the Course Students will be able to:

1. Implement SQL commands for database creation. (Bloom's Level 3: Apply) (Experiment 1-5)
2. Execute PL/SQL blocks for different application. (Bloom's Level 3: Apply) (Experiment 6-9)
3. Implement database connectivity and navigation operations. (Bloom's Level 3: Apply) (Experiment 10)
4. Design Database using different phases of software development life cycle for various applications. (Bloom's Level 6 : create) (Experiment- 11)

3.9 List of Practicals

S. N	Practical	CO Mapped	PI Mapped
1	Study of Open-Source Relational Databases: MySQL	CO1	2.1.2 2.1.3 2.4.2 5.1.1 5.1.2 5.2.2
2	Design and develop at SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence and Synonym.	CO1	
3	Design and develop at least 5SQL queries for suitable database application using SQL DML statements: Insert and Select with operators and functions.	CO1	
4	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: Update and Delete with operators and functions.	CO1	
5	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: all types of Join and Sub-Query.	CO1	
6	Write a PL/SQL block to calculate fine for a library book by accessing borrower information from the database.	CO2	
7	Write a PL/SQL block to create cursor to copy contents of one table into another. Avoid redundancy.	CO2	
8	Write a PL/SQL block using Procedures and Functions.	CO2	
9	Write a PL/SQL block to create trigger on Library table to keep track of updation and deletion of records.	CO2	
10	Implement MYSQL/Oracle database connectivity with PHP/python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.	CO3	
11	Mini Project	CO4	9.1.2 9.2.1 9.2.2 9.2.3 9.2.4 10.2.2

			10.3.1 10.1.3

Oral Questions

PI Mapped: 2.1.2, 2.1.3,2.4.2

Sr.No.	Questions	CO Addressed
1	What is MySQL?	CO1
2	What is the default port for MySQL Server?	
3	What are the advantages of MySQL when compared with Oracle?	
4	Difference between CHAR and VARCHAR?	
5	What is the difference between primary key and candidate key?	
6	What is a foreign key?	CO1
7	What is a View?	
8	What is an Index?	
9	What are all the different types of indexes?	
10	What is a Cursor?	
11	What happens when the column is set to AUTO INCREMENT and if you reach maximum value in the table?	
12	How can you see all indexes defined for a table? Indexes are defined for the table by:	
13	What do you mean by % and _ in the LIKE statement?	
14	What is the difference between NOW() and CURRENT_DATE()?	CO2
15	What is a JOIN?	
16	Different types of joins?	
17	What is subquery?	

18	What is a trigger in MySQL?	
19	How many Triggers are possible in MySQL?	
20	What is PL/SQL?	
21	Explain the purpose of %TYPE and %ROWTYPE data types with the example?	
22	What do you understand by PL/SQL cursors?	
23	Explain cursor types?	
24	Explain the difference in execution of triggers and stored procedures?	
25	Why is group-clause used?	
26	What is JSON? Explain?	
27	What is meant by JSON objects?	
28	Explain JSON syntax rules?	
29	What are the advantages of JSON over XML?	
30	Define Database.	
31	What is DBMS?	
32	What are the various kinds of interactions catered by DBMS?	
33	Segregate database technology's development.	
34	Who proposed the relational model?	
35	What are the features of Database language?	CO1
36	What do database languages do?	
37	Define database model	
38	What is SQL?	
39	Enlist the various relationships of database.	
40	Define Normalization.	CO1
41	Enlist the advantages of normalizing database.	

42	Define Denormalization.	
43	Define DDL and DML.	
44	Enlist some commands of DDL	CO2,CO1
45	Define Union All operator and Union.	
46	Define cursor.	
47	Enlist the cursor types.	
48	Why is group-clause used?	
49	Compare Non-clustered and clustered index	
50	Define Aggregate functions.	
51	Define Scalar functions.	
52	What restrictions can you apply when you are creating views?	
53	Define “correlated subqueries”.	
54	Define Join and enlist its types.	
55	What do you mean by Index hunting?	
56	What are the advantages of MySQL when compared with Oracle?	
57	Difference between CHAR and VARCHAR?	
58	Give string types available for column?	
59	How to get current MySQL version	
60	What are the drivers in MySQL?	
61	What does a TIMESTAMP do on UPDATE CURRENT_TIMESTAMP data type?	
62	What is the difference between primary key and candidate key?	
63	What, if a table has one column defined as TIMESTAMP?	
64	What happens when the column is set to AUTO INCREMENT and if you reach maximum value in the table?	

65	How can we find out which auto increment was assigned on Last insert?	
66	How can you see all indexes defined for a table?	
67	What is the difference between NOW() and CURRENT_DATE()?	
68	What is a trigger in MySQL?	
69	How many Triggers are possible in MySQL?	
70	What is the difference between TRUNCATE and DELETE in MySQL?	
71.	Explain what is JDBC?	CO3
72.	What is PHP?	CO3
73.	What is ODBC?	CO3

4.Name of the Course – Microcontrollers

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	3 Hrs/ Week	--	2 Hrs/Week

Online/In-sem	Theory	Practical	Term-work	Total Marks	Credit
30 marks	70 marks	50 marks	-	50 marks	TH/TW – 3, PR+OR - 1

4.1Syllabus

Unit I: Introduction to Microcontroller Architecture (6L)
Difference between microprocessor and microcontroller Introduction to the Microcontroller classification, Feature and block diagram of 8051 and explanation, Program Status Word (PSW), 8051. Overview of Instruction set, memory organization, Interrupt structure, timers and its modes, Serial communication: concept of baud rate, Data transmission and reception using Serial port. Sample programs of data transfer, Delay using Timer (0&1) and interrupt, Data transmission and reception using Serial port. I/O Port Programming, All programs in C language.

Unit II: IO Port Interfacing-I (6L)
Pin diagram and its functioning Port structure, IO Interfacing Requirements, Interfacing of: LEDS, Keys, 7- segment multiplexed display, DAC 0808, ADC 0809 Stepper motor, Relay, Buzzer, Opto-isolators, \ Design of Data acquisition System (DAS): All programs in C language

Unit III: PIC 18F XXXX Microcontroller Architecture (6L)
Comparison of PIC family, Criteria for Choosing Microcontroller, features, PIC18FXX architecture with generalized block diagram. MCU, Program and Data memory organization, Bank selection using Bank Select Register, Pin out diagram, Reset operations, Watch Dog Timers, Configuration registers and oscillator options (CONFIG), Power down modes, Brief summary of Peripheral support, Overview of instruction set.

Unit IV: Peripheral Support in PIC 18FXXXX (6L)
Timers and its Programing (mode 0 &1), Interrupt Structure of PIC18F with SFR, PORTB change Interrupts, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using ADC: All programs in embedded C.

Unit V: Real World Interfacing with PIC18FXXXX (6L)
Port structure with programming, Interfacing of LED, LCD and Key board, Motion Detectors, DAC for generation of waveform, Design of PIC test Board and debugging, Home protection System: All programs in embedded C

Unit VI: Serial Port Programming interfacing with 18FXXXX (6L)

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI & I2C), USART (Receiver and Transmitter), interfacing of RTC (DS1307) with I2C and EEPROM with SPI. Design of Traffic Light Controller; All programs in embedded C.

4.2 Course Objectives

1. To explain architecture and features of typical Microcontroller 8051 and PIC 18F.
2. To explain interfacing of real world peripheral devices with microcontroller 8051 and PIC 18F.
3. To discuss the serial communication details and interfacing with microcontroller.

4.3 Course Outcomes

At the end of the course the Student will be able to:

1. Describe the architecture and features of Microcontroller 8051. (U1) (BTL – 2, Understand)
2. Develop interfacing of various electronic components/ devices with Microcontroller 8051. (U2) (BTL – 6, Create)
3. Discuss the architecture and features of Microcontroller PIC 18F. (U3) (BTL – 2, Understand)
4. Develop interfacing of various electronic components/ devices with Microcontroller PIC 18F. (U4, U5) (BTL – 6, Create)
5. Explain the serial communication details and interfacing with microcontroller 8051 and PIC 18F. (U1, U6) (BTL – 2, Understand)

4.4 Text Books

1. Mahumad Ali Mazadi, Janice Gillispie Mazadi, Rolin D McKinlay, "The 8051 Microcontroller & Embedded Systems (Using Assembly and C)", PHI, 2 nd Edition
2. Mahumad Ali Mazadi, Rolin D McKinlay and Danny Causey, "PIC Microcontroller & Embedded System", Pearson Education, 3 rd Edition

4.5 Reference Books

1. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Cengage Learning, 3 rd Edition
2. Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition
3. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE, 1 st Edition
4. Data Sheet of PIC 18Fxxxx series

4.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus

1. www.microchip.com
2. www.ti.com
3. www.wisdomjobs.com
4. www. electronicspost.com
5. NPTEL Course "Microcontroller and Applications" Link of the Course:
   https://nptel.ac.in/courses/117/104/117104072/
   https://nptel.ac.in/courses/108/105/108105102/

4.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned	CO Mapped
1	**1**	Overview of MCS-51 architecture, Block diagram and explanation of 8051	**T1**	6	CO1, CO5
2		Memory organization, Addressing modes, Overview of Instruction set, Sample programs (assembly) , Delay Calculation.			
3		Timers and its modes, Delay using Timer, Programming Timer 0&1			
4		Serial communication modes, Data transmission and reception using Serial port			
5		Interrupt structure, Port structure			
6		Interfacing of:			
7		LCD and Keypad			
8		LEDS, 7-segment multiplexed display			
9		ADC 0809			
10		Study of software development tool chain (IDE), hardware debugging tools (timing analysis using logic analyser)			
11	**2**	Interfacing of:	**T1**	6	CO2
12		Pin diagram and its functioning, Port structure			
13		IO Interfacing Requirements			
14		Interfacing of: LEDS, Keys, 7-segment multiplexed display			
15		DAC 0808, ADC 0809			
16		Stepper motor, Relay, Buzzer, Opto-isolators			
17		Design of Data acquisition System (DAS)			
18		All programs in C language			
19		Pin diagram and its functioning, Port structure			

20	**3**	PIC18FXX architecture with generalized block diagram	**T2**	6	CO3
21		Program and Data memory organization, Bank selection using Bank Select Register			
22		Pin out diagram, Reset operations			
23		Watch Dog Timers, Configuration registers and oscillator options (CONFIG)			
24		Overview of instruction set	Datasheet of PIC 18F4520		
25		Power down modes, Brief summary of Peripheral support			
26	**4**	Timers and its Programing (mode 0 &1)	**T2**	6	CO4
27		Interrupt Structure of PIC18F with SFR			
28		PORTB change Interrupts, Use of timers with interrupts			
29		CCP modes: Capture, Compare and PWM generation			
30		DC Motor speed control with CCP			
31		Block diagram of in-built ADC with Control registers			
32		Sensor interfacing using ADC, All programs in embedded C			
33	**5**	Port structure with programming, Interfacing of LED	**T2**	6	CO4
34		LCD and Keyboard, Motion Detectors			
35		DAC for generation of waveform			
36		Design of PIC test Board and debugging			
37		Home protection System			
38		All programs in embedded C			
39	**6**	Basics of Serial Communication Protocol • Study of RS232	**T2**	6	CO5
40		RS 485, I2C			
41		SPI, MSSP structure (SPI & I2C)			
42		USART (Receiver and Transmitter)			
43		Interfacing of RTC (DS1307) with I2CEEPROM with SPI, Design of Traffic Light Controller			
44		All programs in embedded C			

4.8 Unit wise Lecture Plan

4.8 a. Unit No.-I

Pre-requisites: -

Basics covered in Computer Organization

Objectives: -
To explain the architecture and features of typical Microcontroller (8051)

Outcomes: -
CO1: Explain the architecture and features of Microcontroller 8051 and PIC 18F.

PI Mapped:-
1.4.1, 2.1.2, 2.2.2

Lecture No	Details of the Topic to be covered	References	CO Mapped
1	Overview of MCS-51 architecture, Block diagram and explanation of 8051	**T1**	**CO1, CO5**
2	Memory organization, Addressing modes, Overview of Instruction set, Sample programs (assembly), Delay Calculation.		
3	Timers and its modes, Delay using Timer, Programming Timer 0&1		
4	Serial communication modes, Data transmission and reception using Serial port		
5	Interrupt structure, Port structure		
6	Interfacing of:		
7	LCD and Keypad		
8	LEDS, 7-segment multiplexed display		
9	ADC 0809		
10	Study of software development tool chain (IDE), hardware debugging tools (timing analysis using logic analyser)		

Question Bank: Theory

Theory Paper

Q. No.	Question	Marks	CO Mapped
	Unit 1		
1	Draw and explain the Flag structure of 8051 with bank 2 selection.	6	CO1, CO5
2	Draw and explain the interrupt structure of 8051 microcontroller in detail.	6	
3	Explain structure of internal memory organization of 8051.	6	
4	Explain the use of following registers: (1) DPTR, (2) TMOD, (3) PC.	6	
5	Explain structure of Port 0 and Port 1 of 8051.	4	
6	Explain Mode 1 and Mode 2 of timers in 8051	4	

7	In serial communication, how baud rate is set? Show calculation for 2400 baud.	6	
8	Explain the addressing modes of 8051 with example.	6	
9	Explain SCON register in detail. Also calculate the hexadecimal count in TH1 when the baud rate of the microcontroller is 1200.	6	
10	Explain MCS-51 architecture in detail.	8	
11	Write a ALP for transferring the data 'MICROCONTROLLER' serially at a baud rate of 4800.	6	
11	**HOTS: Assuming XTAL = 16 MHz, we are generating a square wave on P1.2, find the lowest square wave frequency that we can generate using mode 1**		
12	**HOTS: How can the baud rate of data transfer be doubled?**		

Q. No.	**Oral Questions**	**CO Mapped**
1	The 8051 DIP package is a _____ - pin package.	CO1, CO5
2	Which are the functions assigned to pins 20 and 40?	
3	What are registers in Microcontroller?	
4	What is an interrupt? List various types of interrupts available in 8051 Microcontroller.	
5	What is stack pointer in 8051 Microcontroller?	
6	What are Address Bus, Data Bus and Control Bus in Microprocessor 8051?	
7	Which interrupt has highest priority?	
8	What is an Interrupt service routine?	
9	What are the various criteria to choose the microcontroller?	
10	What is difference between microprocessor and microcontroller?	
11	List some 8051 Microcontroller applications in embedded systems.	
12	List some features of 8051 Microcontroller.	
13	What are the various types of memories used in microcontroller/microprocessor?	
14	Intel 8051 follows which architecture?	
15	What is the difference between Harvard Architecture and Von Neumann Architecture?	
16	8051 Was Developed Using Which Technology?	
17	Why 8051 Is Called 8 Bit Microcontroller?	
18	What Is the Width of Data Bus and Address Bus?	
19	What Location Code Memory Space and Data Memory Space Begins?	
20	How Much on Chip RAM Is Available?	
21	List Out Addressing Modes in 8051?	
22	How Much Total External Data Memory That Can Be Interfaced To The 8051?	
23	What is Special Function Registers (SFR)?	
24	Give Example of Bit Address and Byte Address?	
25	What Are the Four Distinct Types of Memory In 8051?	
26	Tell The Addresses Which Are Bit Addressable?	
27	What Is Lst File?	
28	Explain Db.?	
29	What Is Equ?	

30	How Are Labels Named in Assembly Language?	
31	Are All the Bits Of Flag Register Used In 8051?	
32	What Are Issues Related to Stack and Bank 1.?	
33	Which Bit of The Flag Register Is Set When Output Overflows To The Sign Bit?	
34	Explain JNC.	
35	Can Port 0 Be Used As Input Output Port?	
36	Which 2 Ports Combine To Form The 16 Bit Address For External Memory Access?	
37	Can Single Bit Of A Port Be Accessed In 8051?	
38	Other Than SETB, CLR Are There Any Single Bit Instructions?	
39	What is a timer in microcontroller? What is its function?	
40	What are the types of timers?	
41	Which registers are used while programming a timer?	
42	How to calculate delay for a timer?	

4.8b. Unit No.-II

Objectives:-
To **explain** interfacing of real world peripheral devices with microcontroller 8051 and PIC 18.

Outcomes:-
CO2: Develop interfacing to real world devices using Microcontroller 8051 and PIC 18F.
CO3: Explain use of hardware and software tools for developing applications.

PI Mapped:-
1.4.1, 2.1.2, 2.2.2, 2.3.1

Lecture No.	Details of the Topic to be covered	References	CO Mapped
	Interfacing of:	**T1**	CO2
11	Pin diagram and its functioning, Port structure		
12	IO Interfacing Requirements		
13	Interfacing of: LEDS, Keys, 7-segment multiplexed display		
14	DAC 0808, ADC 0809		
15	Stepper motor, Relay, Buzzer, Opto-isolators		
16	Design of Data acquisition System (DAS)		
17	All programs in C language		
18	Pin diagram and its functioning, Port structure		

Question Bank: Theory

Theory Paper

Q. No.	Unit II		CO Mapped
1	How to interface LEDs to 8051 microcontrollers? Write a program for flashing LEDs interfaced to port 2.	6	CO2
2	Explain the steps of key press and key scanning of a keypad interfaced to 8051 microcontrollers.	6	
3	Write a program to detect the key pressed in the keypad interfaced to 8051 microcontrollers.	6	
4	Explain interfacing of 7-segment multiplexed display to 8051 microcontrollers.	6	
5	Write a program to display the letters 'HI' on 7-segment multiplexed display interfaced to 8051 microcontrollers.	6	
6	Explain interfacing of LCD to 8051 microcontrollers.	6	
7	Write a program to display the string 'MICRO' on LCD interfaced to 8051 microcontrollers.	6	
8	Explain interfacing of ADC 0809 to 8051 microcontroller.	6	
9	Write a program to read analog input from a sensor and write the converted output to 8051 microcontrollers.	6	
10	Describe various software and hardware tools for development of microcontroller-based system.	6	
11	What is the principle on which electromagnetic relays operate?	3	
12	Why do we use ULN2803 while interfacing a relay with 8051?	4	
13	With neat diagram write an assembly language program to interface ADC0809 to 8051 microcontrollers.	6	
14	A stepper motor uses the following sequence of binary numbers to move the motor. How do you generate them in 8051C.? Sequence: 1100,0110,0011,1001.	6	
15	Draw and explain interfacing diagram of Opto-isolator	6	
16	With suitable diagram explain the Buzzer interfacing with 8051 microcontrollers.	6	
17	Design a Data Acquisition System for 8051 microcontrollers.		
19	**HOTS:** Which of the following ADCs provide smallest step size and best resolution - a. 8-bit b. 10 bit c. 12 bit d. 16 bit e. They all are same.		
20	**HOTS:** Some microcontrollers have inbuilt PWM circuitry. Why is this considered as an inbuilt DAC for these chips?		
21	**HOTS:** What are advantages of placing an optoisolator between the motor and the microcontroller		

Q. No.	Oral Questions	CO Mapped
1	Which are the two registers in the LCD module?	CO2
2	How can data be transferred to the LCD from a port using only 4 port lines?	
3	To display letters and numbers, data is to be sent in _____ code.	

4	What is the hex value of the command code for “display on, cursor on”?	
5	Which are the control pins of the LCD? What are their functions?	
6	How does the LCD distinguish between command and data?	
7	How does the busy flag aid in making the LCD program more efficient?	
8	In reading the columns of a keyboard matrix, if no key is pressed, the output will be all _____ (1s, 0s).	
9	What is key bouncing? How can it be avoided?	
10	What is common anode and common cathode connection in seven segment display?	
11	What is a pull-up resistor? How is it connected to a LED?	
12	What changes are required in the circuit if multiple seven segment LED displays are used?	
13	To access the chip, what logic level should be given on the CS line of ADC0804.	
14	The ADC0804 is a _____ - bit ADC.	
15	What is the function of the EOC pulse?	
16	In the ADC0804, what should be the Vref/2 value for a step size of 20 mV, 5 mV?	
17	In the ADC0804, what is the role of pins Vin(+) and Vin(-)?	
18	What is the importance of OE pin?	
19	How is a particular analog channel selected?	
20	In what way is the ADC0808 different from ADC0408?	
21	What is the need of ALE on ADC chip?	
22	What advantage does a serial ADC offer?	
23	What is an IDE?	
24	What is a logic analyzer?	
25	What is the purpose of IDE?	
26	What are hardware debugging tools?	
27	Which method of DAC is used in DAC0808?	
28	Which device uses a short optical transmission path to transfer an electrical signal between circuits or elements of a circuit, while keeping them electrically isolated from each other.	
29	The speed of motor depends on which of factor?	
30	What steps are needed to follow for interfacing of buzzer with 8051?	

4.8 c. Unit No.-III

Objectives: -

To explain architecture and features of typical Microcontroller 8051 and PIC 18F.

Outcomes: -

CO2: Develop interfacing to real world devices using Microcontroller 8051 and PIC 18F.
CO3: Explain use of hardware and software tools for developing applications.
CO4: Design an embedded application using microcontroller

PI Mapped:-
1.4.1, 2.1.2, 2.2.2, 2.2.4

Lecture No.	Details of the Topic to be covered	References	CO Mapped
	Interfacing of:	**T2, Datasheet of PIC 18F4520**	CO3
19	Comparison of PIC family, Criteria for Choosing Microcontroller		
20	PIC Features		
21	PIC18FXX architecture with generalized block diagram		
22	Program and Data memory organization, Bank selection using Bank Select Register		
23	Pin out diagram, Reset operations		
24	Watch Dog Timers, Configuration registers and oscillator options (CONFIG)		
25	Overview of instruction set		
26	Power down modes, Brief summary of Peripheral support		

Question Bank: Theory

Theory Paper

Q. No.	Unit III		CO Mapped
1	Explain in detail Data memory Map of PIC18F with GPR and SFRS.	8	CO3
2	Draw and explain the PIC18F architecture in detail.	8	
3	Explain instruction pipeline flow in PIC18F.	8	
4	List various features of PIC18.	5	
5	Write short note on BOD.	5	
6	Draw and explain structure of Program memory map of PIC18F.	5	
7	Explain working register (WREG) and status register in PIC18.	5	
8	Explain the BOD and Power Down modes of PIC18FXXX.	8	
9	Explain PIC18FXXX port structure.	8	
10	Explain CONFIG registers to select oscillator options.	8	
11	Explain CONFIG registers for BOD and WDT.	6	
12	Draw and explain with example Stack of PIC 18.	6	
13	Differentiate between PIC 10, PIC12, PIC16 and PIC 18.	6	
15	**HOTS:** Find the instruction cycle if the crystal frequency		
16	**HOTS:** If the BOD voltage is set for 4.2V, what does it mean to the system?		

Q. No.	Oral Questions	CO Mapped
1	Name three features of PIC18xxx.	CO3
2	What is the main difference between the PIC18Fxxx and PIC18Cxxx microcontroller?	
3	Give the size of on-chip ROM and RAM.	
4	The PIC is a (n) _____-bit microcontroller.	
5	Explain working register (WREG) in PIC18.	
6	Explain status register in PIC18.	
7	Explain the BOD of PIC18FXXX.	
8	Explain the Power Down modes of PIC18FXXX.	
9	Explain CONFIG registers for BOD and WDT.	
10	Explain the concept of WDT.	
11	Explain CONFIG registers to select oscillator options.	
12	Draw and explain with example Stack of PIC 18.	
13	Explain the Memory organization and types in PIC 18.	
14	Assembly language is a high-level language. True or False.	
15	RISC processors normally have a _____ (large, small) number of general-purpose registers.	
16	How wide is the size of the stack in the PIC18?	
17	The minimum number of instruction cycles needed to execute a PIC18 instruction is _____.	
18	The instruction "TBLRD*" uses register _____ as address pointer.	
19	Which address is used for the CONFIG1H register?	
20	Which command enables the PIC to enter the power down mode during the operation of watchdog timer (WDT)?	

4.8 d. Unit No.-IV

Objectives: -
To explain interfacing of real-world peripheral devices with microcontroller 8051 and PIC 18F.

Outcomes: -
CO1: Explain the architecture and features of Microcontroller 8051 and PIC 18F.

PI Mapped:-
1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1

Lecture No.	Details of the Topic to be covered	References	CO Mapped
27	Timers and its Programing (mode 0 &1)	**T2**	CO4
28	Interrupt Structure of PIC18F with SFR		
29	PORTB change Interrupts, Use of timers with interrupts		
30	CCP modes: Capture, Compare and PWM generation		

31	DC Motor speed control with CCP	**Datasheet of PIC 18F4520**	
32	Block diagram of in-built ADC with Control registers		
33	Sensor interfacing using ADC, All programs in embedded C		

Question Bank: Theory

Theory Paper

	Unit IV		CO Mapped
1	Draw and Explain the interfacing of LCD with Port D and Port E of PIC 18 microcontroller without Busy flag. Write C code to display "SPPU Pune"	8	CO4
2	Explain INTCON2, PIR1 and T3CON register	8	
3	Draw an interfacing diagram for 4 *4 matrix keyboard and display the key pressed on LED write a code	8	
4	Explain T1CON and T2CON Register in PIC 18.	8	
5	Explain Interrupt Structure in PIC 18F	8	
6	Write a C program to generate a square wave of 3 KHz on pin RB6. Use Timer 3 for creating the delay	8	
7	Find the values of PR2, CCPR1L and DC1B1 for PWM frequency of 102KHz with duty cycle 75%. Let XTAL = 10 MHz	8	
8	What do you mean by Port B change interrupt?	8	
	Write embedded C program to implement HEX counter on Port and display the count	8	
9	Assume that a 60Hz external clock is being fed to pin T0CKI (RA4). Write a C Program for counter 1 in 8-bit mode to display minutes and seconds on Port B and D	8	
10	Write a C18 program to toggle LED connected to CCP pin of PIC 18 after arrival of 10 students in a room.	5	
11	Draw block diagram of Timer 0 and write a program to generate a square wave at RA4 of 2500 Hz assuming XTAL frequency as 10 MHz and 4 as prescalar	8	
12	**HOTS: A DC motor is moving a load. How do we keep the rpm constant**		

Q. No.	Oral Questions	CO Mapped
1	How many timers are present in PIC18F? Explain them.	CO4
2	Explain INTCON2, PIR1 and T3CON register	
3	Explain T1CON and T2CON Register in PIC 18.	
4	Explain Interrupt Structure in PIC 18F	
5	What do you mean by Port B change interrupt?	
6	How many priorities are available with PIC 18?	
7	What is the significance of #pragma in the C18 program?	

8	What is a CCP module?	
9	What is the difference in capture mode and compare mode?	
10	What can be done using PWM mode?	
11	To get a 2-ms delay, what numbers should be loaded into TMR0H and TMR0L using 16-bit mode? Assume that XTAL = 10 MHz.	
12	To get a 100-µs delay, what numbers should be loaded into TMR0H and TMR0L using 8-bit mode? Assume that XTAL = 10 MHz.	

4.8 e. Unit No.-V

Objectives:-
To explain interfacing of real-world peripheral devices with PIC 18F.

Outcomes:-
CO2: Develop interfacing to real world devices using Microcontroller 8051 and PIC 18
CO3: Explain use of hardware and software tools for developing applications.

PI Mapped:-
1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1

Lecture No.	Details of the Topic to be covered	References	CO Mapped
34	Port structure with programming, Interfacing of LED	**T2**	CO4
35	LCD and Keyboard, Motion Detectors		
36	DAC for generation of waveform		
37	Design of PIC test Board and debugging		
38	Home protection System		
39	All programs in embedded C		

Question Bank: Theory

Unit V			CO Mapped
1	Explain how to interface LCD with PIC18FXXXX .	8	CO4
2	Describe Port B in PIC18FXXXX	8	
3	Draw a neat diagram of matrix keyboard connected to the port of PIC18FXXXX	8	
4	Explain steps for Interfacing of LED with PIC18FXXX	8	
5	Draw a circuit diagram to interface DAC with PIC 18FXXX	8	
6	Explain the port structure of PIC18F	8	

7.	Explain step wise procedure and design methodology of PIC test Board and debugging.	8	
8	How to interface 4*4 keypad to PIC18F	8	
9	How to generate PWM signal using CCP module in PIC18F	8	
10	A LED is connected to each pin of port D. Write a C program that will turn on each LED from pin D0 to D7. Call a delay module before turning on the next LED.	8	
11	Draw an interfacing diagram of LED connected to Port B of PIC18F and write program embedded C program for Ring counter	8	
12	Design of DAS system for pressure monitoring system(use any suitable sensor)	10	
13	Design a PIC18 based data acquisition system for temperature measurement using LM35.	10	
14	**HOT**Design a frequency counter for counting number of pulses and display same on LCD**		
15	**HOT**Design frequency counter for the range from DC to 5MHz frequency using PIC18FXXX.Design and draw interfacing circuit. Also explain required flowchart.**		

Q. No.	Oral Questions	CO Mapped
1	While programming for LCD display, what initialization must be done?	CO4
2	List the features of Data acquisition system.	
3	What is key debouncing?	
4	Which keys are encoded for scan lines with '1101' value (RB1 low) condition?	
5	What value of 'B' should be loaded in the TRISB register if return lines (RB7: RB4) and RB3:RB0 are supposed to be inputs and outputs respectively after the PORT B initialization?	
6	What is the purpose of using Schmitt Trigger in the hardware circuit for key debouncing?	
7	In LCD, what is role of RS pin?	
8	What is the difference between non matrix keyboard and matrix keyboard?	
9	4*4 matrix keyboard is connected to which port of PIC microcontroller	
10	Explain important pins of LCD while interfacing with PIC18F	
11	Draw an interfacing diagram of motion detector with PIC18F	
12	Explain interfacing of DAC with PIC18F	

4.8 f. Unit No.-VI

Objectives:-

To discuss the serial communication details and interfacing with microcontroller.

Outcomes:-

CO4: Design an embedded application using microcontroller

PI Mapped:-
1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1

Lecture No.	Details of the Topic to be covered	References	CO Mapped
40	Basics of Serial Communication Protocol • Study of RS232	**T2**	CO5
41	RS 485, I2C		
42	SPI, MSSP structure (SPI & I2C)		
43	USART (Receiver and Transmitter)		
44	Interfacing of RTC (DS1307) with I2CEEPROM with SPI, Design of Traffic Light Controller		
45	All programs in embedded C		

Question Bank: Theory

Theory Paper

Q. No.	Question	Marks	CO Mapped
	Unit VI		
1	Explain the MSSP structure of PIC in detail	8	CO5
2	Compare the SPI and I2C protocol.	8	
3	What are the features of RTC. Draw an interfacing diagram to interface with PIC	8	
4	Compare SPI and I2C protocol	8	
5	Draw and Explain interfacing of ADC for analog input 0-5 V and write a C code	8	
6	Explain TXSTA and RCSTA registers for PIC 18	8	
7	Write a program to send the message SPPU to the serial port continuously. Assume a SW is connected to pin RB2. Monitor its status and set the baud rate as follows: SW=1 for 9600; SW =2 for 38400. Assume XTAL = 10MHz.	8	
8	Draw and Explain interfacing of DS1307 with PIC 18	8	
9	Interface EEPROM using I2C to store and retrieve data	8	
10	Design a PIC test board	5	
11	Design a home protection system	8	
12	Write a short note on I2C protocol	5	
13	Write a short note on SPI protocol	5	
14	Explain the role of TSR register in serial communication of PIC18F	5	
15	With Fosc = 16MHz , find the value to be loaded in SPBRG register for baud rate 2400 and 4800	4	

16	Write a PIC 18 program to transfer serially message “Thank you” continuously at 57600 baud rate. Quadruple the baud rate .Explain the changes in TXSTA register. Assume XTAL = 10 MHz.	8	
17	Program PIC18F in C to receive bytes of data serially and display it on PORTB. Set baud rate to 9600, with XTAL= 10MHz	5	
18	**HOTS: How does SPI protocol distinguish between the read and write cycles?**		

Q. No.	Oral Questions	CO Mapped
1	Explain the MSSP structure of PIC.	CO5
2	Compare the SPI and I2C protocol.	
3	What are the features of RTC?	
4	Explain interfacing of ADC for analog input	
5	Explain TXSTA and RCSTA registers for PIC 18	
6	Explain the role of TSR register in serial communication of PIC18F	
7	What are the types of ROM memories available with PIC 18?	
8	What is the difference in ROM, EEPROM, Flash ROM?	
9	Which registers are required for serial communication? Explain.	
10	Which registers are required for A-to-D conversion? Explain.	
11	Which registers are required for reading from EEPROM? Explain.	
12	Which registers are required for writing in EEPROM? Explain.	
13	Explain the control register in DS 1307.	

4.9 Practical Session

Course Objectives:

1. To illustrate programs on Memory transfer with microcontroller 8051 using embedded C language.
2. To demonstrate interfacing of real world devices with microcontroller 8051 using embedded C language.
3. To demonstrate interfacing of real world devices like button, LED, relay, buzzer, LCD, keypad with microcontroller PIC 18F using embedded C language.
4. To demonstrate serial communication, generation of PWM signal for DC Motor control with microcontroller PIC 18F using embedded C language.

Course Outcomes: -

At the end of the course students will be able to –

1. Develop programmes on Memory transfer with microcontroller 8051 in embedded C (Group A: 1).
2. Demonstrate interfacing of real world devices with 8051 microcontroller in embedded C language using Keil IDE (Group A: 2, 5).
3. Demonstrate interfacing of real world devices with PIC18F microcontroller in embedded C language using MP-LAB IDE (Group B: 6, 7, 9).

4. Illustrate serial communication, generation of PWM signal for DC Motor control with PIC 18F microcontroller in embedded C language using MP-LAB IDE (Group C: 11, 13).

List of Practicals:
Minimum 10 experiments (Experiment number 2, 3, 5, 6, 7, 9, 10, 12 are compulsory; any one from 1 and 4, 8, 11 and 13)
List of Practical's:

Group A (Any Three)

1. Simple programs on Memory transfer.
2. Parallel port interacting of LEDS—Different programs (flashing, Counter, BCD, HEX, Display of Characteristic)
3. Interfacing of Multiplexed 7-segment display (counting application)
4. Waveform Generation using DAC
5. Interfacing of Stepper motor to 8051- software delay using Timer

Group B (Any Three)

6.Write a program for interfacing button, LED, relay & buzzer as follows

A. On pressing button1 relay and buzzer is turned ON and LED's start chasing from left to right
B. On pressing button2 relay and buzzer is turned OFF and LED start chasing from right to left .

7. Interfacing of LCD to PIC 18FXXXX
8. Interfacing of 4X4 keypad and displaying key pressed on LCD.
9. Generate square wave using timer with interrupt

Group C (Any Two)

11. Interfacing serial port with PC both side communication.
12. Interface analog voltage 0-5V to internal ADC and display value on LCD
13. Generation of PWM signal for DC Motor control.
14. Interfacing of RTC using I2C protocol

Virtual LAB Links (Additional Any Two)

http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/labs/index.php

Sr. No.	Name of the Practical	CO Mapped	PI Mapped
1	Simple programmes on Memory transfer. (Group A: 1)	CO1	2.4.2, 2.4.3, 5.1.2, 5.2.2
2	Parallel port interacting of LEDS—Different programs (flashing, Counter, BCD, HEX, Display of Characteristic) (Group A: 2)	CO2	
3	Interfacing of Stepper motor to 8051- software delay using Timer. (Group A: 5)	CO2	
4	WAP for interfacing button, LED, relay and buzzer as follows - On pressing button1 relay and buzzer is turned ON and LED's start chasing from left to right; When button 2 is pressed relay and buzzer is turned OFF and LED"s start chasing from left to right. (Group B: 6)	CO3	
5	Interfacing of LCD to PIC 18FXXXX. (Group B: 7)	CO3	

6	Generate square wave using timer with interrupt. (Group B: 9)	CO3	
7	Interfacing serial port with PC both side communication. (Group C: 11)	CO4	
8	Generation of PWM signal for DC Motor control. (Group C: 13)	CO4	
9	Interfacing of 8051 Microcontroller with various display devices. (Virtual LAB)		
10	Interfacing of 8051 Microcontroller with DC motor. (Virtual LAB)		
11	WAP to interface EEPROM 24C128 with PIC 18F using SPI to store and retrieve data	CO2	

Sr. No.	**MCQs**	**CO Mapped**
	Unit I	
Q.	The flag register in the 8051 is called _____	**CO1, CO5**
A	Flag register	
B	Program Status Register	
C	Program Status Word	
D	Status register	
Ans	D	
Q.	What is the width of Data Bus and Address Bus?	
A	12 bits, 16 bits	
B	8 bits, 16 bits	
C	8 bits, 12 bits	
D	16 bits, 24 bits	
Ans	B	
Q.	Which pins of the 8051 are set aside for serial communication?	
A	16 and 17	
B	20 and 40	
C	18 and 19	
D	10 and 11	
Ans	D	
Q.	Which port of 8051 needs pull-up resistors to function as an I/O port?	
A	Port 0	
B	Port 1	
C	Port 2	
D	Port 3	
Ans	A	
Q.	When is TI flag in SCON register raised?	
A	During the transfer of STOP bit	
B	During the transfer of START bit	

C	Upon RESET
D	On an Interrupt
Ans	A
Q.	Which address in the interrupt vector table is assigned to the INT1 and Timer1 interrupts?
A	001BH, 0023H
B	0013H, 0023H
C	0003H, 0013H
D	0013H, 001BH
Ans	D
Q.	With each PUSH instruction, the stack pointer register, SP is _____ by 1.
A	Advanced
B	Incremented
C	Decremented
D	multiplied
Ans	**B**
Q.	Name 16-bit registers in the 8051.
A	PC
B	DPTR
C	Both of the above
D	None of the above
Ans	C
Q.	The 3 components in 8051 port structure are
A	D latch, Input driver, Input buffer
B	D latch, Output driver, Input buffer
C	D latch, Output driver, Output buffer
D	D latch, Output driver, Input driver
Ans	**B**
Q.	DAA command adds 6 to the nibble if
A	CY and AC are 1
B	Either CY and AC are 1
C	No relation with CY and AC
D	CY is 1
Ans	**B**
Q.	How is the status of the Carry, Auxilary Carry and Parity flag affected if write instructions: MOV A, #9C ADD A, #64H?
A	CY=0, AC=0, P=0
B	CY=1, AC=1, P=0
C	CY=0, AC=1, P=0

D	CY=1, AC=1, P=1	
Ans	**B**	
Q.	What is the function of the SCON register?	
A	to control SBUF and SMOD registers	
B	to program the start bit, stop bit, and data bits of framing	
C	to control SMOD registers	
D	none of the mentioned	
Ans	**B**	
	Unit II	
Q.	Internal registers of LCD are	
A	Command register	
B	Data Register	
C	Both	
D	none of the above	
Ans	C	
Q.	To detect key pressed which of the following is grounded	
A	all rows	
B	all columns	
C	one row at a time	
D	none of the above	
Ans	C	
Q.	The main function of ALE pin of 8051 is	
A	latch the addresses	
B	de-multiplex the multiplexed address and data signals available at port 0	
C	enabling the arithmetic logic	
D	none of the mentioned	
Ans	B	
Q.	8 input DAC has	
A	8 discrete voltage levels	
B	64 discrete voltage levels	
C	124 discrete voltage levels	
D	256 discrete voltage levels	
Ans	D	
Q.	Which of the following is not a component of a stepper motor?	
A	Windings	
B	Rotor and Stator	
C	both windings, rotor and stator	
D	Brush	
Ans	C	

Q.	Why do we need a ULN2803 in driving a relay?	
A	for switching a motor	
B	for increasing the current	**CO2**
C	for increasing the power	
D	for switching the voltage	
Ans	B	
Q.	What are Optoisolators?	
A	it is a driver	
B	it is a thing isolated from the entire world	
C	it is a device that can be used as an electromagnetic relay without a driver	
D	none of the mentioned	
Ans	B	
Q.	LM35 has how many pins?	
A	2	
B	1	
C	3	
D	4	
Ans	C	
Q.	Why is Vref of ADC set to 2.56 V if analog input is connected to the LM35?	
A	to set the step size of the sampled input	
B	to set the ground for the chip	
C	to provide supply to the chip	
D	all of the mentioned	
Ans	A	
Q.	Individual segments in a seven-segment display are coded	
A	Randomly	
B	Clockwise	
C	Anti-clockwise	
D	7 to 0	
Ans	A	
Q.	In ADC0808/0809 IC which pin is used to select Step Size?	
A	Vref	
B	Vin	
C	Vref/2 & Vin	
D	None of the mentioned	
Ans	A	
Q.	Identify the row and the column for the following case when for the row D3-D0 = 1110 and for the column D3-D0 = 1101	

A	first row and second column	
B	first row and third column	
C	second row and first column	
D	second row and second column	
Ans	A	
Q.	For writing commands on an LCD, RS bit is	
A	Set	
B	Reset	
C	set and reset	
D	None of the mentioned	
Ans	B	
Q.	How can we change the speed of a DC motor using PWM?	
A	By changing amplitude of PWM	
B	By keeping fixed duty cycle	
C	By changing duty cycle of PWM	
D	By increasing power of PWM	
Ans	C	
Q.	An interrupt breaks the execution of instructions and diverts its execution to	
A	Interrupt service routine	
B	Counter word register	
C	Execution unit	
D	control unit	
Ans	A	
Q.	A stepper motor with a step angle of 15 degrees has _____steps per revolution	
A	72	
B	27	
C	24	
D	16	
Ans	**C**	
Q.	Which of the following interface is used for waveform generation using the 8051 microcontrollers?	
A	ADC	
B	DAC	
C	ACD	
D	CAD	
Ans	**B**	
Q.	Data acquisition system consists of	
A	Transducers	

B	signal conditioning	
C	ADC	
D	all of the above	
Ans	**D**	
	Unit III	
Q.	How many clock pulses are confined by each machine cycle of Peripheral-Interface Controllers?	
A	4	
B	8	
C	12	
D	16	
Ans	A	
Q.	Which flags are more likely to get affected in status registers by Arithmetic and Logical Unit (ALU) of PIC 16 CXX on the basis of instructions execution?	
A	Carry (C) Flags	
B	Zero (Z) Flags	
C	Digit Carry (DC) Flags	
D	All of the above	
Ans	D	
Q.	What is the execution speed of instructions in PIC especially while operating at the maximum value of clock rate?	
A	0.1 μs	
B	0.2 μs	
C	0.4 μs	
D	0.8 μs	
Ans	B	
Q.	Which status bits exhibit carry from lower 4 bits during 8-bit addition and are especially beneficial for BCD addition?	
A	Carry bit (C)	
B	Digits Carry bit (DC)	
C	Both A & B	
D	None of the above	
Ans	B	
Q.	Which among the below stated reasons is/are responsible for the selection of PIC implementation/design on the basis of Harvard architecture instead of Von-Newman architecture?	
A	Improvement in bandwidth	
B	Instruction fetching becomes possible over a single instruction cycle	**CO3**
C	Independent bus access provision to data memory even while accessing the program memory	
D	All of the above	

Ans	D
Q.	Which condition/s of MCLR (master clear) pin allow to reset the PIC?
A	High
B	Low
C	Moderate
D	All of the above
Ans	B
Q.	Which bank of RFS has a provision of addressing the status register?
A	Only Bank 1
B	Only Bank 2
C	Either Bank 1 or Bank 2
D	Neither Bank 1 nor Bank 2
Ans	C
Q.	Which operational feature of PIC allows it to reset especially when the power supply drops the voltage below 4V?
A	Built-in Power-on-reset
B	Brown-out reset
C	Both A & B
D	None of the above
Ans	B
Q.	Which kind of mode is favorable for MCLR pin for indulging reset operations?
A	Normal mode
B	Sleep mode
C	Power-down mode
D	Any flexible mode
Ans	B
Q.	Generation of Power-on-reset pulse can occur only after _____
A	the detection of increment in V_{DD} from 1.5 V to 2.1 V
B	the detection of decrement in V_{DD} from 2.1 V to 1.5 V
C	the detection of variable time delay on power up mode
D	the detection of current limiting factor
Ans	A
Q.	Which timer/s possess an ability to prevent an endless loop hanging condition of PIC along with its own on-chip RC oscillator by contributing to its reliable operation?
A	Power-Up Timer (PWRT)
B	Oscillator Start-Up Timer (OST)
C	Watchdog Timer (WDT)
D	All of the above

Ans	C
Q.	Which register/s is/are mandatory to get loaded at the beginning before loading or transferring the contents to corresponding destination registers?
A	W
B	INDF
C	PCL
D	All of the above
Ans	A
Q.	Which crucial feature/function of Brown-Out-Reset (BOR) makes the PIC to be completely unique and distinct from other microcontrollers?
A	It can reset the PIC automatically in running condition
B	It can reset the PIC even when the supply voltage increases above 4V
C	It can reset the PIC without enabling the power-up timer
D	All of the above
Ans	A
Q.	Which statement is precise in relation to FSR, INDF and indirect addressing mode?
A	Address byte must be written in FSR before executing INDF instruction in indirect addressing mode
B	Address byte must be written in FSR after executing INDF instruction in indirect addressing mode
C	Address byte must be written in FSR at the same time during the execution of INDF instruction in indirect addressing mode
D	Address byte must be always written in FSR as it is independent of any instruction in indirect addressing mode
Ans	A
Q.	What is the purpose of using the start-up timers in an oscillator circuit of PIC?
A	For ensuring the inception and stabilization of an oscillator in a proper manner
B	For detecting the rise in V_{DD}
C	For enabling or disabling the power-up timers
D	For generating the fixed delay of 72ms on power-up timers
Ans	A
Q.	Which program location is allocated to the program counter by the reset function in Power-on-Reset (POR) action modes?
A	Initial address
B	Middle address
C	Final address
D	At any address reliable for reset operations
Ans	A
Q.	When does it become very essential to use the external RC components for the reset

	circuits?	
A	Only if initialization is necessary for RAM locations	
B	Only if V_{DD} power-up slope is insufficient at a requisite level	
C	Only if voltage drop exceeds beyond the limit	
D	Only if current limiting factor increases rapidly	
Ans	B	
Q.	Which crucial feature/function of Brown-Out-Reset (BOR) makes the PIC to be completely unique and distinct from other microcontrollers?	
A	It can reset the PIC automatically in running condition	
B	It can reset the PIC even when the supply voltage increases above 4V	
C	It can reset the PIC without enabling the power-up timer	
D	All of the above	
Ans	A	
Q.	Which register acts as an input-output control as well as data direction register for PORTA in bank 2 of RFS?	
A	INDF (80H)	
B	TRISB (85H)	
C	TRISA (85H)	
D	PCLATH (8A)	
Ans	C	
Q.	Which program location is allocated to the program counter by the reset function in Power-on-Reset (POR) action modes?	
A	Initial address	
B	Middle address	
C	Final address	
D	At any address reliable for reset operations	
Ans	A	
Q.	Which among the below specified registers are addressable only from bank1 of RFS?	
A	PORTA (05H)	
B	PORTB (06H)	
C	FSR (04H)	
D	ADCON0 (07H)	
Ans	A	
Unit IV		
Q.	What would be the value of ADC clock source, if both the ADC clock bits are selected to be ‘1’?	
A	$F_{OSC}/2$	
B	$F_{OSC}/8$	
C	$F_{OSC}/32$	
D	F_{RC}	

Ans	D	
Q.	Which bit permits to enable (if set) or disable (if cleared) all the interrupts in an INTCON register?	
A	GIE	
B	ADIE	
C	RBIE	
D	TOIE	
Ans	A	
Q.	What happens when the supply voltage falls below 4V during the power-up timer delay of 72ms in PIC?	
A	CPU resets PIC once again in BOR mode	**CO4**
B	BOR reset mode gets disabled	
C	PIC does not remain in BOR mode until the voltage increases irrespective of stability	
D	Power-up timer kills 72ms more again	
Ans	A	
Q.	Which channel would be selected if the values of channel bits CHS0 & CHS1 are '1' & '0' respectively in ADC Status Register?	
A	AIN0	
B	AIN1	
C	AIN2	
D	AIN3	
Ans	C	
Q.	When does it become feasible for portB pins (RB4 to RB7) to support its unique feature of 'interrupt on change'?	
A	By configuring all the pins (RB4-RB7) as inputs	
B	By configuring all the pins (RB4-RB7) as outputs	
C	By configuring any one of the pins as inputs	
D	By configuring any one of the pins as outputs	
Ans	A	
Q.	What among the below specified functions is related to PWM mode?	
A	Generation of an interrupt	
B	Generation of rectangular wave with programmable duty cycle with an user assigned frequency	
C	Variations in the status of an output pin	
D	Detection of an exact point at which the change occurs in an input edge	
Ans	B	
Q.	Which mode allows to deliver the contents of 16-bit timer into a SFR on the basis of rising/falling edge detection?	

A	Capture Mode
B	Compare Mode
C	PWM Mode
D	MSSP Mode
Ans	A
Q.	Which digital operations are performed over the detected mismatch outputs with an intention to generate a single output RB port change output?
A	OR
B	AND
C	EX-OR
D	NAND
Ans	A
Q.	Which bit of OPTION register has a potential to decide the falling or rising edge sensitivity for the external interrupt INT?
A	RBPU
B	INTEDG
C	PSA
D	RTS
Ans	B
Q.	Where does the conversion interrupt flag (ADIF) end after an accomplishment of analog-to-digital (ADC) conversion process?
A	INTCON
B	ADCON0
C	OPTION
D	None of the above
Ans	B
Q.	The functionalities associated with the pins RA0- RA3 in ADCON1 are manipulated by _____
A	PCFG1 & PCG0
B	VREF
C	ADON
D	All of the above
Ans	A
Q.	Which among the below mentioned aspect issues are supported by capture/compare/PWM modules corresponding to time in PIC?
A	Control
B	Measurement
C	Generation of pulse signal
D	All of the above
Ans	D

Q.	What happens when the program control enters the Interrupt Service Subroutine (ISS) due to enabling of CCP1IE bit in PIE1 especially during the initialization of CCP1 Module in capture mode?	
A	CCP1F bit gets cleared in PIR1 by detecting new capture event	
B	GIE bit gets enabled	
C	Contents of CCPR1L & CCPR1H are automatically copied in TMR1L & TMR1H respectively	
D	Interrupt flag bit CCP1IF gets enabled in PIR	
Ans	A	
Q.	Which register is suitable for the corresponding count, if the measurement of pulse width is less than 65,535 μs along with the frequency of 4 MHz?	
A	4-bit register	
B	8-bit register	
C	16-bit register	
D	32-bit register	
Ans	C	
Q.	The capture operation in counter mode is feasible when mode of CCP module is _____	
A	synchronized	
B	asynchronized	
C	synchronized as well as asynchronized	
D	irrespective of synchronization	
Ans	A	
Q.	What is the fundamental role exhibited by the CCP module in compare mode in addition to timer 1?	
A	To vary the pin status in accordance to the precisely controlled time	
B	To vary the duty cycle of the rectified output	
C	To vary the oscillator frequencies in order to receive larger periods	
D	To vary the status of synchronization levels	
Ans	A	
Q.	How does the pin RC2/CCP1 get configured while initializing the CCP module in the compare mode of operation?	
A	As an input by writing it in TRISC register	
B	As an output by writing it in TRISC register	
C	As an input without the necessity of writing or specifying it in TRISC register	
D	Compare mode does not support pin RC2/CCP1 configuration CCP initialization	
Ans	B	
Unit V		
Q.	What is/are the consequences of driving the LED in the form of an output function?	
A	Pin sources the current when made low without glowing LED	

B	Pin sinks the current when made high without glowing LED	
C	Pin sources the current when made high by glowing LED	
D	Pin sinks the current when made low by glowing LED	
Ans	D	
Q.	How many rows and columns are present in a 16*2 alphanumeric LCD?	
A	rows=2, columns=32	
B	rows=16, columns=2	
C	rows=16, columns=16	
D	rows=2, columns=16	
Ans	D	
Q.	Which instruction is used to select the first row first column of an LCD?	**CO4**
A	0x08	
B	0x0c	
C	0x80	
D	0xc0	
Ans	C	
Q.	The RS pin is _____ for an LCD.	
A	input	
B	Output	
C	input &output	
D	None of the above	
Ans	A	
Q.	What is the purpose of using Schmitt Trigger in the hardware circuit for key debouncing?	
A	Noise Elimination	
B	Improvement in Noise Immunity	
C	Increase in Noise Figure	
D	Reduction in Noise Temperature	
Ans	B	
Q.	Which keys are encoded for scan lines with '1101' value (RB1 low) condition?	
A	0, 4, 8, C	
B	1, 5, 9, D	
C	2, 6, A, E	
D	3, 7, B, F	
Ans	C	
Q.	Which type of lens is generally used in the PIR sensors?	
A	Concave lens	
B	Convex lens	
C	Bifocal lens	

D	Fresnel Lens
Ans	B
Q.	In DAC the input is_____ and output is_____
A	analog, digital
B	Current, voltage
C	Digital, analog
D	Analog, current
Ans	C
Q.	The output of DAC0808 is in the form of_____
A	electric pulse
B	current
C	voltage
D	All the above mentioned
Ans	B
Q.	In the design of PIC test board,the microcontroller selected is PIC 18F4550 which works on the frequency of oscillator ranging from _____
A	0 to 20 MHz
B	0 to 30 MHz
C	30 to 40 MHz
D	None of the above
Ans	A
Unit VI	
Q.	Which of the following can be used for long distance communication?
A	I2C
B	Parallel port
C	SPI
D	RS232
Ans	D
Q.	Which of the following is not a serial protocol?
A	SPI
B	I2C
C	Serial port
D	RS232
Ans	D
Q.	Which of the following have an asynchronous data transmission?
A	SPI
B	RS232
C	Parallel port
D	I2C
Ans	B

Q.	Which among the below stated conditions are selected by the SSPCON & SSPSTAT control bits?	
A	Slave Select mode in slave mode	**CO5**
B	Data input sample phase	
C	Clock Rate in master mode	
D	All of the above	
Ans	D	
Q.	What should be the value of SSPM3:SSPM0 bits so that SPI can enter the slave mode by enabling SS pin control?	
A	0000	
B	0100	
C	0010	
D	0001	
Ans	B	
Q.	What is the purpose of a special function register SPBRG in USART ?	
A	To control the operation associated with baud rate generation	
B	To control an oscillator frequency	
C	To control or prevent the false bit transmission of 9th bit	
D	All of the above	
Ans	A	
Q.	How is the baud rate specified for high-speed (BRGH = 1) operation in an asynchronous mode?	
A	FOSC / 8 (X +1)	
B	FOSC / 16 (X +1)	
C	FOSC / 32 (X +1)	
D	FOSC / 64 (X +1)	
Ans	B	
Q.	Which bits assist in determining the I2C bit rate during the initialization process of MSSP module in I2C mode?	
A	SSPADD	
B	SSPBUF	
C	Both a & b	
D	None of the above	
Ans	A	
Q.	Where does the baud rate generation occur and begins to count the bits required to get transmitted, after an execution (set) of BF flag?	
A	SCL line	
B	SDA line	
C	Both a & b	

D	None of the above	
Ans	B	
Q.	Which bit of SSPCON must be necessarily set to enable the synchronization of serial port?	
A	WCOL	
B	SSPOV	
C	CKP	
D	SSPEN	
Ans	D	

5. Name of the course: Fundamentals of Java Programming (Elective I)

Weekly Work Load(in Hrs)	Lecture	Tutorial	Practical
	3	-	2

In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	25			125	4

5.1 Syllabus

UNIT I: JAVA Fundamentals

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java. Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping

Unit II: Classes & Objects

Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (Complex Class & String Class).

UNIT II: Classes and Objects

Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class

UNIT III: Methods & Inheritance in JAVA

Abstract Methods and classes, Strings ,One dimensional and two dimensional arrays , wrapper classes,

enumerated types, Command line arguments Inheritance: Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch

UNIT IV: Interfaces & Packages

Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface Packages: Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.

UNIT V: Multithreading & Exception Handling

Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet

UNIT VI: Graphics Programming and File Handling

Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. Managing input/output files: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files.

5.2 Course Objectives

- Discuss the fundamental concepts of Java programming.
- Illustrate the concept of data encapsulation , data abstraction ,constructor and destructor in Java.

- Discuss the concept of inheritance and dynamic method dispatch using Java .
- Illustrate the concept of interfaces and packages using Java .
- Discuss the concept of multithreading and exception handling using Java .
- Explain the concept of graphics programming and file handling using Java .

5.3 Course Outcomes

Upon successful completion of this course, students should be able to:

- **Describe** the basic principles of Java programming language
  (Bloom's Level 1 : Remember) (Unit I)
- **Apply** the concept of data encapsulation , data abstraction ,constructor and destructor in Java .
  (Bloom's Level 3: Apply) (Unit II)
- **Demonstrate** the concepts of Inheritance and dynamic method dispatch.
  (Bloom's Level 3 : Apply) (Unit III)
- **Use** the concept of interfaces & packages for program implementation.
  (Bloom's Level 3 : Apply) (Unit IV)
- **Elaborate** multithreading and Exception handling in Java to develop robust programs .

- (Bloom's Level 1 : Remember) (Unit V)

- **Use** Graphics class, AWT packages and manage input and output files in Java .
  (Bloom's Level 3 : Apply) (Unit VI)

5.4 Text Books

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition.

2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.

5.5 Reference Books

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7 th Edition. 3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.

5.6 Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus

NPTEL Course "Programming in Java" Link of the Course: https://nptel.ac.in/courses/106/105/106105191

5.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Total Lecture Planned	CO Mapped
1	JAVA Fundamentals	Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java. Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants,	**8**	

		Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.		
2	Classes and Objects	Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class.	**6**	CO2
3	Methods & Inheritance in JAVA	Abstract Methods and classes, Strings ,One dimensional and two dimensional arrays , wrapper classes, enumerated types, Command line arguments Inheritance: Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch	**8**	CO3
4	Interfaces & Packages	Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface Packages: Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.	**4**	CO4
5	Multithreading & Exception Handling	Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax,	**8**	CO5

		Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet		
6	Graphics Programming and File Handling	Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. Managing input/output files: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files	**5**	CO6

5.8 Unit wise Lecture Plan

5.8 a. Unit No.-I

Pre-requisites :-

Basics of C and C++ programming

Objectives:-

Discuss the fundamental concepts of Java programming.

Outcome:-

Describe the basic principles of Java programming language (Bloom's Level 1 : Remember) (Unit I)

Program Indicators:

1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems

2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1	Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages	T1,T2
2	Java features, Java and World Wide Web, Java RunTime Environment. JVM architecture	T1,T2
3	Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java	T1,T2
4	Java Tokens, Java Statements, Constants, variables, data types.	T1,T2
5	Declaration of variables, Giving values to variables, Scope of variables	T1,T2
6	arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values	T1,T2

7	Operators, Expressions, Type conversion in expressions, Operator precedence and associatively	T1,T2
8	Mathematical functions, Control statements- Decision making & looping.	T1,T2

Question Bank: Theory

Theory Paper

CO Mapped: CO1

Question No.	Question
Q1	Explain evolution of Java
Q2	List applications of Java
Q3	Explain features of Java
Q4	Draw and explain JVM Architecture
Q5	Differentiate between Java and C
Q6	Differentiate between Java and C++
Q7	With the help of example explain final keyword
Q8	With the help of example explain declaration and initialization of array in Java
Q9	Write a program in Java to print the elements in array using for- each loop
Q10	Write a program to find the factorial of a number.
Q11	Write a program to print elements in an array.
Q12	Explain scanner class to read input from the user.
Q13	Write a program to add two numbers

Q14	Write a program to print the name, age and salary of an employee.
Q15	Program to find sum and average of 5 elements in an array using function.

5.8 b. Unit No.-II

Objectives :-

Illustrate the concept of data encapsulation , data abstraction ,constructor and destructor in Java.

Outcomes:-

Apply the concept of data encapsulation , data abstraction ,constructor and destructor to write program in Java. (Bloom's Level 3: Apply)

Program Indicators:

2.1.2 Identify engineering systems, variables, and parameters to solve the problems

2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem

Lecture No.	Details of the Topic to be covered	References
1	Introduction to classes, its definition, declaration of data fields and methods	T1 R1
2	Constructor, object creation, accessing field and methods	T1 R1
3	Revision of class and object declaration, difference between primitive data type and reference variable	T1 R1
4	Difference between primitive data types and reference data types, copy and compare for reference data type, automatic garbage collection, finalize method	T1 R1
5	Finalize method, function overloading	T1 R1
6	Method overloading, constructor overloading, this object, final keyword	T1 R1

Question Bank: Theory

Theory Paper

CO Mapped: CO2

Question No.	Question
Q1	How is the method defined?
Q2	When do we declare a member of a class static
Q3	Design a class to represent a bank account, include the following members A] Data members: 1. Name of depositor 2. Account number 3. Type of account 4. Balance amount in the account B] Methods: 1. To assign initial values 2. To deposit an amount 3.To withdraw an amount after checking balance 4.To display the name and balance
Q4	What is a class ? How does it accomplish data hiding ?
Q5	What are the objects ? How to create object from a class ?
Q6	What is a constructor ? What are its special properties ?
Q7	How do we invoke constructor ?

Q8	Correct the error in the following code
	class VarName {
	public static void main(String [] argos) {
	System.out.println(“Hello World”);
	}
	};

Q9	Explain the concept of reference variable

Q10	What is a method overloading ?

5.8 c. Unit No.-III

Objectives:-

Discuss the concept of inheritance and dynamic method dispatch using Java .

Outcomes:-

Demonstrate the concepts of Inheritance and dynamic method dispatch. (Bloom's Level 3 : Apply) (Unit III)

Program Indicators:

2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models

Lecture No.	Details of the Topic to be covered	References
1	Abstract Methods and classes,	T1 and T2
2	Strings ,One dimensional and two dimensional arrays	
3	wrapper classes,	
4	enumerated types, Command line arguments	
5	Inheritance in Java	
6	Creating Multilevel hierarchy, Constructors in derived class	
7	Method overriding, Dynamic method dispatch.	

Question Bank: Theory

Theory Paper

CO Mapped : CO3

Question No.	Question
Q1	Explain use of static variable and static method in java
Q2	Explain Inheritance and types of Inheritances in java
Q3	Write a program to implement single inheritance in java
Q4	Explain implicit and explicit call for constructors in inheritance
Q5	With the help of example explain use of super keyword
Q6	Write a program to explain use of super to invoke parent class parameterized constructor
Q7	Write a program to implement multilevel inheritance in java
Q8	Write a program to implement hierarchical inheritance in java
Q9	Explain static and dynamic polymorphism
Q10	Explain the concept of method overriding
Q11	Explain significance of dynamic method dispatch
Q12	Write a program to calculate length of a string
Q13	Write a program to join two strings
Q14	Write a program to sort the strings
Q15	Explain Autoboxing and unboxing in wrapper class
Q16	Write a program using command line argument to add two numbers

5.8 d. Unit No.-IV

Objectives :-

Illustrate the concept of interfaces and packages using Java .

Outcomes:-

Use the concept of interfaces & packages for program implementation. (Bloom's Level 3 : Apply) (Unit IV)

Program Indicators:

2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.4.2 Produce and validate results through skilful use of contemporary engineering tools and models

Lecture No.	Details of the Topic to be covered	References
1	Interface concept, need, declaration, difference between class and interface	T1 R1
2	Interface implementation	T1 R1
3	default interface method, static interface method	T1 R1
4	Package, creating, importing, adding class to package, hiding class from package	T1 R1

Question Bank: Theory
Theory Paper
CO Mapped: CO 4

Question No.	Question
Q1	What is an interface ?
Q2	How to include interface into a java program ?
Q3	What is the difference between interface and class?
Q4	What are the similarities between interface and class ?
Q5	Describe the various forms of interface implementation
Q6	What is a package ?
Q7	How to include package into java program

Q8	How do we add class or interface to a package ?
Q9	How do we design a package ?
Q10	List out Java API package

5.8 e. Unit No.-V

Objectives :-

Discuss the concept of multithreading and exception handling using Java .

Outcomes:-

Elaborate multithreading and Exception handling in Java to develop robust programs .

Program Indicators:

2.1.2 Identify engineering systems, variables, and parameters to solve the problems
2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.4.2 Produce and validate results through skillful use of contemporary engineering tools and models

Lecture No.	Details of the Topic to be covered	References
1	Introduction to multithreading: Introduction	T1 and R1
2	Creating thread and extending thread class	
3	Concept of Exception handling: Introduction, Types of errors	
4	Exception handling syntax, Multiple catch statements	
5	I/O basics, Reading console inputs, Writing Console output	
6	Applets: Concepts of Applets, differences between applets and applications	
7	life cycle of an applet, types of applets	
8	creating a simple applet.	

Question Bank: Theory

Theory Paper

CO Mapped: CO5

Question No.	Question
Q1	Differentiate between multithreading and Multitasking
Q2	Explain what is a thread
Q3	Explain life cycle of a thread
Q4	Write a program to handle arithmetic exception
Q5	Explain thread priority with the help of a program
Q6	Explain runnable interface with the help of example
Q7	Explain syntax of try throw and catch block
Q8	Explain reading input from user using bufferReader class
Q9	Explain life cycle of an applet
Q10	Write a program to create an applet

5.8 f. Unit No.-VI

Objectives :-

Explain the concept of graphics programming and file handling using Java .

Outcomes:-

Use Graphics class, AWT packages and manage input and output files in Java .

(Bloom's Level 3 : Apply) (Unit VI)

Lecture No.	Details of the Topic to be covered	References
1	Graphics class, Java API Classes, color control, methods for graphics class, AWT, Hierarchy Of AWT	T1, R1

2	Creation of child of frame class, handling of window event through windowadaptor class, adding component to frame child class, handling events associated with individual component through actionlistener	T1, R1
3	Creation of object of java frame class, java event handling, java awt examples with panels	T1, R1
4	Java swing, container, component, handling events with component	T1, R1
5	File handling, Creation, writing and reading from file	T1, R1

Question Bank: Theory

Theory Paper

CO Mapped: CO5

Question No.	Question
Q1	What is JFC ?
Q2	What is AWT ?
Q3	List difference between swing and AWT in JAva
Q4	What is the difference between paint and repaint method ?
Q5	How to change the button property from enable to disable ?
Q6	List out the containers available in Java
Q7	Explain the drawString method of Graphics class
Q8	Explain the classes associated with file handling
Q9	Explain how to read and write a sentence in a file with the help of program

Q10	Explain different operation that can performed on file
Q11	Explain the hierarchy of AWT
Q12	Explain Window container
Q13	List out the steps to perform event handling

5.9 Practical session

Course Objectives

- To Illustrate basic Java programming language.
- To Discuss classes and objects using Java.
- To Explain inheritance and its type using Java.
- To Illustrate use of package , exception handling and applet designing using Java.

Course Outcomes

At the end of the course student will be able to -

- Develop basic Java programs.
  (Bloom's Level 3 : Apply) (Lab 1-11)
- Demonstrate classes and objects using Java.
  (Bloom's Level 3 : Apply) (Lab 3 and Lab 7)
- Execute programming skills using inheritance in Java.
  (Bloom's Level 3 : Apply) (Lab 7)
- Use package , exception handling and applet designing with the help of Java.
  (Bloom's Level 3 : Apply) (Lab 8-11)

List of Practical

Sr. No.	Name of the Practical	CO Mapped

1	Write some simple programs in Java such as: 1. To find factorial of number. 2. To display first 50 prime numbers. 3. To find sum and average of N numbers	CO1
2	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.	CO1
3	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display " Matching Rectangles", otherwise display " Non-matching Rectangle"	CO1, CO2
4	Write a program in JAVA to demonstrate the method and constructor overloading.	CO1
5	Write Programs in Java to sort 1. List of integers 2. List of names. The objective of this assignment is to learn Arrays and Strings in Java	CO1
6	Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java	CO1
7	Write a program in Java to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.	CO1, CO2, CO3

8	Write a Java program which imports user defined package and uses members of the classes contained in the package.	CO1, CO4
9	Write a java program which use try and catch for exception handling.	CO1, CO4
10	Write a java program in which data is read from one file and should be written in another file line by line.	CO1, CO4
11	A Mini project in Java: A group of 4 students can develop a small application in Java	CO1, CO4
12	**Write a HTML program for applet .(CBS)**	CO1, CO4

Oral Question Bank

Sr. No.	Questions	CO Mapped
1.	Explain basic concepts of object oriented programming. OR Explain oop paradigm concepts. (Note : explain encapsulation,polymorphism,abstraction,inheritance,containment,etc)	CO1, CO2
2.	What are the drawbacks of procedure oriented programming?	CO1, CO2
3.	How to use the ternary operator?	CO1
4	List few tokens from Java	CO1
5	Write down difference between Java and C++ Programming	CO1
6	How OOP Platform ensure reusability and extensibility of modules	CO1, CO2
7	How to represent real life entities of problems in system design	CO1, CO2
8	How OO programming ensures system design with open interface	CO1, CO2
9	List out different programming styles	CO1, CO2

10	What is object	CO1, CO2
11	Define Class	CO1, CO2
12	Explain dynamic binding	CO1
13	List out difference between message driven call and function driven call	CO1, CO2
14	List out advantages and disadvantages of OOP	CO1, CO2
15	Draw pictorial representation of student class	CO1, CO2
16	In Java why main function is called as driver function	CO1

17	In the following statement
	for(i=0;i<5;++i)
	{
	-------- 	
	-------- 	
	-------- 	
	}
	i=6
	Does this program contains error.Justify
		CO1

18	What are the different types of access specifier supported by Java	CO1
19	What are the differences between static binding and late binding	CO1
20	What are the different data types supported by Java	CO1
21	What are keywords? List keywords specific to Java	CO1
22	What is an expression? Is it different from a statement?	CO1

23	What is the effect of following statement if i=1 & j=4
	a. i++
	b. j= j++;
	c. j=++j;
	d. i + ++j;
	e. i= i++ + ++j
		CO1

24	Explain reference variable how it differ from natural variable	CO1
25	What is static function ?	CO1
26	What is a method overloading ?	CO1
27	What is a static variable ?	CO1
28	What is a method overriding ?	CO1, CO3
29	What is data hiding ?	CO1, CO2
30	What is a constructor ? Explain how it differs from normal functions ?	CO1, CO2
31	What is a interface ?	CO1, CO4
32	List types of constructors	CO1
33	State difference between private access specifier and protected access specifier	CO1
34	What are the different types of inheritance	CO1, CO3
35	Can base class access derived class	CO1, CO3
36	What are abstract classes	CO1, CO3
37	What is type casting? Explain with suitable example	CO1

38	What are the primitive data types supported by Java	CO1
39	Write a program in Java To find sum of following harmonic series, 1+(1/2)+(1/3)+…+(1/n) Value of n must be taken from user	CO1
40	Write a program to read the price of an item in decimal form(eg. 55.30) and print the output in paise (eg. 5530 paise)	CO1
41	Write a program to convert temperature from Fahrenheit to Celcius Display the result	CO1
55	How is the method defined? Explain with suitable example	CO1
56	When we declare member of a class as static	CO1
57	Compare overriding and overloading methods	CO1, CO3

5. Name of the Coarse – Computer Networks (Elective -I)

304185 (D)

Weekly WorkLoad (in Hrs)	**Lecture**	**Tutorial**	**Practical**
	03	**-**	**02**

In-sem	**Theory**	**Practical**	**Oral**	**Term work**	**Total Marks**	**Credit**
30	**70**	**25**		**25**	**150**	**1**

5.1 Syllabus

Unit I: Basics of Network & Physical Layer

Types of networks, Network topologies, Design issues for Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing.

Unit II: Data Link Layer

Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelization protocols

Unit III: Network Layer Part I

Introduction to Network Layer: Network-Layer Services, Circuit switching, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6

Unit IV: Network Layer Part II

Unicast & Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP.

Unit V: Transport Layer

Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS,socket programing .

Unit VI: Application Layer
Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP

5.2 Course Objectives

1. To introduce the fundamentals of computer networks.
2. To explain various access control techniques for the data link layer.
3. To illustrate functions and protocols of the network layer.
4. To describe various protocols and congestion control techniques for transport layer.
5. To explain protocols at application layer

5.3 Course Outcomes

After successfully completing the course students will be able to:

1. **CO1:** Introduce fundamentals of computer network. **(Unit-I) (Level-2: Understand)**
2. **CO2:** Explain various access control techniques for the data link layer. **(Unit-II) (Level-2: Understand)**
3. **CO3:** Illustrate functions and protocols of the network layer. (**Unit-III, IV) (Level-2: Understand)**
4. **CO4**: Describe various protocols and congestion control techniques for the transport layer. **(Unit-V) (Level-2: Understand)**
5. **CO5:** Discuss the use of protocols at the application layer. **(Unit-VI,) (Level-2: Understand)**

5.4 Textbooks:

T1-1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, 5 th Edition.
T2-2. Achyut S Godbole, “Data Communication and Networking”, Tata McGraw-Hill, 1 st Edition.

5.5 Reference Books:

1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition,2003
2. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education
3. Greg Tomsho, Ed Tittel, David Johnson. "Guide to Networking Essentials", Thomson India Learning, 5 th Edition, 2007.
4.William Stallings, "Data and Computer Communication", Pearson Education, 8 th Edition, 2000
5. James F. Kurouse & W. Rouse, "Computer Networking: A Top down Approach", Pearson Education, 6 th Edition

5.6 Reference Web Links/ Research Paper/ Referred Book other than Mentioned in Syllabus:

www.cisco.com
Link of the NPTEL Course: https://nptel.ac.in/courses/106/105/106105183/

MOOC / NPTEL Courses:

1. Computer Networks - Course (swayam 2.ac.in)
2. Introduction to Computer Networks & Internet Protocols - Course (swayam 2.ac.in)
3. Computer Networks and Internet Protocol - Course (nptel.ac.in)
4. NPTEL Course "Computer Networks"

5.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	CO Mapped	PI Mapped	Total Lecture Planned	Books Referred
1	**Basics of Network &**	Types of networks, Network topologies, Design issues for	CO1	1.4.1	7	T1,T2, R1

	Physical Layer	Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing.		2.2.2 2.2.4		
2	**Data Link Layer**	Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelization protocols	CO2	1.4.1 2.1.2 2.1.3	6	T1,T2, R1
3	**Network Layer Part I**	Introduction to Network Layer: Network-Layer Services, Circuit switching, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6	CO3	1.4.1 2.1.2 2.1.3	7	T1, T3, T4, R1
4	**Network Layer Part II**	Unicast & Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link	CO3	1.4.1 2.1.2 2.1.3	7	T1, T3, T4, R1

		State, Path Vector, Routing in Internet: RIP, OSPF, BGP.				
5	**Transport Layer**	Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS,socket programming .	CO4	1.3.1 2.1.3	6	T1, R1
6	**Application Layer**	Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP	CO5	1.3.1 1.4.1	5	T1, R1

5.8 Unit wise Lecture Plan

5.8 a. Unit No.-I Basics of Network & Physical Layer

Prerequisites: - Information Theory and Communication Networks

Objectives:

1. To provide students' knowledge of types of networks, network topologies, layered architecture of OSI model and TCP IP protocol suite.

2. To explain Design issues for Layers & role of physical layer.

Outcomes: - Understand the types of networks, network topologies, design issues, functionality and importance of various layers involved in OSI and TCP IP model.

Lecture No.	Details of the Topic to be covered	References
1	Types of networks	**T1,T2, R1**

2	Network topologies	
3	Design issues for Layers	
4	Network models	
5	OSI model	
6	TCP / IP protocol suite	
7	Types of addressing.	

Question Bank: Theory

CO Mapped: CO1

PI Mapped: 1.4.1, 2.2.2, 2.2.4

Q. 1	Draw and explain TCP/IP Protocol suite.
Q. 2	Explain various types of networks.
Q. 3	Differentiate different Ethernet Standards.
Q. 4	Explain Network topologies
Q. 5	Compare OSI model & TCP / IP protocol suite
Q. 6	Explain Design issues for Layers
Q. 7	Draw and explain OSI model.
Q. 8	What are the functions of the Physical and data link layer?
Q. 9	Explain various protocols used in each layer of TCP /IP protocol suite.

5.8 b. Unit No.-II Data Link Layer

Pre-requisites: Basics of Communication Networks

Objectives:

1. To explain Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels.

2. To explain various protocols for Data Link Layer.

Outcomes:

Students will be able to explain Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channel & various protocols for Data Link Layer

Lecture No.	Details of the Topic to be covered	References
1	Data link control, Framing, Flow and error control	T1,T2, R1
2	Protocols for Noiseless, and Noisy Channels	
3	HDLC	
4	Point to Point Protocol	
5	Media Access Control: Random Access	
6	Controlled Access- Reservation,Channelization protocols	

Question Bank: Theory

CO Mapped: CO2

PI Mapped: 1.4.1, 2.1.2, 2.1.3

Q. 1	Explain Data link control.
Q. 2	Explain Framing, Flow and error control.

Q. 3	Explain Protocols for Noiseless Channels.
Q. 4	Explain all Protocols Noisy Channels.
Q. 5	Write a short note on HDLC.
Q. 6	Explain Point to Point Protocol in detail.
Q. 7	Explain Media Access Control: Random Access.
Q. 8	Write a short note on Controlled Access- Reservation, Channelization protocols.

5.8 c. Unit No.-III Network Layer Part-I

Prerequisites:- Basics of Analog communication, Digital Communication

Objectives: - Demonstrate a computer network with the help of physical links and networking protocols.

Outcomes: - Analyze the requirements for a given organizational structure and select the appropriate networking architecture.

PI Mapped: 1.4.1, 2.1.2, 2.1.3

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Network Layer	**T1,T2, R1**
2	Network-Layer Services	
3	Circuit switching, Packet Switching	
4	Network-Layer Performance, IPv4 Addresses	
5	Forwarding Of IP Packets, Network Layer Protocols: Internet Protocol (IP)	

6	ICMPv4, Next Generation IP	
7	IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6	

Question Bank: Theory

CO Mapped: CO3

PI Mapped: 1.4.1, 2.1.2, 2.1.3

Q. 1	Differentiate Physical Address and Logical Address.
Q. 2	How many network addresses and host addresses are supported by class A, class B networks?
Q. 3	State the goals of the Network layer.
Q. 4	What does a router do when it receives a packet with a destination address that it does not have an entry for, in its routing table?
Q. 5	What is the use of TTL in IP header? / What is the router's role in controlling the packet lifetime?
Q. 6	Write the difference between Distance vector routing and Link state routing
Q. 7	How are broadcast and multicast addresses represented in IP addressing schemes?
Q. 8	What is the difference between IPV4 and IPV6?
Q. 9	Explain the packet format of IPV4

Q. 10	Explain Network Layer Protocols:
Q. 11	Explain Internet Protocol (IP) in detail.

5.8 d. Unit No.-IV Network Layer Part-II

Prerequisites: - Analog communication, Digital Communication

Objectives: - Demonstrate a computer network with the help of physical links and networking protocols.

Outcomes: - Analyze the requirements for a given organizational structure and select the appropriate networking architecture.

Lecture No.	Details of the Topic to be covered	References
1	Unicast and Multicast Routing: Introduction	**T1, T3, T4, R1**
2	Routing Algorithms, Unicast Routing Protocols	
3	Introduction, Multicasting Basics, Intra-domain Multicast Protocols	
4	Inter-domain Multicast Protocols, IGMP	
5	Distance Vector, Link State, Path Vector	
6	Routing on the Internet: RIP,	
7	OSPF, BGP protocols	

Question Bank: Theory

CO Mapped: CO3

PI Mapped: 1.4.1, 2.1.2, 2.1.3

Q. 1	Write a short note on Ipv6 Protocol
Q. 2	Explain Inter-domain Multicast Protocols
Q. 3	Explain Unicast and Multicast Routing
Q. 4	Explain various Routing Algorithms in detail.
Q. 5	Explain Unicast Routing Protocols.
Q. 6	Explain ICMPv6 Protocol in detail.
Q. 7	Explain the process of Transition From IPv4 toIPv6
Q. 8	Explain the packet format of IPV6 in detail.
Q. 9	Explain the packet format of ICMPv6

5.8.e. Unit No. - V Transport Layer

Prerequisites:-

Analog communication, Digital Communication

Objectives: -

To make the students understand functions and role of Transport layer, types of protocols

Outcomes: -

Understand the functionality and importance of Transport Layer in TCP IP protocol suite

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Transport Layer	

2	Transport-Layer Protocols	**T1, R1**
3	Datagram Protocol(UDP)	
4	Transmission Control protocol (TCP),	
5	Stream Control Transmission Protocol (SCTP)	
6	Comparison of UDP,TCP,SCTP	
7	Congestion control and QoS, socket programming	

Question Bank: Theory

Theory Paper

CO Mapped: CO4

PI Mapped: 1.3.1, 2.1.3

Q. 1	What is the maximum case of UDP datagram?
Q. 2	Explain in detail all Transport layer services?
Q. 3	Describe the SCTP protocol
Q. 4	Compare TCP, UDP and SCTP
Q. 5	What is the method to improve QoS?
Q. 6	Which service is provided by TCP?
Q. 7	Describe the UDP protocol and discuss the difference between UDP and TCP
Q. 8	Explain the design issues of transport layers

Q. 9	Congestion control and QoS, socket programming
Q. 10	Write a note on socket programming.

5.8 f. Unit No.-VI Application Layer

Objectives: -

To make the students understand functions and role of Application layer, types of protocols

Outcomes: -

Understand the functionality and importance of Application Layer

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Application Layer	T1, R1
2	Standard Client Server Protocols World Wide Web and HTTP, FTP	
3	Electronic Mail, Telnet	
4	FTP, SMTP	
5	IMAP, POP, DNS	
6	BOOTP, DHCP	

Question Bank: Theory

CO Mapped: CO5

PI Mapped: 1.3.1, 1.4.1

Q. 1	Which protocol supports email and give details about that protocol?
Q. 2	What are the functions of Telnet?
Q. 3	What are the functions of DNS?

Q. 4	Explain in detail about the working principles of Simple Network Management Protocol (SNMP)

Q. 5	What are the functions of SSH?

Q. 6	What is meant by FTP?

Q. 7	Why is network management required?
Q. 8	Write a short note on Electronic Mail, Telnet.
Q. 9	Explain BOOTP in detail.
Q. 10	Explain DHCP server in detail.
Q. 11	Write short notes on IMAP, POP, DNS.

5.9 Lab Practice-I (404186)

Course Objectives (Practical)

- To demonstrate installation of LAN and relevant networking devices.
- To Elaborate network traffic and different protocols using network simulation and protocol analyzer tools.
- To implement **a** router using RIP, HTTP & FTP servers using a network simulation tool.
- To configure different (proxy, web servers) and routers using a network simulator.

Course Outcomes (Practical)

- Demonstrate installation of LAN and relevant networking devices. **(Expt. No. 1,2)**

(Level 2, Understand)

- Observe network traffic and different protocols using network simulation and protocol analyzer tools. **(Expt. No. 3,5) (Level 2, Understand)**
- Implement router using RIP, HTTP & FTP servers using network simulation tool. **(Expt. No. 4,6) (Level 2, Understand)**
- Configure different (proxy, web servers) and routers using network simulator. **(Expt. No. 7,8) (Level 2, Understand)**

5.9 List of Practical

Sr. No.	Name of the Practical	CO Addressed	PI Mapped
	Group A		
1	Implementation of LAN using suitable multiuser Windows operating System and demonstrating client-server and peer to peer mode of configuration.	**CO1**	**1.4.1** **5.5.1**
2	Simulating various Networks (LAN, WAN) using relevant network devices on Simulator using Ping, ipconfig / ifconfig, Host name, Whois, Netstat, Route, Tracert/Traceroute/ Tracepath, NSlookup ARP, Finger Port Scan, nmap.	**CO1**	
3	Observe and note the details of the live type of traffic (ARP, Frame analysis, ethernet) from the interface using packet capture and analysis tool.	**CO2**	
4	Using a Network Simulator (e.g., packet tracer) Configure router using RIP.	**CO3**	**1.4.1** **2.4.4** **5.5.1**
	Group B		
5	Observe and note the working of protocols using PING / TRACEROUTE / PATHPING and capture packets in LAN using packet capture and analysis tool.	**CO2**	**1.4.1** **5.5.1**

6	Configure servers like HTTP / FTP and understand packet sequence and data flowing between client-server using packet analysis tools	**CO3**	**1.4.1** **2.4.4** **5.5.1**
7	Executing Proxy, web Server using simulator.	**CO4**	**1.4.1** **2.4.3**
8	Executing Telnet, DHCP Server using simulator	**CO4**	**2.4.4** **5.5.1**