

Progressive Education Society's
Modern College of Engineering
Department of Electronics & Telecommunication Engineering



Curriculum Booklet
Third Year
2019-Pattern
Semester -II

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-VI														
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
304192	Cellular Networks	03	-	-	30	70	-	-	-	100	03	-	-	03
304193	Project Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304194	Power Devices & Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
304195	Elective-II	03	-	-	30	70	-	-	-	100	03	-	-	03
304196	Cellular Networks Lab	-	02	-	-	-	-	-	50	50	-	01	-	01

30419 7	Power Devices & Circuits Lab	-	02	-	-	-	-	50	-	50		01		01
30419 8	Elective-II Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
30419 9	Internship**	-	-	-	-	-	100	-	-	100	-	-	04	04
30420 0	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304191 B	Mandatory Audit Course 6 &	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		12	10	00	120	280	125	75	100	700				
Total Credit											12	05	04	21

Abbreviations:

In-Sem: In semester

End-Sem: End semester

TH: Theory

TW : Term

WorkPR: Practical

OR: Oral

TUT: Tutorial

Note: Students of T.E. (Electronics & Telecommunications) have to opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

1. Name of the Course – Cellular Networks

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

Online / In-sem	Theory / End-Sem	Practical	Oral	Term-work	Total Marks	Credit
30 M	70 M		50 M	-	150 M	03

1.1 Syllabus

Unit I: Introduction of Wireless Channel (6 Hrs.)

Introduction, Free Space Propagation Model, Ground-Reflection Scenario, Hata Model and Receiver-Noise Computation. Channel Estimation techniques and Diversity in wireless communications

Unit II: Orthogonal Frequency Division Multiplexing (6 Hrs.)

Introduction, Motivation and Multicarrier basics, OFDM example, bit error rate for OFDM. Multiple-Input **Multiple-Output Wireless Communications**: Introduction to MIMO Wireless Communications, MIMO System Model and MIMO-OFDM.

Unit III: Introduction to Mobile Communication (8 Hrs.)

Introduction to Cellular Service Progression, Cell Geometry, Overview of Cellular mobile and Network architecture, Cellular radio system design-- Frequency assignments, frequency reuse channels, Concept of cell splitting and Cell sectoring. Significance of Handover in cellular systems with Handoff algorithms and roaming

Unit IV: Wireless System Planning (6 Hrs.)

Link-Budget Analysis, Tele-traffic Theory, Tele-traffic System Model and Steady State Analysis.

Unit V: Wireless and Mobile Technologies and Protocols and their performance evaluation (6 Hrs.)

Introduction, Wireless and mobile technologies, LTE- advanced, 5G – Architecture, wireless local area network and Simulations of wireless networks.

Unit VI: Performance Analysis Issues (8 Hrs.)

Introduction to Network coding, basic hamming code and significance of Information Theory. Interference suppression and Power control. MAC layer scheduling and connection admission in mobile communication.

1.2 Course Objectives

To make the students understand

- Various propagation Model and Estimation techniques of wireless communication systems.
- OFDM and MIMO technologies to explain modern wireless systems.
- Various aspects of mobile communication system.
- Various aspects of wireless-system planning.
- Different Generation of Mobile Networks.
- Diversified issues that can enhance Network Performance

1.3 Course Outcomes

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

- Understand fundamentals of wireless communications.
- Discuss and study OFDM and MIMO concepts.
- Elaborate fundamentals mobile communication.
- Describes aspects of wireless system planning.
- Understand modern and futuristic wireless networks architecture.
- Summarize different issues in performance analysis.

1.4 Text Books:

1. Rappaport, T. S., “Wireless Communications--Principles and Practice”, Pearson, 2 nd Edition.
2. Jagannatham, A. K., “Principles of Modern Wireless Communication Systems”, McGraw-Hill Education

1.5 Reference Books:

1. Cristopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications”, Wiley, 2nd Edition.
2. E. Dahlman, J. Skold, and S. Parkvall, “4G, LTE-Advanced Pro and The Road to 5G”, Academic Press, 3 rd Edition.
3. B. P. Lathi, “Modern Digital and Analog Communications Systems”. Oxford university press, 2015, 4th Edition.
4. Obaidat, P. Nicopolitids, “Modeling and simulation of computer networks and systems: Methodologies and applications” Elsevier, 1 st Edition

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

- NPTEL Course “Introduction to Wireless & Cellular Communications” Link of the Course: <https://nptel.ac.in/courses/106/106/106106167/>
- NPTEL Course “Advanced 3G and 4G Wireless Mobile Communications” Link of the Course: <https://nptel.ac.in/courses/117/104/117104099/>

1.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction, Free Space Propagation Model, Ground-Reflection Scenario, Hata Model and Receiver-Noise Computation. Channel Estimation techniques and Diversity in wireless communications	T2	6L
2	II	Introduction, Motivation and Multicarrier basics, OFDM example, bit error rate for OFDM. Multiple-Input Multiple-Output Wireless Communications: Introduction to MIMO Wireless Communications, MIMO System Model and MIMO-OFDM.	T2	6L
3	III	Introduction to Cellular Service Progression, Cell Geometry, Overview of Cellular mobile and Network architecture, Cellular radio system design-- Frequency assignments, frequency reuse channels, Concept of cell splitting and Cell sectoring. Significance of Handover in cellular systems with Handoff algorithms and roaming	T1, R5	8L
4	IV	Link-Budget Analysis, Tele-traffic Theory, Tele-traffic System Model and Steady State Analysis.	T2	6L
5	V	Introduction, Wireless and mobile technologies, LTE-advanced, 5G – Architecture, wireless local area network and Simulations of wireless networks.	R4	6L

6	VI	Introduction to Network coding, basic hamming code and significance of Information Theory. Interference suppression and Power control. MAC layer scheduling and connection admission in mobile communication.	R3, R4	8L
---	----	---	--------	----

1.8 Unit wise Lecture Plan

1.8 a. Unit No.-I- Introduction of Wireless Channel

Pre-requisites: -

Digital Communication

Objectives: -

- To describe propagation models and estimation techniques of wireless communication systems

Outcomes: -

Describe propagation models and estimation techniques of wireless communication systems.

PI Mapping:-

- 1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
- 1.2.1 Apply laws of natural science to an engineering problem
- 1.4.1 Apply E&TC engineering concepts to solve engineering 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
- 2.2.4 Compare and contrast alternative solution processes to select the best process.

Lecture No.	Details of the Topic to be covered	References
1	Introduction,	T1, R1, R5, R7, R8
2	Free Space Propagation Model	
3	Ground-Reflection Scenario	
4	Hata Model	
5	Receiver-Noise Computation	
6	Channel Estimation techniques	

Question Bank: Theory

Q. 1 List and explain different radio propagation mechanisms with suitable examples (6 Marks).

Q. 2 Explain the need for wireless communication.

Q. 3 Write a short note on a Wireless Network.

Q. 4 Define and explain :

- a. Path loss
- b. RF signal interference
- c. Fading.

Q. 5 What is LOS communication?

Q. 6 Explain multipath propagation and its effects.

Q. 7 What is fading and what are its types?

Q. 8 State and explain different reasons for fading.

Q. 9 State and explain various properties of RF waves.

Q. 10 Write a note on the 3G cellular system.

Q. 11 Explain 4G cellular system and state its features.

Q. 12 Explain the 5G cellular system and state its features.

Q. 13	Explain the 5G cellular system and state its features.
Q. 14	Describe the term multipath fading.
Q. 15	Explain the free space propagation model.
Q. 16	Explain the ground reflection model.
Q. 17	Write a short note on Hata Model.
Q. 18	With the help of derivation explain the concept of channel estimation in wireless systems.
Q. 19	Explain the concept of diversity reception in wireless systems.
Q. 20	Explain the concept of <ul style="list-style-type: none"> a. Microscopic diversity reception in wireless systems. b. Macroscopic diversity reception in wireless systems. c. Space diversity reception in wireless systems. d. Frequency diversity reception in wireless systems. e. Time diversity reception in wireless systems.
Q. 21	What is small scale fading? What are the factors that influence it?

Question Bank: Tutorial

Q. 1	For a transmitting antenna with an operating frequency of 1 GHz and the maximum dimension of 1 m, find the value of far-field distance.
Q. 2	Express the output power of 50 W of a transmitter in terms of dBm and dBW.
Q. 3	If the output power of 50 W is applied to a transmitting antenna of unity gain and carrier frequency of 1 GHz, calculate the received power in dBm by a unity gain receiving antenna that is at a free space distance of 90 m from the transmitter. Also find the value of P_r (10 km).

Q. 4 The received power at a distance of 100 km is 5 nW for a communication link. Determine the received power at a distance 200 km for the same link. Assume free space propagation mechanism.

Q. 5 If a transmitter produces 50 W of power, express the transmit power in units of : dBm and dBW. if 50 W is applied to a unity gain antenna with a 900 MHz carrier frequency, find the received power in dBm at free space distance of 100 m from the antenna. What is P_r (10 km)? Assume unity gain for the receiver antenna.

Q. 6 Assume a receiver is located 10 km from a 50 W transmitter. The carrier frequency is 6 GHz and free space propagation is assumed. $G_t = 1$ and $G_r = 1$. Find the power at the receiver in dBm.

Q. 7 Calculate the change in received signal power in a free space propagation environment at two different points such as the distance of the second point is ten times the distance of the first point. Express your answer in dB.

Q. 8 In the following cases, tell whether the two-ray model could be applied, and explain why or why not

Case 1: $h_t = 35$ m, $h_r = 3$ m, $d = 250$ m

Case 2: $h_t = 30$ m, $h_r = 1.5$ m, $d = 450$ m.

Q. 9 In a cellular radio system, a mobile receiver is located 5 km from the base station. It uses an antenna with gain 2.55 dB. The electric field at 1 km from the transmitter is 10^{-3} V/m. If the carrier frequency is 900 MHz, then find the electric field at the mobile receiver using the 2 ray ground reflection model. the heights of the transmitting and receiving antenna are 50 m and 1.5 m, respectively.

Q. 10 In the two ray ground reflection model, the phase difference is required to be kept below 6.261 radians. The receiver antenna height is 2m, carrier frequency is 900 MHz and the angle of incidence must be less than 5° . Find the minimum transmitter-receiver separation distance and the height of the transmitter antenna.

Q. 11	Find median path loss using Okumura's model for $d = 50$ km, $h_{te} = 100$ m, $h_{re} = 10$ m. If EIRP from the base station is 1 kW at 900 MHz, find received power. Take $A_{mu}(900 \text{ MHz}(50\text{km})) = 43$ dB and $G_{AREA} = 9$ dB.
Q. 12	For a large city, compute the median loss using Hata model at a distance $d = 8$ km, $f_c = 2.1$ GHz, $h_{re} = 2$ m and $h_{te} = 40$ m.
Q. 13	Calculate the noise power spectral density n_0 and the noise power if noise figure $F = 5$ dB, $T = 293$ K and the bandwidth $B = 30$ kHz.

1.8 b. Unit No.-II- Orthogonal Frequency Division Multiplexing

Pre-requisites:-

Digital Communication concepts

Objectives:-

- To elaborate OFDM and MIMO-OFDM technologies.

Outcomes:-

- Explain OFDM and MIMO-OFDM technologies.

PI Mapping:-

- 1.1.2 Apply advanced mathematical techniques to model and solve E&TC Engineering problems
- 1.4.1 Apply E&TC engineering concepts to solve engineering 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	Introduction, Motivation and Multicarrier basics	T2 7.1 and 7.2
2	OFDM example	T2 7.3
3	Bit error rate for OFDM	T2 7.4
4	Introduction to MIMO Wireless Communications,	T2 6.1 with example 6.1

5	MIMO System Model	T2 6.2 with example 6.5
6	MIMO-OFDM.	T2 7.5

Question Bank: Theory

- Q. 1** Explain the Multicarrier Modulation Transmitter and Receiver **PI Mapped : 2.1.2**
- Q. 2** Explain the concept of OFDMA along with its advantages, disadvantages and applications.
- Q. 3** Draw and Explain OFDMA Transmitter and Receiver.
- Q. 4** Explain BER of OFDM
- Q. 5** Draw and Explain OFDM Transmitter and Receiver schematic with Cyclic Prefix.
- Q. 6** Draw and Explain OFDMA Transmitter and Receiver.
- Q. 7** Explain Cyclic Prefix in OFDM.
- Q. 8** Draw and Explain OFDM Transmitter and Receiver schematic with Cyclic Prefix.
- Q. 9** Explain the MIMO input output system model.
- Q. 10** What is the MIMO Zero Forcing Receiver?
- Q. 11** Draw and Explain MIMO OFDM Transmitter and Receiver model.
- Q.12** Write a short on Multi Antenna Techniques
- Q. 13** Explain concept of MIMO wrt 4G Technology

Q. 14	Explain single-carrier communication system and multi carrier communication system
Q. 15	What are the advantages and disadvantages of MCM system
Q. 16	Define and explain OFDM - PAPR
Q. 17	How to avoid ISI

Question Bank: MCQ

Q. 1	<p>The data rate supported by OFDM is _____.</p> <ul style="list-style-type: none"> ● 1000 Mbps ● 100 Mbps ● 10000 kbps ● 1Mbps
Q. 2	<p>The overall symbol rate in single and MCM systems is _____.</p> <ul style="list-style-type: none"> ● variable ● different ● same ● none of the above
Q. 3	<p>Why is a cyclic prefix required in an OFDMA?</p> <p>a) To ensure symbol time is an integer number</p> <p>b) To help overcome multipath and ISI</p> <p>c) To maintain orthogonality</p> <p>d) To make OFDMA scalable</p>
Q. 4	<p>In MIMO, which factor has the greatest influence on data rates?</p> <p>a) The size of antenna</p> <p>b) The height of the antenna</p> <p>c) The number of transmit antennas</p> <p>d) The area of receive antennas</p>

Q. 5 Common data rates of IEEE 802.11 OFDM are _____

- a) 18 Mbps
- b) 200 Mbps
- c) 50 Mbps
- d) 54 Mbps

Q. 6 OFDM is a technique of

1. encoding digital data
 2. multiple carrier frequencies
 3. wide band digital communication
 4. 4G mobile communication
-
- a. 1,2 and 3 are correct
 - b. 2 and 3 are correct
 - c. 1, 2 and 4 are correct
 - d. All the four correct

1.8 c. Unit No.-III- Introduction to Mobile Communication

Prerequisites:-

Digital Communication concepts

Objectives:-

- To discuss fundamental concepts of mobile communication.

Outcomes:-

- Elaborate fundamental concepts of mobile communication.

PI Mapping:-

- 1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems
- 1.4.1 Apply E&TC engineering concepts to solve engineering 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
- 2.2.4 Compare and contrast alternative solution processes to select the best process.
- 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Cellular Service Progression	T1 & R5 Chapter 3
2	Cell Geometry	
3	Overview of Cellular mobile and Network architecture,	
4	Cellular radio system design	
5	Frequency assignments	
6	Frequency reuse channels	
7	Concept of cell splitting and Cell sectoring	
8	Significance of Handover in cellular systems with Handoff algorithms and roaming	

Question Bank: Theory

- Q. 1** Write a note on frequency reuse and its advantages.
- Q. 2** With a neat diagram explain in brief the concept of frequency reuse, cell splitting and cell sectoring.
- Q. 3** Draw the frequency reuse pattern with cluster size 7.
- Q. 5** Explain different channel assignment strategies.
- Q. 6** What is a handoff? Why is it necessary in a mobile cellular system? Explain mobile assisted handoff.
- Q. 7** With a neat diagram explain intra cell handover and inter cell handover.
- Q. 8** Explain the need of handoff and factors influencing it.
- Q. 9** Draw a neat figure to illustrate the handoff scenario at the cell boundary.
- Q. 10** What is a handoff? Why is it necessary in a mobile cellular system? Explain soft handoff.
- Q. 11** Write a note on interference and system capacity.
- Q. 12** With a neat diagram, describe co-channel and adjacent channel interference in GSM.
- Q. 13** Prove that for hexagonal geometry, the co-channel reuse ratio is given by $Q = (3N)^{1/2}$
- Q. 14** Explain the concept of cell splitting with a neat diagram. Show that if cell radius is reduced by a factor of $\frac{1}{2}$ then traffic load increases by a factor of 4. Assume the shape of the cell as circular.
- Q. 15** What is the microcell zone concept? How is it used to improve capacity?

Q. 16	Explain the following cell sizes with its application : 1. Microcell 2. Pico cell 3. Macro cell 4. Femto cell.
Q. 17	Explain the concept of cellular telephone system along with block diagram.
Q. 18	What are the functions of MTSO?
Q. 19	State various handoff strategies.
Q. 20	Explain the concept of delayed handoff and state its advantages.
Q. 21	State the difference between soft and hard hand off.

Question Bank: Tutorial

Q. 1	A particular FDD cellular system uses two 25 kHz simplex channels to provide full duplex voice and control channels. The total band allocated for the system is 40 MHz. Compute the number of channels available per cell if the system uses : 1. 3 cell reuse 2. 4 cell reuse 3. 12 cell reuse. If 2 MHz of the allocated spectrum is dedicated to control channels, determine the distribution of voice and control channels in each cell and in each of the three systems.
Q. 2	Calculate the system capacity if cluster size is 7 and per cell number of channels are 72. Calculate the system capacity if 14 such clusters are available.
Q. 3	Determine : <ol style="list-style-type: none"> 1. The channel capacity for a cellular telephone area comprised of 7 macrocells with 16 channels per cell. 2. Channel capacity if each macrocell is further split into 4 minicells. 3. Channel capacity if each minicell is further split into 4 microcells.
Q. 4	A spectrum of 30 MHz is allocated to a wireless FDD cellular system which uses two 25 kHz simplex channels to provide full duplex voice and control channel, compute the number of channels available per cell if the system uses: <ol style="list-style-type: none"> 1. 4 cell reuse 2. 7 cell reuse 3. 12 cell reuse

Assume 1 MHz of spectrum is allocated to control the channel. Give distribution of voice and control channels.

Q. 5 Consider a cellular system in which total available voice channels to handle the traffic are 960. The area of each cell is 6 km^2 and the total coverage area of the system is 2000 km^2 . Calculate

1. The system capacity if the cluster size, $N = 4$
2. The system capacity if the cluster size, $N = 7$

How many would a cluster of size 4 have to be replicated to cover the entire cellular area?

Does decreasing the reuse factor increase the N increases the system capacity? Justify your answer.

Q. 6 A cellular system has 32 cells, each cell has 1.6 km radius and the system reuse factor of 7. The system is to support 336 traffic channels in total. Determine the total geographical area covered, the number of traffic channels per cell and total number of simultaneous calls supported by this system.

Q. 7 Define co-channel cells and determine distance from nearest co-channel cell having radius 0.64 km and co-channel reuse factor of 12.

Q. 8 A cellular service provider decides to use a digital cellular method that can tolerate a signal to noise interference ratio 15 dB in the worst case. What is the frequency reuse factor and cluster size for maximum capacity if the path loss exponent is (a) $n = 4$ (b) $n = 3$? Assume that there are 6 co-channels in the first tier and all of them are at the same distance from mobile.

Q. 9 Explain co-channel interference in cellular systems. A cellular system has a cluster size of 7 and the path loss exponent $n = 4$. Determine the S/I for the system. Now, if each cell is separated into 120° sectors, what will be the improvement in S/I compared to a non-sectored system in dB?

Q. 10 Determine the signal to co-channel interference ratio for the system explained in example 9 in dB, assuming path loss exponent $n = 4$. For the same system if, the cell is sectored in 120° sectors, what will be the improvement S/I ratio compared to non-sectored systems, in dB? Also, determine adjacent channel interference for the same system.

Question Bank: MCQ

Q. 1 What are the main reasons for using cellular systems?

- to support many users, low power and localization?
- is profit maximization for service providers
- are user location and frequency reuse
- as they are easy to use.

Q.2 Why are waves with a very low frequency not used for data transmission in computer networks?

- They require large antennas, have lower BW and are difficult to manage in cells and frequency reuse schemes
- They require small antennas and have higher BW
- They do not penetrate material
- They can be easily shielded

Q.3 Which of the following is / are the main part(s) of the basic cellular system?

- A mobile unit
- A cell site
- A mobile telephone switching office
- All of the above

Q.4 State whether true or false

1. The cells or subdivision of a geographical area are always hexagonal
 2. A land to mobile call originates through the telephone exchange
- a) True, False
 - b) False, True
 - c) False, False
 - d) True, True

1.8 d. Unit No.-IV- Wireless System Planning

Prerequisites:-

Digital Communication concepts

Objectives:-

- To perform link budget for wireless-system planning.

Outcomes:-

- Execute wireless-system planning.

PI Mapping:-

- 1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problem
- 1.4.1 Apply E&TC engineering concepts to solve engineering problems.
- 2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem.
- 2.2.2 Identify, assemble and evaluate information and resources.
- 2.2.3 Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions

Lecture No.	Details of the Topic to be covered	References
1	Link-Budget Analysis	from T2 refer 8.8-8.11 with example
2	Link-Budget Analysis	
3	Tele-traffic Theory	
4	Tele-traffic System Model	
5	Tele-traffic System Model	
6	Steady State Analysis	

Question Bank: Theory

Q. 1 Define : Erlang, CCS, holding time, BHCR, BHCA, CCR, grade of service (GOS), blocking probability, trunk, trunking, traffic, calling rate and holding time

Q. 2 Explain the assumptions used in :

1. Pure chance traffic
2. Statistical equilibrium
3. Erlang distribution for queuing systems
4. Second Erlang distribution for queuing systems

Q. 3 Derive second Erlang distribution of a queuing system.

Q. 4 Derive the first Erlang distribution for lost call systems.

Q. 5 Define grade of service and blocking probability for lost call system and explain its significance.

Q. 6 Write short note on :

1. Traffic performance
2. Loss system in tandem

Q. 7 Explain the design procedure for 'N' by 'N' switch with two stages and number of links = N. What is the total number of cross points required?

Q. 8 Derive the second Erlang distribution formula of a queuing system.

Q. 9 Explain with a neat diagram queuing system.

Q. 10 State and explain Erlang's delay formula.

Q. 11 What is the link budget? State and explain formula for link budget.

Q. 12 What is the path loss? Explain the factors affecting path loss.

Q. 13 Derive mathematical model for pure chance traffic.

Q. 14 Derive mathematical model for traffic equilibrium

Question Bank: Tutorial

Q. 1 Consider a wireless-signal-propagation scenario with cell radius $d = 8$ km, carrier frequency $f_c = 2.1$ GHz, transmit antenna height $h_{te} = 40$ m, and receive antenna height $h_{re} = 2$ m. Let the standard deviation $\sigma = 6$ dB for the log-normal shadowing and it is required to achieve a reliability of $\rho = 95\%$. The temperature $T = 293$ K, bandwidth $B = 30$ kHz, noise figure $F = 5$ dB. Further, the wireless link has a receive antenna gain of 5 dB, cabling losses of 3 dB and a transmit antenna gain of 12 dB. Consider a scenario with a level of interference equal to the noise power, and a Rayleigh fading channel with average power unity. Through a link-budget analysis, compute the transmit power required to achieve a bit-error rate of 10^{-4} at the receiver for BPSK modulation.

Q. 2 During the busy hour a company makes 120 outgoing calls of average duration 2 minutes. It receives 200 incoming calls of average duration of 3 minutes. Compute the following :

1. The outgoing traffic
2. The incoming traffic
3. Total traffic

Q. 3 During the busy hour, on an average a customer with a single telephone line makes 3 calls and receives 3 calls. The average call duration is 2 min. What is the probability that a caller will find the line engaged?

Q. 4 In a telephone system, the avg. call duration is 2 min. A call has already lasted for 4 min. What is the probability that

1. will the call last at least another 4 min?
2. will the call end within the next 4 min?

Q. 5 The exchange serves 2000 subscribers. If the average BHCA is 10,000 & CCR is 60%. Calculate BHCR.

Q. 6 A group of 20 servers carry a traffic of 10 E. If the average duration of a call is 3 min, calculate the number of calls put through a single server and the group as a whole in one hour period.

Q. 7 During a busy hour, 1000 calls were offered to a group of trunks & 5 calls were lost. The average call duration was 2 min. Find

1. The traffic offered
2. The traffic carried
3. The traffic lost
4. Grade of service
5. Total duration of congestion

Q. 8 A group of 5 trunks is offered 2 E of traffic. Find :

1. GOS
2. Probability that one trunk is busy
3. Probability that one trunk is free
4. Probability that at least one trunk is free

Q. 9 Group of 18 trunks provide a GOS of 0.01 when offered 15 E of traffic.

1. How much is GOS improved if one trunk is added to the group?
2. How much GOS deteriorates if one trunk is out of service?

Q. 10

- a. By using traffic capacity table for full availability groups find number of trunks required for to give GOS of 0.001 for the following load offered
- b. GOS for 20% overload 0.02 : 1 E, 2 E, 4 E, 10 E, 40 E, 80 E in each case determine the occupancy and number of trunks required per erlang.

Q. 11 A telecommunication company dimensions is route by the following criteria:

1. GOS for normal load : 0.005
2. GOS for 10% overload : 0.02
3. GOS for 20% overload : 0.01
4. GOS for 30% overload : 0.001

From the traffic capacity table for full availability groups find the number of trunks required for 15 E, 55 E and 65 E.

Q. 12 The traffic statistics of a company using EPABX indicates that 200 outgoing calls are initiated every hour during the working hours. Equal number of calls are received. On an average each call lasts for 180 seconds. If the GOS required is 0.01, determine the number of lines required between EPABX and main exchange.

1.8 e. Unit No.-V - Wireless and Mobile Technologies and Protocols and their performance evaluation

Prerequisites: - Digital Communication concepts

Objectives:-

- To understand the protocols and different Generations of Mobile Networks To explain wireless network architecture.

Outcomes:-

- Illustrate wireless network architecture.

PI Mapping:-

- 1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problem
- 1.4.1 Apply E&TC engineering concepts to solve engineering problems.
- 2.1.2 Identify engineering systems, variables, and parameters to solve the problems
- 2.2.4 Compare and contrast alternative solution processes to select the best process.
- 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

Lecture No.	Details of the Topic to be covered	References
1	Introduction, Wireless and mobile technologies	R4- “Modeling and simulation of computer networks and systems: Methodologies and applications” by Obaidat, P. Nicopolitids
2	LTE- advanced	
3	5G – Architecture	
4	Wireless local area network	
5	Simulations of wireless networks	

Question Bank: Theory
Theory Paper

Q. 1 Draw a neat diagram of GSM architecture and explain the function of each block in it.

Q. 2	Explain the functions of MSC, BSC and VLR in GSM architecture
Q. 3	State and explain the data services in GSM
Q. 4	Write down the applications, advantages and disadvantages of GSM
Q. 5	Explain the features and services of GPRS
Q. 6	Comparison between GPR and GSM
Q. 7	Explain GSM EDGE Network Architecture
Q. 8	Explain 3G Mobile Technologies, its advantages, disadvantages and applications
Q. 9	Explain UMTS Network Architecture
Q. 10	Describe 4th Generation Mobile Technologies
Q. 11	Explain LTE Network Architecture
Q. 12	List out various opportunities and challenges in 5G Technologies
Q. 13	With the help of Layers, explain 5G concept in wireless technology
Q. 14	Explain 1G to 5G mobile generations
Q. 13	With the help of Layers, explain 5G concept in wireless technology
Q. 14	Explain 1G to 5G mobile generations
Q. 15	Compare GSM and CDMA

Q. 16	State the specification of 4G LTE
Q. 17	Explain various phases in development of 4G LTE
Q. 18	Explain LTE Network Architecture
Q. 19	Explain FDD frame structure in LTE
Q. 20	Explain LTE frame structure in detail
Q. 21	Write short note on 5G
Q. 22	State advantages and disadvantages of WLAN
Q. 23	Explain FDD frame structure in LTE
Q. 24	Explain different architectures of WLAN
Q. 25	Explain the protocol architecture of IEEE 802.11
Q. 26	Explain in detail IEEE 802.11 MAC sub layer
Q. 27	Describe MAC frame structure for IEEE 802.11
Q. 28	Compare various IEEE 802.11x standards (a/b/g/i/n etc.)

1.8 f. Unit No.-VI- Performance Analysis Issues

Pre-requisites:- Digital Communication concepts

Objectives:-

To elaborate various performance parameters in wireless communication.

Outcomes:-

- Identify various performance parameters in wireless communication.

PI Mapping:-

- 1.1.1 Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problem
- 1.4.1 Apply E&TC engineering concepts to solve engineering problems.
- 2.2.4 Compare and contrast alternative solution processes to select the best process.
- 2.4.1 Apply engineering mathematics and computations to solve mathematical models
- 2.4.4 Extract desired understanding and conclusions consistent with objectives and limitations of the analysis

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Network coding	From Internet Source
2	Basic hamming code and significance of Information Theory	R2- 13.1, 13.2, 14.1, 14.2 and 14.3
3	Interference suppression and Power control.	R4 - 4, 4.1, 4.2 and 4.3
4	MAC layer scheduling and connection admission in mobile communication.	

Question Bank: Theory

Q. 1 Write short note on measure of Information

Q. 2 Define Entropy

Q. 3	Derive the equation for maximum Entropy. Give its properties.
Q. 4	Explain types of channel
Q. 5	Derive the channel capacity of Binary Symmetric channel
Q. 6	State Shannon's second theorem/ State channel coding theorem.
Q. 7	Explain Information capacity theorem
Q. 8	Prove that maximum capacity for a channel with infinite Bandwidth will be $1.44 * S/N_0$ where S is the signal power and N_0 is noise power spectral density
Q. 9	Show that Shannon's limit for AWGN channel is -1.6dB
Q. 10	State the types of Error in digital communication system
Q. 11	Explain the following with reference to Linear Block Code: <ul style="list-style-type: none"> i. Hamming Weight ii. Hamming Distance iii. Hamming Code iv. Code Rate v. Block Length
Q. 12	Explain Hamming Code with suitable examples
Q. 13	Explain salient features of CDMA
Q. 14	Write a short note on Medium Access Protocol

Q. 15 Compare FDMA, TDMA, CDMA and SDMA

Q. 16 Explain various ALOHA Protocols

Question Bank: Tutorial

Q. 1 A binary symbol occurs with a probability of 0.75. Determine the information in bits.

Q. 2 A source puts outcome of the five possible messages during each message interval. The probabilities of these messages are $P_1=1/2$, $P_2=1/4$, $P_3=1/8$, $P_4=1/16$, $P_5=1/16$

Q. 3 Prove that the entropy of extremely likely and extremely unlikely message is zero.

Q. 4 A discrete memoryless source is capable of transmitting three distant symbols m_0 , m_1 and m_2 . Their probabilities are $1/2$, $1/4$, $1/4$. Calculate the source entropy.

Q. 5 Find the entropy of the second order extended source of the discrete memoryless source. This source is capable of transmitting 3 distinct symbols m_0 , m_1 and m_2 . Their probabilities are $1/2$, $1/4$, $1/4$.

Q. 6 A source emits 1000 symbols per second from a range of 5 symbols with probabilities $[1/2, 1/4, 1/8, 1/16, 1/16]$. Find source entropy and information rate.

Q. 7 A 3 bit PCM system generates 1000 samples/sec. If the quantized samples are produced by the system with probabilities $\{1/4, 1/4, 1/8, 1/8, 1/16, 1/16, 1/16, 1/16\}$. Then find the information rate. If symbols are equiprobable, what will be the information rate?

Q. 8 A channel has a bandwidth of 5kHz and Signal to Noise power Ratio of 63. Determine the BW needed if SNR is reduced to 31.

Q. 9 A voice grade telephone channel has a BW of 3400Hz. If the SNR on the channel is 30dB, calculate channel capacity. If the channel is to be used to transmit 48000 bps of data, find min SNR needed

Q. 10 Find the capacity of channel, if $P(y_1/x_1) = 0.5$

Q. 11 A Gaussian has 2MHz BW. Calculate the channel capacity if the signal power to noise spectral density ratio is 10^5 Hz. Also find the maximum information rate at which information is transmitted.

Q. 12 Find the capacity of a channel having BW 1MHz and SNR of 10 dB

Q. 13 Encode the data block 1011 using Hamming code assuming even parity

Q. 14 Encode 1100 using (7,4) Hamming code if odd parity is used

Q. 15 Generate Hamming Code for Binary sata 110110 at the transmitter and decode the coded sequence at the receiver

1.9 List of Practical

Sr. No.	Name of Experiment	Simulation Software used	CO Mapped
Group A			
1	Compute and compare the median loss by employing Hata model for various distances for carrier frequencies of 2.1 GHz and 6 GHz. Assume transmit and receive antenna heights of 40 m and 2 m in a large city. Plot the graph of path loss vs distance.	MATLAB	
2	Simulate BER performance over a Rayleigh fading wireless channel with BPSK transmission for SNR: 0 to 50 dB.	MATLAB	
3	Simulate BER performance over a wireline AWGN channel with BPSK transmission for SNR: 0 to 50 dB.	MATLAB	
Group B			
4	Perform a Link-Budget analysis for a wireless communication system.	MATLAB	
5	Simulate BER performance of multi-antenna Rayleigh channel for SNR varying from 0 to 60 dB.	MATLAB	
6	Compute doppler shift of the received signal for different carrier frequency of mobile generations by considering vehicle is moving at 60 miles per hour at an angle of 30 degree with the line joining the base station.	Scilab	
Group C			
7	Simulate mobile environment to evaluate performance parameters using any open source Network Simulator tool.	NS2	

8	Program to implement OFDM and evaluate frame error rate against SNR.	MATLAB	
9	Simulate a cellular system with 48 channels per cell and blocking probability of 2%. Assume traffic per user is 0.04 E. What is the number of users that can be supported in a city of 603 km ² area if cell radios are changed in the steps of 500 m, 700m, 900 m, 1000 m, 1200 m and 1500 m.	Scilab	

Oral Questions:

Practical 1: Hata Model

1. Name the different outdoor propagation models.
2. Is the Okumura model suitable for urban / rural areas?
3. State the application of the Okumura model.
4. Is the Hata model used for signal strength prediction?
5. What is L_{50} dB?
6. State the constraints on transmit and receive antenna heights in the Hata Model.
7. State the features of the Okumura Model.
8. Hata model is valid for which frequency range?
9. State the features of the Hata Model.

Practical 2, 3, 5: SNR vs BER for various channels

10. What is the concept of a multi-antenna Rayleigh channel?
11. If $L=2$ & $L=4$, then, what is the variation observed in the BER of the multi-antenna Rayleigh channel?
12. What is the wireline AWGN channel?
13. What is the effect on BER if SNR increases?
14. Why does BER decrease as SNR increases?

Practical 4: Link budget analysis

15. What is the link budget? State and explain formula for link budget.
16. What is the path loss? Explain the factors affecting path loss.
17. Name the various additive and negative components for the net signal power at the receiver.
18. In this experiment as the bandwidth goes on increasing what is its effect on the transmitted power?

Practical 6: Doppler shift

19. State the formula for the mobile's Doppler frequency.
20. What is constructive and destructive interference?
21. Explain the concept of fading in a multipath environment.

Practical 7: OFDM

22. How many subcarriers are used in this experiment?
23. How many subcarriers are allotted for data, pilot and how many are unused?

24. What is the concept of cyclic prefix? Why is it used in OFDM?
25. What is the duration of the BPSK-OFDM symbol in this experiment?
26. What is the total BW assumed in this experiment?
27. How much BW is allotted to each subcarrier in this experiment?
28. How many symbols are allotted for cyclic prefix?
29. Which modulation is used in this experiment?

Practical 9: Cellular System

30. Define blocking probability.
31. Define traffic.
32. What is the unit of traffic?
33. $1 \text{ E} = \text{___ CCS} = \text{___ CS} = \text{___ CM}$. Fill in the blanks.
34. If cell radius is increased, what is its effect on the number of users?
35. What is meant by cell splitting, cell sectorization?
36. What is the concept of frequency reuse? What are its advantages?
37. What is a cell?
38. What is the function of MTSO?
39. With the help of cell splitting / sectoring does the cell capacity increase?

2.Name of the course: Project Management (304193)

Weekly Workload(in Hrs)	Lecture	Tutorial	Practical
	3	-	-

Online/ In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30	70	-	-	-	100	3

2.1 Syllabus

Unit I: Fundamentals of Project Management

6 Hrs

Basics of Project Management: Definition of Project, The Project Life Cycle, Definition of project management, Need of Project management, Project Management process and its importance, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

Unit II : Project Identification, Selection & Planning

6 Hrs

Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre Feasibility Study, Feasibility Studies, Project Break-even point.

Project Planning: Introduction and need for Project Planning, Project Life Cycle, Roles, Responsibility and Teamwork, Project Planning Process, Work Breakdown Structure (WBS).

Unit III : Project Organizational structure & Issues

7 Hrs

Organizational Structure and Organizational Issues: Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management

Unit IV : Project Scheduling

7 Hrs

PERT and CPM: Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System **Resources Considerations in Projects:** Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts

Unit V : Project Risk & Financial Management

8 Hrs

Project Risk Management: Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks
Introduction to Project Management Tools such as: Trello, JIRA and Asana.

Financial Management in Projects: Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance, Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models.

Unit VI : Product Development & Entrepreneurship

8 Hrs

Product Development: Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations, concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design

Entrepreneurship: Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process; factors impacting emergence of entrepreneurship

Legal issues related to Product development and Entrepreneurship: Intellectual property rights- patents, trademarks, copyrights, trade secrets, licensing, franchising.

2.2 Course Objectives

- To explain the fundamentals of project management, project identification, project planning, and selection criteria of the project.
- To illustrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources.
- To describe how to handle the risks effectively as well as managing finances for the project.
- To introduce the complete product development process and requirements for entrepreneurship along with related legal issues.

2.3 Course Outcomes

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

- Explain the fundamentals of project management, project identification, project planning, and selection criteria of the project. (BTL-2) (Unit 1,2)
- Demonstrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources. (BTL-3) (Unit 3,4)

- Describe how to handle the risks effectively as well as how to manage finances for the project. (BTL-2) (Unit 5)
- Discuss the complete product development process and requirements for entrepreneurship along with related legal issues. (BTL-2) (Unit 6)

2.4 Textbooks:

1. H.Kerzer, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", John Wiley & Sons, Inc., 10th Edition, 2009.
2. Chandra, P., "Projects", Tata McGraw-Hill Education, 8th Edition, 2009.

2.5 Reference Books

1. Morris, P. W. G. and Pinto, J. K., "The Wiley Guide to Managing Projects", JohnWiley & Sons, 2004.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3rd Edition 2009.
3. R. Majumdar, "Product Management in India", PHI, 2nd Edition, 2010.
4. G.S. Batra, "Development of Entrepreneurship", Deep and Deep publications, New Delhi.
5. Christine Petersen, "The Practical Guide to Project Management", PMP, 1st Edition, 2013.
6. Russell W. Darnall, John M. Preston, "Project Management from Simple to Complex", The Saylor Foundation.
7. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 2nd Edition, 1969.
8. Lewis, R., "Project Management: Strategic Design and Implementation", McGraw-Hill, 5th Edition. 2006.
9. Venkataraman. R., J.K. Pinto, "Cost and Value Management in Projects", John Wiley & sons.

2.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	1	Fundamentals of Project Management	T1	8 Hrs
2	2	Project Identification, Selection & Planning	T1,T2	6 Hrs
3	3	Project Organizational structure & Issues	T1,R5,R6	6 Hrs
4	4	Project Scheduling	R4	6 Hrs
5	5	Project Risk & Financial Management	T1,R2	6 Hrs
6	6	Product Development & Entrepreneurship	T3	6 Hrs

Overview of Teaching Plan

Unit	Broad Topics Covered	Total Lectures Planned	CO Addressed
1.	Fundamentals of Project Management	6 Hrs	CO1 2.2.1, 2.2.2, 2.2.4 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4 9.3.1
2.	Project Identification, Selection & Planning	6 Hrs	CO1 2.2.1, 2.2.2, 2.2.4 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4 9.3.1
3.	Project Organizational structure & Issues	7 Hrs	CO2 10.5.1, 10.5.2, 10.6.2 11.3.1, 11.3.2
4.	Project Scheduling	7 Hrs	CO2 10.5.1, 10.5.2, 10.6.2

			11.3.1, 11.3.2
5.	Project Risk & Financial Management	8 Hrs	CO3 11.1.1, 11.1.2, 11.2.1, 11.3.2
6.	Product Development & Entrepreneurship	8 Hrs	CO4 10.1.1, 10.1.2, 10.1.2 11.1.1, 11.1.2, 11.2.1, 11.3.2

Individual Hour wise plan:

Lect No	Unit	Topics Covered
1	1	Definition of Project, The Project Life Cycle,
2	1	Definition of project management, Need of Project management,
3	1	Project Management process and its importance,
4	1	The Project Manager (PM), Phases of Project Management Life Cycle,
5	1	Project Management Processes, Impact of Delays in Project Completions,
6	1	Essentials of Project Management Philosophy, Project Management Principles.
8	2	Project Identification and Selection: Introduction, Project Identification Process,
9	2	Project Initiation, Pre Feasibility Study, Feasibility Studies,
10	2	Project Break-even point. Introduction and need for Project Planning,
11	2	Project Life Cycle, Roles,
12	2	Responsibility and Teamwork, P
13	2	Project Planning Process, Work Breakdown Structure (WBS)
14	3	Introduction, Concept of Organizational Structure,

15	3	Roles and Responsibilities of Project Leader,
16	3	Relationship between Project Manager and Line Manager,
17	3	Leadership Styles for Project Managers,
18	3	Conflict Resolution,
19	3	Team Management and Diversity Management,
20	3	Change management
21	4	PERT and CPM: Introduction,
22	4	Development of Project Network, Time Estimation,
23	4	Determination of the Critical Path, PERT Model, Measures of variability,
24	4	CPM Model, Network Cost System Resources Considerations in Projects:
25	4	Introduction, Resource Allocation,
26	4	Project Cost Estimate and Budgets, Cost Forecasts
27	4	Resource Scheduling,
28	5	Introduction, Risk, Risk Management,
29	5	Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks
30	5	Introduction to Project Management Tools such as: Trello, JIRA and Asana.
31	5	Financial Management in Projects: Project Finance structure,
32	5	Process of Project Financial Management:
33	5	Conducting Feasibility Studies, Planning the Project Finance,
34	5	Arranging the Financial Package, Controlling the Financial Package,
35	5	Controlling Financial Risk, Options Models
36	6	Product Development: Introduction, Development Process and organizations,

		product planning, identifying customer needs, Product Significations,
37	6	concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design
38	6	Entrepreneurship: Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process;
39	6	factors impacting emergence of entrepreneurship
40	6	Legal issues related to Product development and Entrepreneurship:
41	6	Intellectual property rights- patents,
42	6	trademarks, copyrights, trade secrets,
43	6	licensing, franchising.

2.8 Unit wise Lecture Plan

2.8 a. Unit No.-I

Fundamentals of Project Management

Pre-requisites :- Knowledge of Basic Management Concepts

Objectives :- To explain the fundamentals of project management, project identification, project planning, and selection criteria of the project.

Outcomes:- Explain the fundamentals of project management, project identification, project planning, and selection criteria of the project. (BTL-2) (Unit 1,2)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Definition of Project, The Project Life Cycle,	T1	CO1
2	Definition of project management, Need of Project management,	T1	

3	Project Management process and its importance,	T1	
4	The Project Manager (PM), Phases of Project Management Life Cycle,	T1	
5	Project Management Processes, Impact of Delays in Project Completions,	T1	
6	Essentials of Project Management Philosophy,	T1	

Question Bank: Theory

Theory Paper (2.2.1, 2.2.2, 2.2.4, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)

Q. 1 How do you correlate the terms 'Organization, Management and Administration' ? List out various functions of Management.

Q. 2 Explain different forms of ownerships

Q. 3 What are the different managerial levels? Elaborate on the different skills required at each level.

Q. 4 Define an "Organization". What are its common characteristics? Compare a "Traditional Organization" and "New Organization"

Q. 5 What are functions of management? Explain steps in planning with flowchart

Q. 6 Discuss four major principles distinguished by F.W.Taylor in management field

Q. 7 Draw organization charts of a line and staff organization. Give four merits and demerits

Q. 8 Explain different Managerial roles

Q. 9	Explain Characteristics of Management
Q. 10	Explain different business sectors in detail
Q.11	Explain Concept of globalization in detail

Q. 12	Compare private and public limited companies. Discuss advantages of joint stock organization
--------------	--

2.8 b. Unit No.-II

Project Identification, Selection & Planning

Pre-requisites: - Importance of Quality

Objectives: - To explain the fundamentals of project management, project identification, project planning, and selection criteria of the project.

Outcomes: - Explain the fundamentals of project management, project identification, project planning, and selection criteria of the project. (BTL-2) (Unit 1,2)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Project Identification and Selection: Introduction, Project Identification Process,	T1,T2	CO1
2	Project Initiation, Pre Feasibility Study, Feasibility Studies,	T1,T2	
3	Project Break-even point. Introduction and need for Project Planning,	T1,T2	
4	Project Life Cycle, Roles,	T1,T2	
5	Responsibility and Teamwork, P	T1,T2	
6	Project Planning Process, Work Breakdown	T1,T2	

	Structure (WBS)		
--	-----------------	--	--

Question Bank:
Theory Paper (2.2.1, 2.2.2, 2.2.4, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)

Q.1	What are 4 methods for identifying and selecting IS projects?
-----	---

Q.2	What are the steps in project identification and selection?
-----	---

Q.3	What type of questions should you consider when planning your project?
-----	--

Q.4	How do you identify a project identification?
-----	---

Q.5	What is the importance of project identification?
-----	---

Q.6	How does project selection differ from project identification?
-----	--

Q.7	What are the problems to be faced in the process of project identification?
-----	---

Q.8	What are the key phases of project identification?
-----	--

Q.9	What are the 4 questions needed in making the project plan?
-----	---

Q.10	What is project selection?
------	----------------------------

Q.11	What are the factors to be looked into in the selections of a project by an entrepreneur?
-------------	---

Q.12	What questions should be answered when planning and organizing a workplan?
-------------	--

2.8 c. Unit No.-III

Project Organizational structure & Issues

Pre-requisites :- Knowledge of finance requirement

Objectives:- To illustrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources.

Outcomes:- Demonstrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources. (BTL-3) (Unit 3,4)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Introduction, Concept of Organizational Structure,	T1,R5,R6	CO2
2	Roles and Responsibilities of Project Leader,	T1,R5,R6	
3	Relationship between Project Manager and Line Manager,	T1,R5,R6	
4	Leadership Styles for Project Managers,	T1,R5,R6	
5	Conflict Resolution,	T1,R5,R6	
6	Team Management and Diversity Management,	T1,R5,R6	
7	Change management	T1,R5,R6	

Question Bank

Theory Paper (10.5.1, 10.5.2, 10.6.2,11.3.1, 11.3.2)

Q. 1	What are some of the issues with organizational structure?
Q. 2	What are the 4 types of project organizational structures?
Q. 3	How do you solve organizational structure problems?
Q. 4	What factors affect organizational structure design?
Q.5	How can you establish project organisation and structure?
Q. 6	What are the challenges of organizational development?
Q. 7	How will knowing an organization's structure help employees?
Q. 8	Can an organization's structure be changed quickly?
Q. 9	Why it is important to understand the organizational structure where the project will be completed?
Q. 10	What are some ways that organizational structure can impact the role of project manager?
Q. 11	What role does organizational structure play in the organization's efficiency and effectiveness?
Q. 12	How does the organizational structure in each company affect communication?

2.8 d. Unit No.-IV

Project Scheduling

Prerequisites:- Need of HR Management

Objectives:- To illustrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources.

Outcomes:- Demonstrate the concept of organizational structure within a project and the techniques for effective project scheduling considering resources. (BTL-3) (Unit 3,4)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	PERT and CPM: Introduction,	R4	CO2
2	Development of Project Network, Time Estimation,	R4	
3	Determination of the Critical Path, PERT Model, Measures of variability,	R4	
4	CPM Model, Network Cost System Resources Considerations in Projects	R4	
5	Introduction, Resource Allocation,	R4	
6	Project Cost Estimate and Budgets, Cost Forecasts	R4	
7	Resource Scheduling	R4	

Question Bank

Theory Paper (10.5.1, 10.5.2, 10.6.2,11.3.1, 11.3.2)

Q. 1 What are the challenges while scheduling a project?

Q. 2 What does project scheduling include?

Q. 3 What are the 7 questions you should ask yourself before embarking on a research project?

Q. 4 Why are schedules underestimated on projects?

Q. 5	.Why schedule issues often cause the most conflicts on projects?
Q. 6	What makes scheduling coordination difficult?
Q. 7	What are the tools for project scheduling?
Q. 8	How do you control a project schedule?
Q. 9	.What is schedule overrun during the construction of the project?
Q.10	What are the factors most challenging about scheduling?
Q.11	When should the project schedule be developed?
Q. 12	How do you prevent schedule overruns?
Q. 13	.How do you manage schedule slippage for a project?

2.8 e. Unit No.-V

Project Risk & Financial Management

Prerequisites:- Need of Entrepreneurship

Objectives:- To describe how to handle the risks effectively as well as managing finances for the project.

Outcomes:- Describe how to handle the risks effectively as well as how to manage finances for the project. (BTL-2) (Unit 5)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Introduction, Risk, Risk Management,	T1,R2	CO3
2	Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks	T1,R2	
3	Introduction to project management tools such as : Trello, JIRA, Asana.	T1,R2	
4	Financial management in projects: Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance	T1,R2	
5	Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models	T1,R2	
6	Introduction, Risk, Risk Management,	T1,R2	
7	Arranging the Financial Package, Controlling the Financial Package,	T1,R2	
8	Controlling Financial Risk, Options Models	T1,R2	

Question Bank: Theory
Theory Paper (11.1.1, 11.1.2, 11.2.1, 11.3.2)

Q. 1 What are the 3 most general categories of risks to a project?

Q. 2 What is financial risk in project management?

Q. 3 What are the 3 5 most significant risks that could affect the project's progress and completion?

Q. 4 What are the five questions in assessing risk factors?

Q. 5 How do you manage risk in a project interview question?

Q. 6 How does project Impact risk?

Q. 7 How can project management reduce risk?

Q. 8 What are the 4 types of financial risk?

Q. 9 How can project risk management help improve project performance?

Q. 10 How does risk affect a company's financial decisions?

Q. 11 How does financial risk arise and how to measure it?

Q. 12 What is the difference between project risk and business risk?

2.8 f. Unit No.-VI

Product Development & Entrepreneurship

Prerequisites:-Concept of Marketing

Objectives:- To introduce the complete product development process and requirements for entrepreneurship along with related legal issues.

Outcomes:- Discuss the complete product development process and requirements for entrepreneurship along with related legal issues. (BTL-2) (Unit 6)

Lecture No.	Details of the Topic to be covered	References	CO Addressed
1	Product Development: Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations,	T3	CO4
2	concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design	T3	
3	Entrepreneurship: Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process;	T3	
4	factors impacting emergence of entrepreneurship	T3	
5	Legal issues related to Product development and Entrepreneurship:	T3	
6	Intellectual property rights- patents,	T3	
	trademarks, copyrights, trade secrets,		
	licensing, franchising.		

Question Bank: Theory

Theory Paper (10.1.1, 10.1.2, 10.1.2, 11.1.1, 11.1.2, 11.2.1, 11.3.2)

Q. 1 What is product development in entrepreneurship?

Q. 2 Why is new product development important to entrepreneurs?

Q. 3 What are the 4 types of product development processes?

Q. 4 What are the challenges in product development strategy?

Q. 5 What problems could occur when introducing a new product to your business?

Q. 6 Why is quality considered for product development?

Q. 7 What motivates you to become an entrepreneur?

Q. 8 What do you need to possess to become a successful entrepreneur?

Q. 9 Why do entrepreneurs try to start businesses or develop new products?

Q. 10 What is the difference between a small business and an entrepreneur?

Q. 11 What is the importance of knowing the characteristics of an entrepreneur?

Q. 12 What are the challenges that an entrepreneur is facing nowadays?

3. Name of the Subject – Power Devices & Circuits (304186)

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

Online / In-sem	Theory	Practical	Oral	Term-work	Total Marks	Credit
30 M	70 M	50 M	-	50 M	200	

3.1 Syllabus

Unit I: Study of Power Devices (6L)

Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR, GTO, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, various repetitive and non-repetitive ratings of SCR, GTO, Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto-isolator) circuits for various power devices, importance of series and parallel operations of various power devices (no derivation and numerical).

Unit II: AC-DC Power Converters (6L)

Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads and its performance analysis and numerical, Effect of source inductance, Significance of power factor and its improvement using PWM based techniques, three phase Full converters using SCR for R load and its performance analysis, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers.

Unit III: DC-AC Converters (6L)

Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, concept and need of harmonic elimination / reduction in inverters, Three Phase voltage source inverter for balanced star R load with 120 and 180 degree mode of operation, device utilization factor,

Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits (no derivation and numerical).

Unit IV: DC-DC converters (6L)

Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non-isolated) such as type A, B, C, D & E, switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back, Half and full Bridge isolated and non-isolated interleaved bidirectional topologies, and concept of integrated converter and design of LM3524 based choppers, concept of maximum power point tracking (MPPT).

Unit V: Power Devices Protection and Circuits (6L)

Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design, Resonant converters such as Zero current switching (ZCS) and Zero voltage switching (ZVS), Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards, Importance of isolation transformer.

Unit VI: Power Electronics Applications (6L)

AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver, DC motor drive for single phase separately excited dc motor, BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs, Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger, case study of power electronics in electric vehicle and photovoltaic solar system.

3.2 Course Objectives:

- To Introduce different power devices, their construction, characteristics and triggering circuits.
- To Explain working of AC voltage controllers, resonant converters & analysis of controlled rectifiers, inverters, DC choppers for different loads.
- To Describe different protection circuits & EMI minimizing techniques.

- To Describe different motors drives, various power electronics applications like UPS, SMPS, Fan Regulator, Electronic Ballast, LED Lamp driver etc.

3.3 Course Outcomes:

After successfully completing the `course students will be able to

1. Explain different power devices, their construction, characteristics and triggering circuits. **(Level 2 Understand)**
2. Analyze performance of AC voltage controllers, controlled rectifiers, inverters, DC choppers for different loads. **(Level 4 Analysis)**
3. Describe working of different resonant converters, protection circuits & EMI minimizing techniques. **(Level 2 Understand)**
4. Elaborate different motor drives, & various power electronics applications like UPS, SMPS, Fan Regulator, Electronic Ballast, LED Lamp driver etc. **(Level 2 Understand)**

3.4 Text Books:

1. M. H. Rashid, “Power Electronics circuits devices and applications”, PHI 4th edition 2017, New Delhi.
4. M. D. Singh and K. B. Khanchandani, “Power Electronics”, TMH, 2nd Edition 2006.

3.5 Reference Books

1. Bogdan M. Wilamowski, J. David Irwin, “The Power Electronics and Motor Drives Handbook”, CRC Press, 1st Edition, 2011. ; eBook: ISBN 9780429165627, 2019.
2. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters publications and design” 2nd edition, John Willey & sons, Singapore
3. P.C. Sen, “Modern Power Electronics”, S Chand & Co New Delhi.
4. Ali Emadi Alireza Khaligh Zhong Nie Young Joo Lee, “Integrated Power Electronic Converters and Digital Control”, CRC Press, 1st Edition.
5. Vinod Kumar Khanna “Insulated Gate Bipolar Transistor IGBT Theory and Design”, John Wiley & Sons, Illustrated Edition.
6. L. Ashok Kumar, S. Albert Alexander and Madhuvanthani Rajendran, “Power Electronic Converters for Solar Photovoltaic Systems”, Elsevier, 1st Edition, 2020.

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

www.nptel.ac.in

www.nptelvideos.in

www.freevideolectures.com

NPTEL Course on “Power Electronics ”

Link of the Course:

<https://nptel.ac.in/courses/108/105/108105066/>

<https://nptel.ac.in/courses/108/102/108102145/>

<https://nptel.ac.in/courses/108/107/108107128/>

<https://nptel.ac.in/courses/108/108/108108077/>

<https://batteryuniversity.com/>

3.7 Teaching Plan & CO -PI Mapped

Sr. No.	Unit	Topics to be covered	Books Referred	CO Mapped	PI Mapped	Total Lecture Planned
1	I	Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR, GTO, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, various repetitive and non-repetitive ratings of SCR, GTO , Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto-isolator) circuits for various power devices, importance of series and parallel operations of various power devices (no derivation and numerical).	T1, T2, R2, R3	CO1	1.4.1 2.1.2	9L

2	II	<p>Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads and its performance analysis and numerical, Effect of source inductance, Significance of power factor and its improvement using PWM based techniques, three phase Full converters using SCR for R load and its performance analysis, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers.</p>	T1, T2, R2, R3	CO2	1.4.1 2.1.2 2.3.1 2.2.3 2.2.4	7L
3	III	<p>Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, concept and need of harmonic elimination / reduction in inverters, Three Phase voltage source inverter for balanced star R load with 120 and 180 degree mode of operation, device utilization factor, Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits (no derivation and numerical).</p>	T1, T2, R2	CO2	1.4.1 2.1.2 2.3.1 2.2.3 2.2.4	8L

4	IV	Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non-isolated) such as type A, B, C, D & E, switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back, Half and full Bridge isolated and non-isolated interleaved bidirectional topologies, and concept of integrated converter and design of LM3524 based choppers, concept of maximum power point tracking (MPPT).	T1, T2, R2, R3	CO2	1.4.1 2.1.2 2.3.1 2.2.3 2.2.4	6L
5	V	Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design, Resonant converters such as Zero current switching (ZCS) and Zero voltage switching (ZVS), Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards, Importance of isolation transformer.	T1, T2, R2, R3	CO3	2.2.4 7.1.1 7.2.2	6L
6	VI	AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver, DC motor drive for single phase separately excited dc motor, BLDC motor drive, Variable	T1, T2, R1, R6	CO4	1.4.1 2.1.2 2.2.4	6L

		<p>voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs, Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger, case study of power electronics in electric vehicle and photovoltaic solar system.</p>				
--	--	--	--	--	--	--

3.8 Unit wise Lecture Plan

3.8 a. Unit No.-I- Power Devices

Pre-requisites: - Electronic Devices & Circuits, Basic Electronics

Objectives: -

1. To introduce the fundamentals, Construction, Steady state characteristics of various power devices such as SCR, MOSFET, IGBT.
2. To explain drive circuits requirements & various drive circuits for SCR, MOSFET, IGBT. To explain series and parallel operations of SCR 's.

Outcomes: -

After successfully completing the course students will be able to

1. Describe the fundamentals, Construction, Steady state characteristics of various power devices such as SCR, MOSFET, IGBT.
2. To explain drive circuits requirements & various drive circuits for SCR, MOSFET, IGBT. To explain series and parallel operations of SCR's.

Lecture No.	Details of the Topic to be covered	References
1	Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR,	T1, T2, R2, R3
2	Construction, VI characteristics (input, output and transfer if any), switching characteristics of GTO	
3	Construction, VI characteristics (input, output and transfer if any), switching characteristics of Power MOSFET	
4	Construction, VI characteristics (input, output and transfer if any), switching characteristics and IGBT	
5	Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT,	
6	Various repetitive and non-repetitive ratings of SCR, GTO, Power MOSFET & IGBT and their significance,	
7	Requirement of a typical triggering / driver (such as opto-isolator) circuits for various power devices	
8	Importance of series and parallel operations of various power devices	
9	Synchronized UJT triggering – Content Beyond Syllabus	

Question Bank: Theory

CO Mapped: CO1

PI Mapped: 1.4.1, 2.1.2

- Q. 1** Explain construction of SCR, GTO, Power MOSFET & IGBT.
- Q. 2** Draw & explain V-I characteristics of GTO.
- Q. 3** Draw & explain V-I characteristics of SCR.
- Q. 4** Why SCR is called as current controlled device? Define Latching current and Holding current.
- Q. 5** Explain applications of Power MOSFET & GTO.
- Q. 6** Explain output (drain) and transfer characteristics of IGBT.
- Q. 7** Give a comparison between MOSFET, IGBT, GTO & SCR.
- Q. 8** Draw & explain two transistor analogy of SCR.
- Q. 9** Explain SCR ratings: I_L , I_H , V_{BO} , V_{BR} , dv/dt , di/dt , surge current & rated current
- Q.10** Draw construction of N-channel enhancement type MOSFET & explain its steady state characteristics.

Q.11	Explain construction & steady state characteristics of SCR.
Q.12	
Q.13	Compare freewheeling & feedback diode.
Q.14	Draw & explain gate drive circuits for Power MOSFET & IGBT
Q.15	Explain in detail gate drive requirements for Power MOSFET & IGBT.
Q.16	Draw & explain in detail series and parallel operations of SCR's.
Q.17	Explain in detail applications of all power devices as a switch with relevant circuit diagram.
Q.18	Draw & explain in detail opto isolator driving circuits for SCR.
Q.19	Explain various repetitive and non-repetitive ratings of SCR, GTO, Power MOSFET & IGBT and their significance,
Q.20	Explain SCR ratings: I_L , I_H , V_{BO} , V_{BR} , dv/dt , di/dt , surge current & rated current.

3.8 b. Unit No.-II- AC-DC Power Converters

Pre-requisites:- Electronic Devices & Circuits, Basic Electronics

Objectives:-

1. To introduce working & analysis of single phase controlled rectifiers for different loads.
2. To explain working & analysis of three phase converters for R load.

Outcomes:-

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

1. To describe working & analysis of single phase controlled rectifiers for different loads.
2. To describe working & analysis of three phase converters for R load.

Lecture No.	Details of the Topic to be covered	References
1	Concept of line & forced commutation, Single phase Semi converters for R and R-L loads	T1, T2, R2, R3
2	Single phase Full converters using SCR for R and R-L loads	
3	Performance analysis and numerical	
4	Effect of source inductance, Significance of power factor and its improvement using PWM based techniques	
5	Three phase Full converters using SCR for R load and its performance analysis,	
6	Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT	
7	Difference between SCR based conventional rectifiers and IGBT based rectifiers.	

Question Bank: Theory
CO Mapped: CO2
PI Mapped: 1.4.1, 2.1.2, 2.3.1, 2.2.3, 2.2.4

Q. 1	What are converters? Explain with circuit diagram and waveforms working of Single Phase half controlled converter with R load & R-L loads.
Q. 2	Explain line & forced commutation.
Q. 3	With neat circuit diagram and all necessary waveforms explain the working of three phase fully controlled bridge converter feeding R load. Explain modes of operation.
Q. 4	A single phase semi converter is operated from 120 V, 50 Hz AC supply. The load is resistive having resistance of 15 ohm. If the average output voltage is 25% of the maximum possible average output voltage, determine firing angle α .
Q. 5	Explain the significance of free-wheeling diode in controlled rectifiers.
Q. 6	A single phase bridge inverter is operated from 48 V dc supply, it has a R load of 2.4 ohm. Find its: Output power P_o & Total Harmonic Distortion (THD).
Q. 7	For a single phase semi converter is operated from 230 V, 50 Hz AC supply. The load is R with $R = 10$ ohm. If the firing angle α is 60° , calculate 1. Average output voltage 2. RMS output voltage.
Q. 8	What is commutation? Explain natural commutation with forced commutation for SCR.
Q. 8	Define power factor & explain effect of poor power factor.
Q. 9	Enlist various methods of power factor improvement.
Q.10	Explain Effect of source inductance.
Q.11	Explain Single Phase PWM Rectifier using IGBT.
Q.12	Differentiate SCR based conventional rectifiers and IGBT based rectifiers
Q.13	Explain PWM method for power factor improvement.
Q.14	Explain Single phase Full converters using SCR for R and R-L loads.
Q.15	Explain Three phase Full converters using SCR for R and R-L loads.

3.8 c. Unit No.-III- DC-AC Converters

Pre-requisites:- Electronic Devices, Physics

Objectives:-

1. To explain working & analysis of inverters for different loads.
2. To explain performance parameters of inverters.

Outcomes:-

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

1. Describe working & analysis of inverters for different loads.
2. To explain performance parameters of inverters.

Lecture No.	Details of the Topic to be covered	References
1	Single phase bridge inverter for R load using MOSFET / IGBT	T1, T2, R2
2	Performance analysis and numerical,	
3	Cross conduction in inverter, need of voltage control and strategies in inverters	
4	Classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages	
5	Concept and need of harmonic elimination / reduction in inverters, device utilization factor,	
6	Three Phase voltage source inverter for balanced star R load with 120 degree mode of operation	
7	Three Phase voltage source inverter for balanced star R load with 180 degree mode of operation	
8	Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits	

Question Bank: Theory

CO Mapped: CO2

PI Mapped: 1.4.1, 2.1.2, 2.3.1, 2.2.3, 2.2.4

Q. 1 Explain working of three phase inverter in 120° mode of operation for balanced star connected R load with circuit diagram in detail. Draw output voltage waveforms. Show devices conducting in each step.

Q. 2 A single phase full bridge inverter is operated from 48 V dc supply, it has a R load equal to 2.4 ohm. Find its rms output voltage at fundamental frequency.

Q. 3 . What is a need for controlling the voltage at the output terminals of an inverter? Describe and compare various methods employed for the control of output voltage of inverter

Q. 4 What is pulse width modulation? Explain any one PWM technique in detail. Explain with circuit diagram and waveforms operation of single phase current source inverter.

Q. 5 Explain working of three phase six step voltage source inverter in 180° mode of operation. For star connected load draw output voltage waveforms. Show devices conducting in each step.

Q. 6 What is Device utilization factor, explain in detail.

Q. 7 Explain in detail with diagrams, various Harmonics Elimination/Modulation Techniques.

3.8 d. Unit No.-IV DC - DC converters

Pre-requisites:-

Sr.No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	DC - DC converters & AC Voltage Controller	---	---

Objectives:-

1. Introduce the working of principle of step up and step down chopper with their control strategies and performance parameters.
2. Introduce various types of choppers with their characteristics & waveforms.
3. Introduce operation of SMPS, types of SMPS and Single - phase full wave AC voltage controller.

Outcomes: -

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

1. Understand the working of principle of step up and step-down chopper with their control strategies and performance parameters.
2. Describe various types of choppers with their characteristics & waveforms.

3. Describe the operation of SMPS, types of SMPS etc.

Lecture No.	Details of the Topic to be covered	References
1	Classification of choppers, Step down chopper for R and RL load and its performance analysis,	T1, T2, R2, R3
2	Step up chopper, various control strategies for choppers	
3	Types of choppers (isolated and non-isolated) such as type A, B, C, D & E,	
4	Switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back	
5	Concept of integrated converter	
6	Design of LM3524 based choppers, concept of maximum power point tracking (MPPT).	

Question Bank: Theory

CO Mapped: CO2

PI Mapped: 1.4.1, 2.1.2, 2.3.1, 2.2.3, 2.2.4

Q. 1	What are DC-to-DC converters? Explain with circuit diagram waveforms working of 4 Quadrant chopper? State its applications.
Q. 2	A DC chopper has a resistance of 10Ω & input voltage is 220V. When the chopper switch remains ON its voltage drops to 2V. & chopping frequency is 1KHz. If the Duty cycle is 50% Determine, 1) Average o/p volt 2) Rms o/p voltage 3) Chopper freq 4) Input resistance of chopper
Q. 3	What is chopper? Explain in brief.
Q. 4	Which are the various control strategies chopper? Explain in brief.
Q. 5	What is AC to AC controller? Explain with circuit diagram working of 1ϕ AC full wave AC to AC controller with balanced star Load (R)
Q. 6	Explain with circuit diagram & waveforms working of triac based AC power controller ckt. Comment on p.f. Justify why SCR based controllers are preferred over triac based controllers.
Q. 7	What is SMPS? Which are the different types of SMPS?
Q. 8	What is line & load regulation of SMPS? Explain in detail.

Q. 9	Explain working of SMPS with diagram.
Q.10	A single phase full wave AC voltage controller has an input voltage of 230V, 50Hz & it is feeding a resistive load of 10ohms.If firing angle of thyristors is 110degree, find the output rms voltage, input power factor & average current of thyristor.
Q.11	A step-down dc chopper has a resistive load of $R = 15\text{ohm}$ and input Voltage $E_{dc} = 200\text{ V}$. When the chopper remains ON, its voltage drop is 2.5 for a duty cycle of 0.5. Calculate: (1) Average and r.m.s value of output voltage (2) Power delivered to the load.
Q.12	Explain current limit control & time ratio control.
Q.13	What is time ratio control in dc choppers? Explain the use of TRC for controlling the output voltage in choppers
Q.14	Explain the principle of operation of step up chopper. Derive expression for output voltage.
Q.15	Draw a power circuit diagram for a type-A chopper. Show load voltage waveforms for $\alpha = 0.3$ and $\alpha = 0.8$. For both these duty cycles, calculate: the average and rms values of output voltage in terms of source voltage.
Q.16	Explain concept of maximum power point tracking (MPPT).
Q.17	Explain Switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back

Question Bank: (MCQs) - CO2
PI Mapped: 1.4.1, 2.1.2, 2.3.1, 2.2.3, 2.2.4

Q. 1	Choppers is a
a) AC - DC converters	b) AC - AC converters
c) DC - AC converters	d) DC - DC converters
Q. 2	A single phase ac - dc converter is also known as
a) Rectifier	b) Inverter
c) Chopper	d) Regulator
Q. 3	four quadrant chopper cannot be operated as
a) One quadrant chopper	b) Cycloconverter
c)) Inverter	d) Bidirectional rectifier
Q. 4	For bidirectional operation of converters
	a. A parallel combination of controllable switch and a diode is used
	b. A parallel combination of controllable switch and capacitor is used
	c. A series combination of controllable switch and a diode is used
	d. A series combination of controllable switch and a capacitor is used
Q. 5	The average value of the output voltage in a step - down dc chopper is given by
a) $V_0 = V_s$	b) $V_0 = D V_s$
c) $V_0 = V_s / D$	d) $V_0 = V_s / (1 - D)$
Q. 6	A step - down choppers can be used in

a) a. Electric traction	b) b. Electric vehicles
c) c. Machine tools	d) d. All of these
Q. 7 The output current in PWM DC - DC converters is equal to	
a) Average value of the output inductor current	b) Product of an average inductor current and a function of duty ratio
c) Either (a) or (b)	d) None of these
Q. 8 The control method used for PWM dc - dc converter is	
a) Voltage mode control	b) Current mode control
c) Hysteric control	d) All of these
Q. 9 The ac voltage controller can be used for	
a) Lighting and heating control	b) On - line transformer tap changing
c) Soft starting	d) All of these
Q.10 Which one of the following is the most suitable device for dc-to-dc converter?	
a) BJT	b) GTO
c) MOSFET	d) Thyristor
Q.11 The control method used for PWM dc - dc converter is	
a) Voltage mode control	b) Current mode control
c) Hysteric control	d) All of these
Q.12 Unipolar modulation is generally used in	
a. AC - AC converters	
b. AC - DC converters	
c. DC - AC converters	
d. DC - DC converters	
Q.13 An ac chopper is feeding an inductive load, the firing pulse to the SCR	
a) May have a width equal to turn ON time of the SCR	b) Should be a single pulse of long duration
c) Should be a series of pulses of short duration	d) Should be train of pulses of duration equal to the conduction period of the SCR
Q.14 AC power in a load can be controlled by using	
a) two SCR's in parallel opposition	b) two SCR's in series
c) three SCR's in series	d) four SCR's in series
Q.15 Single-phase fully controlled thyristor bridge ac-dc converter is operating at a firing angle of 25° and on overlap angle of 10° constant dc output current of 20 A. the fundamental power factor (displacement factor) at input ac mains is	
a) 0.78	b) 0.827
c) 0.866	d) 0.9

Q.16 four quadrant chopper cannot be operated as

- | | |
|-------------------------|----------------------------|
| a) One quadrant chopper | b) Cycloconverter |
| c) Inverter | d) Bidirectional rectifier |

Q.17 If an ac chopper is feeding an inductive load, the firing pulse to the SCR

- | | |
|--|--|
| a) May have a width equal to turn ON time of the SCR | b) Should be a series of pulses of short duration |
| c) Should be a single pulse of long duration | d) Should be train of pulses of duration equal to the conduction period of the SCR |

3.8 e. Unit No.-V

Resonant Converters & Protection of Power Devices & Circuits

Pre-requisites:-

Unit	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Resonant Converters & Protection of Power Devices & Circuits	---	

Objectives:-

1. Introduce need for resonant converters, SLR half bridge DC/DC converter in low frequency.
2. Explain the concept of zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.

Outcomes:-

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

1. Describe need for resonant converters, SLR half bridge DC/DC converter in low frequency.
2. Compare zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.

Lecture No.	Details of the Topic to be covered	References
1	Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design	T1, T2, R2, R3
2	Resonant converters such as Zero current switching (ZCS)),	
3	Zero voltage switching (ZVS)	
4	Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards	
5	Importance of isolation transformer	

Question Bank: Theory

CO Mapped: CO3

PI Mapped: 2.2.4, 7.1.1, 7.2.2

Q. 1	Explain need for resonant converters
Q. 2	Draw the circuit diagram & explain SLR half bridge DC/DC converter in low frequency.
Q. 3	Write short notes on : 1. Cooling & heat sinks. 2. Over voltage conditions, over voltage protection circuits 3. Over current fault conditions.
Q. 4	Draw the circuit diagram & explain in detail zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.
Q. 5	Compare zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.
Q. 6	Explain cooling & heat sinks in detail.
Q. 7	Explain in detail over current & over voltage protection circuits.
Q. 8	Explain the electromagnetic interference. Which are the sources of EMI, minimizing techniques?
	Importance of isolation transformer

3.8 f. Unit No.-VI- Power Electronics Applications

Pre-requisites:-

Sr. No.	Broad Topic to be covered	Linkage with previous subjects in the curriculum	Year
1	Power Electronics Applications	---	---

Objectives:-

1. Introduce the concept of ON-line and OFF line UPS with battery AH
2. Introduce the concept of Electronic ballast: Characteristics of fluorescent lamps and advantages over conventional ballast
3. Introduce the concept of Single phase separately excited DC motor drive, stepper motor drive, BLDC motors.
4. Introduce the concept of Variable voltage & variable frequency three phase induction motor drive.

Outcomes:-

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

1. Use analysis of SMPS for the selection of ON-line or OFF line UPS with battery AH for specific duration.
2. Describe the concept of Single phase separately excited DC motor drive, stepper motor drive, BLDC motors.
3. Describe the concept of Variable voltage & variable frequency three phase induction motor drive.

Lecture No.	Details of the Topic to be covered	References
1	AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver	T1, T2, R1, R6
2	DC motor drive for single phase separately excited dc motor,	
3	BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive.	

4	On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs	
5	Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger,	
6	Case study of power electronics in electric vehicle and photovoltaic solar system.	

Question Bank: Theory

CO Mapped: CO4

PI Mapped: 1.4.1, 2.1.2, 2.2.4

Q. 1	What is UPS? Which are the different types of UPS? Explain in detail.
Q. 2	Explain working of UPS with diagram.
Q. 3	Compare ON line UPS with OFF line UPS with typical block diagram. Justify why ON line UPS is better than OFF line UPS.
Q. 4	Explain construction of battery backup time, battery charger rating.
Q. 5	Explain in detail Electronic ballast. Also explain characteristics of fluorescent lamps and advantages over conventional ballast.
Q. 6	Explain principle of DC motor & compare it with BLDC motor.
Q. 7	State specifications & applications of UPS.
Q. 8	Explain construction & working principle of DC motor, stepper motor.
Q. 9	Write short notes on Electronic ballast.
Q.10	Explain Single phase separately excited DC motor drive, stepper motor drive
Q.11	Explain Variable voltage & variable frequency three phase induction motor drive.
Q.12	Explain in detail LED Lamp with Driver Circuit.
Q.13	Explain in detail with circuit diagram fan Regulator
Q.14	Explain power electronics in electric vehicle and photovoltaic solar system.
Q.15	Explain AC Voltage Controller using IGBT & SCR
Q.16	Explain various selection criteria and performance parameters of batteries in battery operated power systems.
Q.17	Explain battery charging models and modes for EVs
Q.18	Explain Architecture of EVs battery charge and also explain PFC stage circuit topologies with details of Full-bridge boost rectifier.
Q.19	Explain Full-bridge interleaved for EV battery charger,

Question Bank: (MCQs) – CO4

PI Mapped: 1.4.1, 2.1.2, 2.2.4

Q. 1	Which of the following statements is false? (a) A DC motor converts electrical energy to mechanical energy (b) The efficiency of a DC motor is the ratio input power to output power (c) A DC generator converts mechanical power to electrical power (d) The efficiency of a DC generator is the ratio output power to input power		
	a) C only	b) C and D only	
	c) B only	d) None of the above	
Q. 2	The d.c. series motor should always be started with load because		
	a) at no load, it will rotate at dangerously high speed	b) it will fail to start.	
	c) it will not develop high starting torque.	d) all are true.	
Q. 3	In a stepper motor the angular displacement		
	a) can be precisely controlled.	b) it cannot be readily interfaced with micro computer based controller.	
	c) the angular displacement cannot be precisely controlled.	d) it cannot be used for positioning of work tables and tools in NC machines.	
Q. 4	If the speed of a DC machine is doubled and the flux remains constant, the generated e.m.f.		
	a) remains the same	b) is doubled	
	c) is halved	d) None of the above	
Q. 5	Which of the following configurations is used for both motoring and generative braking?		
	a) First quadrant chopper	b) Second quadrant chopper	
	c) Two quadrant chopper	d) Four quadrant chopper	
Q. 6	A stepper motor is		
	a) a dc motor.	b) a single-phase ac motor.	
	c) a multi-phase motor.	d) a two phase motor	
Q. 7	The d.c. series motor should always be started with load because		
	a) at no load, it will rotate at dangerously high speed.	b) it will fail to start.	
	c) it will not develop high starting torque.	d) all are true.	
Q.8	The speed of a d.c. shunt motor at no-load is (A) 5 to 10% (B) 15 to 20% (C) 25 to 30% (D) 35 to 40% higher than its speed at rated load.		
Q.9	The armature resistance of a DC motor is 0.5, the supply voltage is 200V and the back e.m.f. is 196V at full speed. The armature current is:		
	a) 4A	b) 8A	b) 400A
			d) 392A
Q.10	Regenerative braking		

a) Can be used for stopping a motor.	b) Cannot be easily applied to DC series motors.
c) Can be easily applied to DC shunt motors	d) Cannot be used when motor load has overhauling characteristics.
Q.11 The concept of V/f control of inverters driving induction motors results in	
a) <input type="radio"/> constant torque operation	b) speed reversal
c) reduced magnetic loss	d) harmonic elimination
Q.12 In a series-wound generator running at constant speed, as the load current increases, the terminal voltage	
a) increases	b) decreases
c) stays the same	d) None of the above
Q.13 Which braking is not possible in series motor?	
a) Regenerative braking.	b) Counter <u>current</u> braking.
c) Dynamic braking.	d) Rheostat braking
Q.14 Polarity of supply <u>voltage</u> is reversed in which type of braking? <input type="radio"/>	
a) Regenerative braking.	b) Dynamic braking.
c) Plugging.	d) None of these.
Q.15 In industries which electrical braking is preferred? <input type="radio"/>	
a) Regenerative braking.	b) Plugging.
c) Dynamic braking.	d) None of the above.
Q.16 What type electric drive is used in cranes?	
a) Multimotor.	b) Group.
c) Individual.	d) Both A and C.
Q.17 The armature current of a dc motor fed from a thyristor power convertor contains ripple. The ripple in the armature current affects	
a) Commutating capability of the motor	b) Overload capacity of the motor
c) Torque capability of the motor	d) Control ability of the speed of the motor
Q.18 Which of the following configurations is used for both motoring and generative braking?	
a) First quadrant chopper	b) Second quadrant chopper
c) Two quadrant chopper	d) Four quadrant chopper
Q.19 When we need to drive a dc shunt motor at different speeds in both directions (forward and reverse) and also to brake it in both the directions, which one of the following would you use?	
a) A half-controlled SCR bridge	b) A full controlled thyristor bridge
c) A dual converter	d) A diode bridge
Q.20 A fully controlled thyristor bridge drives a DC motor. The system is capable of	
a) Motoring and braking in both directions	b) Only motoring in both directions, no braking
c) Motoring in forward direction and braking in reverse direction	d) Only motoring in forward direction, no braking
Q.21 Which of the following statements is false for a series-wound DC motor?	

a) The speed decreases with increase of resistance in the armature circuit	b) The speed increases as the flux decreases
c) The speed can be controlled by a diverter	d) The speed can be controlled by a shunt field regulator
Q.21 If the speed of a DC machine is doubled and the flux remains constant, the generated e.m.f.	
a) remains the same	b) is doubled
c) is halved	d) None of the above

3.9 List of Practical

Sr. No.	Name of the Practical	CO Mapped
1	Characteristics of SCR: i. Plot V-I characteristics, ii. Observe the effect of gate current, iii. Measure I_H & I_L	CO1
2	V-I Characteristics of MOSFET / IGBT: i. Plot output characteristics, ii. Plot transfer characteristics	CO1
3	Single phase Semi / Full Converter with R & R-L load: i. Observe load voltage waveform, ii. Measurement of firing angle, average o/p voltage across loads, iii. Verification of theoretical values with practically measured values.	CO2
4	Single-Phase PWM bridge inverter for R load: i. Observe output rms voltage waveforms.	CO2
5	Step down dc chopper using power MOSFET / IGBT: i. Measure duty cycle and observe effect on average load voltage for DC chopper	CO2
6	Find load & line regulation of given SMPS.	CO3
7	Single phase AC voltage controller using SCRs for R load: i. Observe output rms voltage waveforms, ii. Measurement of firing angle, o/p voltage across load, iii. Verification of theoretical values with practically measured values.	CO2
8	Speed control of DC motor / stepper motor / ac motor i. Speed control of DC motor using armature voltage control / field control method. Measure RPM and plot graph of speed versus armature voltage and field current OR ii. Study drive circuit for stepper motor- phase sequencing and microstepping OR	CO3

	iii. Plot speed-torque characteristic of three phase induction motor.	
9	To study over voltage / over current protection circuit.	CO4

Oral Questions

Sr. No.	Oral Questions	CO Mapped
Q. 1	Explain output (drain) and transfer characteristics of IGBT.	CO1
Q. 2	Compare MOSFET, IGBT & SCR.	
Q. 3	Draw & explain two transistor analogy of SCR	
Q. 4	Explain applications of Power MOSFET with control requirements.	
Q. 5	Draw gate characteristics of SCR. Explain how value of gate voltage and gate current can be selected.	
Q. 6	Draw characteristics of SCR & explain in detail.	
Q. 7	Why SCR is called as current controlled device? Define Latching current and Holding current.	
Q.8	Explain all specifications of SCR.	
Q.9	Explain I_L , I_H , VBO, VBR, dv/dt , di/dt , surge current & rated current in detail.	
Q.10	Explain opt isolator driving circuit for SCR.	
Q.11	Draw & explain SCR/MOSFET as a switch.	
Q.12	What is commutation? Explain natural commutation with forced commutation for SCR.	
Q.13	What is converter? Which are the basic types of converters?	CO2
Q.14	Define power factor & explain effect of poor power factor.	
Q.15	Enlist various methods of power factor improvement.	
Q.16	Explain phase angle controlled converter (PAC) for power factor improvement.	
Q.17	Explain extinction angle control (EAC) method for power factor improvement.	
Q.18	Explain symmetrical angle control (SAC) method for power factor improvement.	
Q.19	Explain PWM method for power factor improvement.	
Q.20	Compare PAC, EAC, SAC& PWM techniques for power factor improvement.	
Q.21	What is inverter? Draw & explain the inverter.	
Q.22	Explain working of three phase inverter in 120° mode of operation for balanced star connected R load with circuit diagram in detail.	
Q.23	Draw output voltage waveforms. Show devices conducting in each step for 120° mode of operation for balanced star connected R load	

Q.24	Explain with circuit diagram and waveforms operation of single phase current source inverter.	
Q.25	Explain in detail performance parameters of inverter.	
Q.26	What is pulse width modulation? Explain any one PWM technique in detail.	
Q.27	What is Chopper? Which are the various types of chopper? Explain	
Q.28	Which are the various control strategies chopper? Explain in brief.	
Q.29	Classify choppers on the basis of quadrant operation.	
Q.30	Explain in detail with diagrams, various Harmonics Elimination/Modulation Techniques.	
Q.31	Draw & explain SMPS.	
Q.32	What is difference between switched mode power supply and linear power supply?	
Q.33	What is SMPS? Which are the different types of SMPS?	CO3
Q.34	What is line & load regulation of SMPS? Explain in detail.	
Q.35	What is a need for controlling the voltage at the output terminals of an inverter?	
Q.36	Describe and compare various methods employed for the control of output voltage of inverter.	
Q.37	What is resonant converter?	
Q.38	Explain need for resonant converters.	
Q.39	Draw the circuit diagram & explain SLR half bridge DC/DC converter in low frequency.	
Q.40	Explain in detail Cooling & heat sinks. Over voltage conditions, over voltage protection circuits Over current fault conditions.	CO4
Q.41	Draw the circuit diagram & explain in detail zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.	
Q.42	Compare zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters.	
Q.43	Explain cooling & heat sinks in detail. Explain in detail over current & over voltage protection circuits.	
Q.38	Explain the electromagnetic interference. Which are the sources of EMI, minimizing techniques?	
Q.39	What is UPS? Which are the different types of UPS? Explain in detail.	
Q.40	Explain working of UPS with diagram.	CO3
Q.41	Compare ON line UPS with OFF line UPS with typical block	
Q.42	Justify why ON line UPS is better than OFF line UPS.	

Q.43	Explain construction of battery backup time, battery charger rating.	
Q.44	Explain in detail Electronic ballast. Also explain characteristics of fluorescent lamps and advantages over conventional ballast.	
Q.45	Explain principle of DC motor & compare it with BLDC motor.	
Q.46	State specifications & applications of UPS.	
Q.47	Explain construction & working principle of DC motor, stepper	
Q.48	What is Electronic ballast? Explain in detail.	
Q.49	Explain Single phase separately excited DC motor drive, stepper motor drive.	

4. Name of the Subject – Advanced Java Programming (Elective II)

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

Online/ In-sem	Theory	Practical	Term-work AJP	Total Marks	Credit
30 marks	70 marks	25 marks	-	125 marks	TH/TW – 3, PR - 1

4.1 Syllabus

Unit I: Applet

6L

Applet Basics – Introduction, limitations of AWT, Applet architecture – HTML APPLET tag – Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables

Unit II: Event Handling using AWT/Swing components

8L

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.

Unit III: GUI Programming

6L

Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.

Unit IV: Database Programming using JDBC

6L

The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries

Unit V: Remote Method Invocation (RMI)

6L

Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.

Unit VI: Networking

8L

The java.net package, Connection oriented transmission – Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example. InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example. Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview – the Java web server – The Life Cycle of a Servlet, your first servlet.

4.2 Course Objectives

- Discuss the GUI applications using AWT, Swing and Applet.
- Illustrate the concept of event handling.
- Discuss Java Database Connectivity (JDBC) for database management.
- Discuss remote method invocation (RMI).
- Explain networking classes.

4.3 Course Outcomes

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

CO1: Design GUI application using Applet, AWT and Swing. (Bloom's Level 6: Create) (Unit I,III).

CO2: Apply the concept of AWT /Swing components to handle events. (Bloom's Level 3: Apply) (Unit II)

CO3: Demonstrate concept of JDBC (Java Database Connectivity) for database management. (Bloom's Level 3: Apply) (Unit IV)

CO4: Apply remote method invocation. (Bloom's Level 3: Apply) (Unit IV)

CO5: Demonstrate client / server communication using Java Networking classes. (Bloom's Level 3 : Apply) (Unit VI)

4.4 Text Books

1.	1. Herbert Schildt, “Java: The complete reference”, Tata McGraw Hill, 7th Edition
2.	Jim Keogh, “Complete Reference J2EE” , Enterpr
3.	E. Balaguruswamy, “Programming with JAVA: A Primer” McGraw Hill Education, India, 5th Edition

4.5 Reference Books

1.	“Java 6 Programming”, Black Book, Dreamtech
2.	“Java Server Programming, Java EE6 (J2EE 1.6)”, Black Book, Dreamtech
3.	M.T. Savaliya, “Advanced Java Technology”, Dreamtech

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

1.	NPTTEL Course “Programming in Java” https://nptel.ac.in/courses/106/105/106105191/
2.	Udemy course “Advanced Java Programming” https://www.udemy.com/course/advanced-java-programming

4.7 Teaching Plan

Sr. No .	Unit	Topics to be covered	Book Refer red	Total Lecture Planned	CO Map ped	PI Map ped
1	1	Applet Basics – Introduction, limitations of AWT,	T1,T3	6	CO1	1.3.1
2		Applet architecture – HTML APPLET tag – Passing parameter to Appletget,				2.1.2
3		DocumentBase() and getCodeBase() ,				2.1.3
4		Japplet: Icons and Labels Text Fields Buttons, Combo Boxes ,				
5		Checkboxes, Tabbed Panes,				
6		Scroll Panes, Trees: Tables				
7	2	Event Handling: Events, Event sources, Event classes	T1,T3	8	CO2	1.3.1
8		Event Listeners, Delegation event model,				2.1.2
9		handling mouse and keyboard events, Adapter classes				2.1.3

10		inner classes. The AWT class hierarchy,				
11		user interface components- labels, button, canvas, scrollbars, text components				
12		checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics,				
13		layout manager – layout manager types – boarder, grid, flow				
14		layout manager types – card and grib bag.				
15	3	Designing Graphical User Interfaces in Java, Components and Containers,	T1,T3	6	CO1	1.3.1 2.1.2 2.1.3
16		Basics of Components, Using Containers, Layout Managers,				
17		AWT Components, Adding a Menu to Window				
18		Extending GUI Features Using Swing Components, Java Utilities (java.util Package)				
19		The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence				
20		Map, Understanding Hashing, and Use of Array List & Vector				
21	4	The Concept of JDBC, JDBC Driver Types & Architecture,	T1,T3	6	CO3	1.3.1 2.1.2 2.1.3
22		JDBC Packages, A Brief Overview of the JDBC process				
23		Database Connection, Connecting to non-conventional Databases Java Data Based Client/server				
24		Basic JDBC program Concept				
25		Statement, Result Set, Prepared Statement, Callable Statement,				
26		Executing SQL commands, Executing queries				
27	5	Remote Method Invocation: Architecture, RMI registry,	T1,T3	6	CO4	1.3.1 2.1.2 2.1.3
28		the RMI Programming Model; Interfaces and Implementations;				
29		Writing distributed application with RMI, Naming services				
30		Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets,				
31		Remote Object Activation; The Roles of Client and Server,				
32		Simple Client/Server Application using RMI				
33	6	The java.net package, Connection oriented transmission – Stream Socket Class		8	CO5	1.3.1 2.1.2

34	creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example.	T1,T3 ,R1,R 2			2.1.3
35	InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address,				
36	TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies,				
37	TCP/IP Server Sockets, Datagram, DatagramSocket, DatagramPacket				
38	A Datagram Example. Connecting to a Server, Implementing Servers				
39	the Java web server – The Life Cycle of a Servlet, your first servlet.Sending EMail, Servlet overview				
40	the Java web server – The Life Cycle of a Servlet, your first servlet.				

4.8 Unit wise Lecture Plan

4.8 a. Unit No.-I

Pre-requisites: -

Fundamental Java Concepts

Objectives: - Discuss the GUI applications using AWT, Swing and Applet.

Outcomes: - **CO1:** Design GUI application using Applet, AWT and Swing. (Bloom's Level 6: Create) (Unit I,III).

Lecture No	Details of the Topic to be covered	References
1	Applet Basics – Introduction, limitations of AWT,	T1,T3
2	Applet architecture – HTML APPLET tag – Passing parameter to Appletget,	
3	DocumentBase() and getCodeBase() ,	
4	Japplet: Icons and Labels Text Fields Buttons, Combo Boxes ,	
5	Checkboxes, Tabbed Panes,	
6	Scroll Panes, Trees: Tables	

Question Bank: Theory

CO Mapped: CO1

PI Mapped: 1.3.1, 2.1.2,2.1.3

Q. No.	Question
1	Differentiate between applet and application
2	Describe following states of applet life cycle 1. Initialization State 2. Running State 3. Display State
3	Explain applet life cycle with suitable example
4	Explain all attributes available in < applet > tag
5	How to pass parameters to an applet? Write an applet to accept the Account number and balance in form of parameter and print message “ low balane” if the balance is less than 500.
6	Explain < PARAM > Tag of Applet with suitable example
7	Explain following methods for applet with an example Passing parameter to applet Embedding <Applet> tags in java code
8	Design an applet which accepts username as a parameter for html page and display number of characters from it.
9.	What is an applet?
HOTs	
10	What is the difference between applets loaded over the internet and applets loaded via the file system ?
11	How do you communicate between two applets?

4.8 b. Unit No.-II

Pre-requisites: -

Fundamental Java Concepts

Objectives:- Illustrate the concept of event handling.

Outcomes:- CO2: Apply the concept of AWT /Swing components to handle events.

(Bloom’s Level 3: Apply) (Unit II)

Lecture No.	Details of the Topic to be covered	References
1	Event Handling: Events, Event sources, Event classes	T1,T3
2	Event Listeners, Delegation event model,	
3	handling mouse and keyboard events, Adapter classes	
4	inner classes. The AWT class hierarchy,	
5	user interface components- labels, button, canvas, scrollbars, text components	
6	checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics,	
7	layout manager – layout manager types – boarder, grid, flow	
8	layout manager types – card and grib bag.	

Question Bank: Theory

CO Mapped: CO2

PI Mapped: 1.3.1,2.1.2,2.1.3

1	Write a Java Program to toggle the background color on every click of button.
2	What method is used to distinguish between single, double and triple mouse clicks ? Illustrate.
3	What are the various adapter classes that implements commonly used Listener interfaces ? Write a sample java program to demonstrate an Adapter.
4	What is inner classes? explain its type.
5	Explain AWT hierarchy in detail
6	Write a simple java program to demonstrate the use of label components
7	Write a program in java AWT to create menu and menu items
8	Write applet program to that alternatively changes the background color after every click of button
9	Write a Java Program to create AWT radio buttons using checkbox group. Explain various event listener interfaces.
10	List the methods available in the draw shapes
11	Write the short note on – Graphics Programming
12	How will you draw the following graphics in a window? Arcs , Ellipse , circle in java
13	Write a java program which create border layout and adds two text boxes to it.
14	Write a java program which illustrate the use of GridBagLayout
15	What is the function of layout manager? Describe in detail about different layouts in Java GUI
16	What is layout management? State the various types of layout supported by Java. Which layout is default one? Explain swing components.
HOTs	

17	What is the difference between the JDK 1.02 event model and event delegation model introduced with JDK 1.1?
18	What is the relationship between a method's throw clause and the exceptions that can be thrown during the method's execution?

4.8 c. Unit No.-III

Pre-requisites: -

Fundamental Java Concepts

Objectives: - Discuss the GUI applications using AWT, Swing and Applet.

Outcomes: - **CO1:** Design GUI application using Applet, AWT and Swing. (Bloom's Level 6: Create) (Unit I,III).

Lecture No.	Details of the Topic to be covered	References
1	Designing Graphical User Interfaces in Java, Components and Containers,	T1,T3
2	Basics of Components, Using Containers, Layout Managers,	
3	AWT Components, Adding a Menu to Window	
4	Extending GUI Features Using Swing Components, Java Utilities (java.util Package)	
5	The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence	
6	Map, Understanding Hashing, and Use of Array List & Vector	

Question Bank: Theory

CO Mapped: CO1

PI Mapped: 1.3.1,2.1.2,2.1.3

1	List and briefly discuss swing components in java
2	Write a JFrame with Hello World program
3	Write a program to create product enquiry form using frames.
4	How will you display an image on the frame in a window using java
5	List does not support scrolling? Why? How this can be remedied? Explain with suitable example.
6	Write a program in java to display 3 x 3 magic square using Jtable
7	Write short note on collection framework.

8	Explain collection interface with example
9	Write a program which stores list of strings in an arraylist and then display the contents of the list.
1 0	Write difference between ArrayList and LinkedList.
HOTs	
1 1	How can a GUI component handle its own events?
1 2	Why Should Any Swing Call Back Implementation Execute Quickly?

4.8 d. Unit No.-IV

Pre-requisites: -

Fundamental Java Concepts

Objectives: - Discuss Java Database Connectivity (JDBC) for database management.

Outcomes: - CO3: Demonstrate concept of JDBC (Java Database Connectivity) for database management. (Bloom's Level 3: Apply) (Unit IV)

Lecture No.	Details of the Topic to be covered
1	The Concept of JDBC, JDBC Driver Types & Architecture,
2	JDBC Packages, A Brief Overview of the JDBC process
3	Database Connection, Connecting to non-conventional Databases Java Data Based Client/server
4	Basic JDBC program Concept
5	Statement, Result Set, Prepared Statement, Callable Statement,
6	Executing SQL commands, Executing queries

Question Bank: Theory

CO Mapped: CO3

1	What is JDBC -ODBC?
2	Explain driver types of JDBC
3	Explain JDBC Architecture
4	Describe JDBC Packages

5	Explain in brief about JDBC Process
6	Explain about connecting to non conventional databases
7	Explain call able statement
8	How to execute SQL Commands with JDBC
9	Explain role of driver in JDBC
10	What does Connection pooling mean ?
11	What is the use of CallableStatement ?
12	Explain JDBC Components.
13	What is stored procedure? What are the parameter types in stored procedure
14	What is row set?
15	What are the different types of JDBC statements
HOTs	
16	Explain JDBC batch processing.
17	What is the difference between statement and prepared statement

4.8 e. Unit No.-V

Pre-requisites: -

Fundamental Java Concepts

Objectives:- Discuss remote method invocation (RMI).

Outcomes:- CO4: Apply remote method invocation. (Bloom's Level 3: Apply) (Unit IV)

Lecture No.	Details of the Topic to be covered	References
1	Remote Method Invocation: Architecture, RMI registry,	T1,T3
2	the RMI Programming Model; Interfaces and Implementations;	
3	Writing distributed application with RMI, Naming services	
4	Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets,	
5	Remote Object Activation; The Roles of Client and Server,	
6	Simple Client/Server Application using RMI	

Question Bank: Theory

CO Mapped: CO4

PI Mapped:1.3.1,2.1.2,2.1.3

Unit V	
1	Explain about remote invocation method
2	What is RMI registry
3	Explain about RMI programming model its interfaces and implementations
4	Explain distributed application with RMI
5	Explain about naming services
6	What is naming and directory services
7.	Explain about client /server application in RMI
8	Write a simple RMI
9	What is the role of stub in RMI
10	What is the purpose of RMI security manager
11	What Is The Method That Is Used By The Rmi Client To Connect To Remote Rmi Servers?
12	What Is The Function Of Java.net.unknownHostException?
HOTs	
13	What Are The Reasons Of Getting UnknownHostException Error Even If All The Setting Are Properly Configured?
14	What Are The Different Conditions That Has To Be Kept In Mind When Using Serialization Concept?

4.8 f. Unit No.-VI

Pre-requisites: -

Fundamental Java Concepts

Objectives:- Explain networking classes.

Outcomes:- CO5 : Demonstrate client / server communication using Java Networking classes.(Bloom's Level 3 : Apply) (Unit VI)

Lecture No.	Details of the Topic to be covered	References
1	The java.net package, Connection oriented transmission – Stream Socket Class	T1,T3,R1,R2
2	creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example.	
3	InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address,	
4	TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies,	
5	TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket	
6	A Datagram Example. Connecting to a Server, Implementing Servers	
7	the Java web server – The Life Cycle of a Servlet, your first servlet.Sending EMail, Servlet overview	
8	the Java web server – The Life Cycle of a Servlet, your first servlet.	

Question Bank: Theory
CO Mapped : CO5

PI Mapped : 1.3.1,2.1.2,2.1.3

Q. No.	Question
Unit VI	
1	Explain networking classes and interfaces.
2	Give an overview of Socket.
3	What is reserved port?
4	What is proxy server? Explain its working.
5	Explain internet addressing scheme.
6	Write Java program to find IP address of machine.
7	Write Java program to illustrate getByName() and getAllByName() factory method.
8	Explain factory and instance methods.
9	What is IPv4 and IPv6?
10	Write a program to obtain the name of protocol,port number,host name and file name of URL.
11	What is URL?
12	Write short note on URI class.

13	Differentiate TCP and UDP.
14	Write steps in socket programming.
15	Explain servlets? Explain its working.
16	Explain advantages of servlets.
17	Explain life cycle methods of servlets.
18	Differentiate between GET and POST request.
19.	Explain about connection oriented transmission.
20.	Explain java.net package.
HOTs	
21.	Write an UDP client and server program to do the following, 1. lient send any string and server respond with its capital string.
22.	Write HTML form to read username and password.This data is sent to the servlet.If the correct username and passport is given then welcome the person with name otherwise display invalid user.

4.9 List of Practical

Course Objectives:

- To describe Applet basics using Java programming language.
- To Discuss JDBC application.
- To Explain RMI application in Java.
- To Illustrate web application designing using Java.

Course Outcomes: -

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

- Develop Applets in Java. (Bloom's Level 3 : Apply) (Lab 1-3)
- Demonstrate JDBC programming using Java. (Bloom's Level 3 : Apply) (Lab 4)
- Implement Program in Java for RMI Application. (Bloom's Level 3 : Apply) (Lab 5 & 8)
- Demonstrate networking classes using Java. (Bloom's Level 3 : Apply) (Lab 6,7,9,10)

List of Practicals

1. Write a program to demonstrate status of key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown
2. Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. Frame should become visible when the mouse enters it.
3. Develop a GUI which accepts the information regarding the marks for all the subjects of a student

in the examination. Display the result for a student in a separate window.

4. Write a program to insert and retrieve the data from the database using JDBC.
5. Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not.
6. Write a program to demonstrate the use of InetAddress class and its factory methods
7. A. Write Servlet (procedure for client side) to display the username and password accepted from the client. B. Write Servlet (procedure for server side) to display the username and password accepted from the client.
8. Write program with suitable example to develop your remote interface, implement your RMI server, implement application that create your server, also develop security policy file.
9. Write a simple JSP page to display a simple message (It may be a simple html page).
10. Create login form and perform state management using Cookies, HttpSession and URL Rewriting
11. Write Java Beans Program.

Sr. No.	Name of the Practical	CO Mapped	PI Mapped
1	Write a program to demonstrate status of key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown	CO1	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
2	Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. Frame should become visible when the mouse enters it.	CO1	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
3	Develop a GUI which accepts the information regarding the marks for all the subjects of a student in the examination. Display the result for a student in a separate window.	CO1	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
4	Write a program to insert and retrieve the data from the database using JDBC.	CO2	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
5	Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not.	CO3	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2

6	Write a program to demonstrate the use of InetAddress class and its factory methods	CO5	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
7	A. Write Servlet (procedure for client side) to display the username and password accepted from the client. B. Write Servlet (procedure for server side) to display the username and password accepted from the client.	CO5	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
8	Write program with suitable example to develop your remote interface, implement your RMI server, implement application that create your server, also develop security policy file.	CO3	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
9	Write a simple JSP page to display a simple message (It may be a simple html page).	CO5	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
10	Create login form and perform state management using Cookies, HttpSession and URL Rewriting	CO5	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2
11	Write Java Beans Program.	CO5	2.1.2 2.1.3 5.1.1 5.1.2 5.2.2

Oral Questions

PI Mapped : 2.1.2,2.1.3,5.1.1,5.1.2,5.2.2

Sr.No	Questions	CO Mapped
1	What Is An Applet? Should Applets Have Constructors?	CO1
2	How To Insert Your Applets Into Frontpage?	

3	What Is The Order Of Method Invocation In An Applet?
4	What Are The Applets Life Cycle Methods? Explain Them?
5	What Is The Sequence For Calling The Methods By Awt For Applets?
6	When An Applet Is Terminated, The Following Sequence Of Method Calls Takes Place:
7	How Do Applets Differ From Applications?
8	Can We Pass Parameters To An Applet From Html Page To An Applet? How?
9	Can Applets On Different Pages Communicate With Each Other?
10	What Is The Base Class For All Swing Components?
11	Why Do You Canvas?
12	Explain How To Read Information From The Applet Parameters.
13	What Are The Attributes Of Applet Tags?
14	How Can We Determine The Width And Height Of A Applet?
15	Can You Write A Java Class That Could Be Used Both As An Applet As Well As An Application?
16	What is an adapter class?

17	What interface is extended by AWT event listener?	
18	What is an event and what are the models available for event handling?	
19	What is the purpose of the enableEvents() method?	
20	What are the advantages of the model over the event inheritance model?	
21	How can a GUI component handle its own events?	
22	What event results from the clicking of a button?	
23	What is source and listener?	
24	What is the highest level event class of the event delegation model?	
25	What is the difference between the JDK 1.02 event model and event delegation model introduced with JDK 1.1?	
26	What is the relationship between a method's throw clause and the exceptions that can be thrown during the method's execution?	
27	What is JDBC?	CO2
28	Define JDBC Drivers?	

29	What is JDBC Driver?
30	What are the steps to connect to the database in java?
31	What are the JDBC API components?
32	What are the JDBC statements?
33	What are the differences between Statement and PreparedStatement interface?
34	How can we set null value in JDBC PreparedStatement?
35	What are the differences between execute, executeQuery, and executeUpdate?
36	What are the different types of ResultSet?
37	What are the differences between ResultSet and RowSet?
38	What is the role of the JDBC DriverManager class?
39	What are the functions of the JDBC Connection interface?
40	Which interface is responsible for transaction management in JDBC?

41	What is RMI ?	CO3
42	What is the basic principle of RMI architecture ?	
43	What are the layers of RMI Architecture ?	
44	What is the role of Remote Interface in RMI ?	
45	What is the role of the java.rmi.Naming Class ?	
46	What is meant by binding in RMI ?	
47	What is the difference between using bind() and rebind() methods of Naming Class ?	
48	What are the steps involved to make work a RMI program ?	
49	What is the role of stub in RMI ?	
50	What is the return type of Class.forName() method?	
51	What is a Servlet ?	

52	Explain the architechure of a Servlet.
53	What is the difference between an Applet and a Servlet ?
54	Explain the life cycle of a Servlet.
55	What is the difference between doGet() and doPost() ?
56	What is meant by a Web Application ?
57	How do you find out what client machine is making a request to your servlet ?
58	Mention the advantages and disadvantages of using Java Sockets.
59	In Java, who creates the object of Servlets?
60	What is the role of RequestDispatcher Interface in Servlet?
61	What is the role of attribute in servlets?

62	What is Session Tracking? What are the common methods of Session Tracking?	
63	Does JSP allow the use of exception implicit object in any page?	

5. Name of the Course – Network Security (304195E) (Elective II)

Weekly Workload (in Hrs)	Lecture	Tutorial	Practical
	3	-	1

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

5.1 Syllabus

Unit I Attacks on Computers and Computer Security (06 Hrs.)
Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Unit II Cryptography-Concepts and Techniques (06 Hrs.)
Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Unit III Symmetric and Asymmetric key for Ciphers (08 Hrs.)
Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution, Asymmetric key Ciphers, Principles of public key crypto systems, Algorithms (RSA, Diffie Hellman, ECC), Key Distribution.

Unit IV Message Authentication Algorithms and Hash Functions (07 Hrs.)
Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, HMAC, CMAC, Digital signatures, knapsack algorithm, Authentication Applications such as Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.

Unit V E-Mail Security (06 Hrs.)
Pretty Good Privacy, S/MIME, IP security overview, IP Security architecture, Authentication Header, Encapsulating , Security payload, Combining security associations, Key management

Unit VI Web Security (07 Hrs.)
Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Intruders, Intrusion detection, password management, virus and related threats,

Countermeasures, Firewall design principles, types of firewalls, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual Elections.

Overview of Teaching Plan:

Unit	Broad Topics Covered	Total Lectures Planned
I	Attacks on Computers and Computer Security	6 Hrs
II	Cryptography-Concepts and Techniques	6 Hrs
III	Symmetric and Asymmetric key for Ciphers	8 Hrs.
IV	Message Authentication Algorithms and Hash Functions	7 Hrs
V	E-Mail Security	6 Hrs
VI	Web Security	7 Hrs

Individual Hour wise plan:

Sr. No	Content	Duration	Reference Book	Page No.	Remark
UNIT1: Attacks on Computers and Computer Security					
1	Introduction	20 Min	T2	CH-1, Page: 1-1	Theory
2	The need for security	20 Min	T2	CH-1, Page: 2-2	Theory
3	Security Approaches	20 Min	T2	CH-1, Page: 3-3	Models and Practices
4	Principles of Security	60 Min	T2	CH-1, Page: 4-7	Theory, Examples
5	Types of Security Attacks	120 Min	T2	CH-1, Page: 8-22	Theory, Examples
6	Security Services	30 Min	T1	CH-1, Page: 19-22	Theory, Standards
7	Security Mechanisms	30 Min	T1	CH-1, Page: 23-24	Theory, Standards

8	A model for Network Security	60 Min	T1	CH-1, Page: 25-26	Theory, Diagram, Examples
Unit II: Cryptography-Concepts and Techniques					
9	Introduction, plain text and cipher text, substitution techniques,	1 Hr	T1	26-48	Theory
10	transposition techniques,	1 Hr	T1	49-51	Theory, Concept
11	encryption and decryption,	1 Hr	T2	59-62	Theory
12	symmetric and asymmetric key cryptography	1 Hr	T2	62-78	Theory, Concept
13	stenography,.	1 Hr	T1	51-55	Theory, Algorithm
14	key range and key size, possible types of attacks	1 Hr	T1	56-61	Theory
Unit III: Symmetric and Asymmetric key for Ciphers					
15	Block Cipher principles & Algorithms	1Hr	T1	64	Theory, Algorithm
16	Block cipher modes of operation, DES	1Hr	T1	72	Theory, Algorithm
17	AES	1Hr	T1	134	Theory, Algorithm
18	Differential and Linear Crypt analysis,	1Hr	T1	83	Theory, Algorithm
19	Stream ciphers, RC4, Location and placement of encryption function, , Key distribution	1Hr	T1	189,210	Theory, Algorithm
20	Asymmetric key Ciphers, Principles of public key crypto systems	1Hr	T1	201	Theory, Algorithm,Problems
21	RSA	1Hr	T1	257	Theory, Algorithm,Problems
22	Diffie-Hellman, ECC, Key Distribution	1Hr	T1	298, 301, 290	Theory, Algorithm

Unit-IV: Message Authentication Algorithms and Hash Functions

23	Authentication requirements, Functions,	15 min	T – 1	CH-12, Pg : 364-367	Theory
24	Message authentication codes,	15 min	T – 1	CH-12, Pg : 372-374	Theory, Concept
25	Hash Functions, Secure hash algorithm,	01 Hour	T – 1	CH-11, pg : 341 - 352	Theory, Algorithms
26	Hash Based on MAC (HMAC),	45 min	T – 1	CH-12, Pg : 375-380	Theory, Algorithm
27	Cipher-Based Message Authentication Code (CMAC),	30 min	T – 1	CH-12, Pg : 380-383	Theory, Algorithm
28	Digital signatures	30 min	T – 1	CH-13, Pg : 396-400	Theory, Algorithm
29	Knapsack Algorithm	10 min	T – 1	CH-04, Pg : 197-198	Theory, Algorithm
30	Authentication Applications such as Kerberos	01 hour	T – 2 T – 1	CH-07, Pg: 372-377 CH-15, Pg: 452-463	Theory, Concept, Structure
31	X.509 Authentication Service (Digital Certificate),	01 hour	T – 2 T – 1	CH-05, Pg: 206-215 CH-14, Pg: 429-437	Theory, Concept, Structure
32	Public – Key Infrastructure,	15 min	T – 1	CH-14, Pg : 437-439	Theory, Concept, Structure
33	Biometric Authentication.	10 min	T – 1	CH-07, Pg: 371-372	Theory

Unit-V: E-Mail Security

34	Pretty Good Privacy, S/MIME	1hr	T2	CH-18 Pg no 568-602 and	
----	-----------------------------	-----	----	-------------------------	--

				(wireshark packet capture)	
35	IP security overview, IP Security architecture.	2hr	T2	CH-19 Pg no 616-622	
36	Authentication Header, Encapsulating, Security payload	2hr	T2	CH-19 T2 Pg no , 627-633 and (wireshark packet capture)	
37	Combining security associations, Key management	1 hr	T2	CH-19 Pg no , 638-646	
Unit VI: Web Security					
38	Web security considerations,	1Hr	T1	CH-17 Pg no 528	
39	Secure Socket Layer and Transport Layer , The secure electronic transaction,	2Hr	T1	CH 17 Pg no 531-549	
40	Intruders, Intrusion detection, password management	1Hr	T1	CH-18 567-582	
41	virus and related threats Countermeasures,	1Hr	T1	CH 19 Pg no 599-614	
42	Firewall design principles, types of firewalls	1Hr	T1	CH 20 Pg no 621-640	
43	Secure Inter-branch Payment Transactions, Cross site Scripting	1Hr	T1		

Vulnerability, Virtual E lections				
--------------------------------------	--	--	--	--

5.2 Course Objectives

- To elaborate need, types, and services for network security.
- To discuss fundamental concepts of cryptography and its techniques.
- To explain in detail symmetric and asymmetric keys for cipher text.
- To make them aware of various Message Authentication Algorithms and Hash Functions.
- To describe various aspects of E-Mail Security
- To discuss windows and web browser security using various encryption standards.

5.3 Course Outcomes

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

CO1: Describe attacks on computers and computer security. (Unit I)

CO2: Demonstrate various cryptography techniques. (Unit II)

CO3: Illustrate various Symmetric and Asymmetric keys for Cipher text. (Unit III)

CO4: Evaluate different Message Authentication Algorithms and Hash Functions (Unit IV)

CO5: Explain various aspects of E-Mail Security (Unit V)

CO6: Elaborate windows and web browser security using various encryption standards. (Unit VI)

5.4 Text Books:

1. William Stallings, “Cryptography and Network Security”, Pearson Education, 4th Edition
2. Atul Kahate, “Cryptography and Network Security”, McGraw Hill, 3rd Edition.
3. C K Shymala, N Harini, Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India, 1st Edition.

5.5 Reference Books:

1. Forouzan Mukhopadhyay, “Cryptography and Network Security”, Mc Graw Hill, 2nd Edition.
2. Mark Stamp, “Information Security, Principles and Practice”, Wiley India, 2nd Edition
3. W.M. Arthur Conklin, Greg White, “Principles of Computer Security”, TMH, 4th Edition.

4. Neal Krawetz, “Introduction to Network Security”, CENGAGE Learning Distributor, 1st Edition.

5. Bernard Menezes, “Network Security and Cryptography”, CENGAGE Learning Distributor, 1st Edition.

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

NPTEL Course “Introduction to Cyber Security ”

Link of the Course: https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

NPTEL Course “Information Security – 5 – Secure Systems Engineering”

of the Course: <https://nptel.ac.in/courses/106/106/106106199/>

Link

5.7 Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	1	Attacks on Computers and Computer Security	T1	6 Hrs
2	2	Cryptography-Concepts and Techniques		6 Hrs
3	3	Symmetric and Asymmetric key for Ciphers		8 Hrs
4	4	Message Authentication Algorithms and Hash Functions		7 Hrs
5	5	E-Mail Security		6 Hrs
6	6	Web Security		7 Hrs

5.8 Unit wise Lecture Plan

5.8 a. Unit No.-I

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Pre-requisites: - networking architecture, topologies, transmission media, and networking devices.

Objectives: - To Teach

1. need for security and principles of security
2. various attacks on computers and computer security

Outcomes: - Students will be able to

1. describe principles of security
2. Analyze attacks on computers and computer security

Lecture No.	Details of the Topic to be covered	References
1	Introduction, The Need for Security	T-2, CH-1, Pg : 1-2
2	Security Approaches	T-2, CH-1, Pg : 3-3
3	Principles of Security	T-2, CH-1, Pg : 4-7
4	Types of Security Attacks	T-2, CH-1, Pg : 8-22
5	Security Services, Security Mechanisms	T-1, CH-1, Pg : 19-24
6	A Model for Network Security	T-1, CH-1, Pg : 25-26

Question Bank: Theory

Mapping - CO1, PI-2.2.2

- | |
|--|
| 1. Explain CIA TRIAD in network security? |
| 2. What are the key principles of security? |
| 3. Why is confidentiality an important principle of security? Describe the ways of achieving the same. (Hint: Think about the ways in which children use a secret language). |

4. Discuss the reasons behind the significance of authentication. Find out the simple mechanisms of authentication. (Hint: What information do you provide when you use a free email service such as Yahoo or Hotmail?)
5. In real life, how is the message integrity ensured? (Hint: On what basis is a check honored or dishonored?)
6. What is repudiation? How can it be prevented in real life? (Hint: Think what happens if you issue a check and after the bank debits your account with the amount therein, you complain to the bank that you never issued that check).
7. What is access control? How different is it from availability?
8. Why are some attacks called as passive? Why are other attacks called active?
9. Discuss any one passive attack.
10. What is masquerade? Which principle of security is breached because of that?
11. What are replay attacks? Give an example of replay attacks.
12. What is denial of service attack?
13. What is a worm? What is the significant difference between a worm and a virus?

5.8 b. Unit No.-II

Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Pre-requisites: -English alphabets, ASCII characters, matrices

Objectives: - To Teach

1. detailed approach of encryption decryption for the data to transmit.
2. various techniques used for encryption-decryption.

Outcomes: - Students will be able to

1. Demonstrate knowledge of cryptography techniques.
2. Determine plain and cipher text using symmetric and asymmetric keys.

Lecture No.	Details of the Topic to be covered	References
1	Introduction, plain text and cipher text, substitution techniques	T1
2	transposition techniques	T1

3	encryption and decryption	T2
4	symmetric and asymmetric key cryptography	T2
5	steganography,	T1
6	key range and key size, possible types of attacks	T1

Question Bank: Theory

Mapping – CO2, PI-, 1.1.1, 2.1.2, 2.1.3

1. What is plain text? What is cipher text? Give an example of transformation of plain text into cipher text.
2. What are the two basic ways of transforming plain text into cipher text?
3. What is the difference between Substitution Cipher and Transposition Cipher?
4. Discuss the concept of Caesar Cipher.
5. What is the output of plain text Hello there, my name is Atul if we use Caesar Cipher to encode it?
6. How can Caesar Cipher be cracked?
7. What is Mono-alphabetic Cipher? How is it different from Caesar Cipher?
8. Why is Mono-alphabetic Cipher difficult to crack?
9. Discuss Homophonic Substitution Cipher with reference to Mono-alphabetic Cipher.
10. What is the main feature of Polygram Substitution Cipher?
11. Discuss the algorithm for Rail Fence Technique.
12. Assume a plain text Security is important and generate the corresponding cipher text using Rail Fence Technique.
13. How does Simple Columnar Transposition technique work? Assume the same plain text (Security is important) and generate the corresponding cipher text using this technique.
14. What is the modified version of Simple Columnar Transposition technique?
15. What is the principle behind One-time pads? Why are they highly secure?

16. How is Book Cipher different from One-time pad?
17. What is encryption? What is decryption? Draw a block diagram showing plain text, cipher text, encryption, and decryption.
18. Distinguish between Symmetric and Asymmetric Key Cryptography.
19. Explain the various ways of attacks, such as Cipher text only attack, etc.
20. Discuss the Playfair cipher.

5.8 c. Unit No.-III

Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution, Asymmetric key Ciphers, Principles of public key crypto systems, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.

Pre-requisites: - XOR gate, number systems

Objectives: - To Teach

1. block and stream ciphers; differential and linear crypt analysis
2. various Symmetric and Asymmetric keys algorithms for Ciphers

Outcomes: - Students will be able to

1. explain block and stream ciphers; differential and linear crypt analysis
2. Illustrate various Symmetric and Asymmetric keys for Ciphers.

Lecture No.	Details of the Topic to be covered	References
1	Block Cipher principles & Algorithms	T1
2	Block cipher modes of operation, DES	T1
3	AES	T1
4	Differential and Linear Crypt analysis,	T1
5	Stream ciphers, RC4, Location and placement of encryption function, , Key distribution	T1

6	Asymmetric key Ciphers, Principles of public key crypto systems	T1
7	RSA	T1
8	Diffie-Hellman, ECC, Key Distribution	T1

Question Bank: Theory
Mapping – CO3, PI-1.1.1, 2.1.2, 2.1.3, 2.2.4

1. Distinguish between stream and block ciphers.
2. Discuss the idea of algorithm modes with detailed explanation of at least two of them.
3. Write a note on the security and possible vulnerabilities of the various algorithm modes. 4. What is an Initialization Vector (IV)? What is its significance?
5. What are the problems with symmetric key encryption?
6. What is the idea behind meet-in-the-middle attack?
7. Explain the main concepts in DES.
8. How can the same key be reused in triple DES?
9. Explain the principles of the IDEA algorithm.
10. Distinguish between differential and linear cryptanalysis.
11. Explain the subkey generation in the Blowfish algorithm.
12. Explain the usage of the S array in the case of the RC4 algorithm.
13. Discuss how encryption happens in RC5.
14. How does the one-time initialization step work in AES?
15. Explain the steps in the various rounds of AES.

5.8 d. Unit No.-IV

Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, HMAC, CMAC, Digital signatures, knapsack algorithm, Authentication Applications such as Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.

Pre-requisites: -symmetric and asymmetric keys

Objectives: - To Teach

1. the role of network security as a tool for protection of different network entities.
2. different Message Authentication Algorithms and Hash Functions

Outcomes: - Students will be able to

1. apply security algorithms to real world security issues
2. Evaluate different Message Authentication Algorithms and Hash Functions.

Lecture No.	Details of the Topic to be covered	References
1	Authentication requirements, Functions, Message authentication codes,	T1
2	Hash Functions, Secure hash algorithm, Hash Based on MAC (HMAC),	T1
3	Cipher-Based Message Authentication Code (CMAC),	T1
4	Digital signatures, Knapsack Algorithm,	T1
5	Authentication Applications such as Kerberos	T1
6	X.509 Authentication Service (Digital Certificate),	T1
7	Public – Key Infrastructure, Biometric Authentication.	T1

Question Bank: Theory

Mapping – CO4, PI-1.1.1, 2.1.2, 2.1.3, 2.2.4

1. What characteristics are needed in a secure hash function?
2. What is the role of a compression function in a hash function?
3. Explain Cipher-Based Message Authentication Code (CMAC) in details.
4. Describe the Knapsack Algorithm
5. Explain the Authentication Applications-Kerberos
6. Can an unauthorized user use an authentication token?
7. What are the three aspects of a 3-factor authentication?
8. What is the difference between challenge/response tokens and time-based tokens?
9. How does one prevent the misuse of another user's certificate in certificate-based authentication?
10. What is the problem with smart cards if large data needs to be processed?
11. Why do we need to take multiple samples during the user registration process?
12. Explain any one one-way authentication mechanism with its advantages and drawbacks.
13. Explain any one mutual authentication mechanism with its advantages and drawbacks.
14. What is SSO?

5.8 e. Unit No.-V

Pretty Good Privacy, S/MIME, IP security overview, IP Security architecture, Authentication Header, Encapsulating, Security payload, Combining security associations, Key management

Pre-requisites: -

Objectives: - To Teach

1. IP security architecture and authentication process
2. various aspects of E-Mail Security

Outcomes: - Students will be able to

1. explain IP security and authentication process

2. acquaint with various aspects of E-Mail Security

Lecture No.	Details of the Topic to be covered	References
1	Pretty Good Privacy, S/MIME	T2
2	IP security overview.	T2
3	IP Security architecture	T2
4	Authentication Header,	T2
5	Encapsulating, Security payload	T2
6	Combining security associations, Key management	T2

Question Bank: Theory

Mapping – CO5, PI-2.1.2, 2.2.2

1. What are the five principal services provided by PGP?
2. What is the utility of a detached signature?
3. Why does PGP generate a signature before applying compression?
4. What is R64 conversion?
5. Why is R64 conversion useful for an e-mail application?
6. How does PGP use the concept of trust?
7. What is MIME?
8. What is S/MIME?
9. Give examples of applications of IPsec.
10. What services are provided by IPsec?
11. What parameters identify an SA and what parameters characterize the nature of a particular SA?

12. What is the difference between transport mode and tunnel mode?
13. What is a replay attack?
14. Why does ESP include a padding field?
15. What are the basic approaches to bundling SAs?
16. What are the roles of the Oakley key determination protocol and ISAKMP in IPsec?

5.8 f. Unit No.-VI

Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual E lectures.

Pre-requisites: -e-mail security

Objectives: - To Teach

1. various attacks, viruses, and threats
2. windows and web browser security through implementation of various encryption standards.

Outcomes: - Students will be able to

1. Describe various attacks, viruses, and threats.
2. Assimilate various aspects of Web Security

Lecture No.	Details of the Topic to be covered	References
1	Web security considerations,	T1
2	Secure Socket Layer and Transport Layer,	T1
3	The secure electronic transaction,	T1
4	Intruders, Intrusion detection, password management	T1
5	virus and related threats Countermeasures,	T1
6	Firewall design principles, types of firewalls	T1

7	Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual Elections	T1
---	---	----

Question Bank: Theory

Mapping – CO6, PI-2.1.2, 2.2.2

1. List the characteristics of a good firewall implementation.
2. What are the three main actions of a packet filter?
3. How is a circuit gateway different from an application gateway?
4. What is the disadvantage of a Screened host firewall, Single-homed bastion?
5. How is Screened host firewall, Dual-homed bastion different from Screened host firewall, Single-homed bastion?
6. What are the limitations of a firewall?
7. Explain the AH and ESP protocols.
8. What is Intruders? Explain Intrusion Detection with suitable example.
9. Explain virus and related threats and its Countermeasures.
10. Explain web security considerations
11. Describe Secure Socket Layer and Transport Layer Security
12. Explain The secure electronic transaction process
13. Explain Secure Inter-branch Payment Transactions process
14. Describe the following
Cross site Scripting Vulnerability
Virtual Elections

5.9 List of Practical

Sr.No	Experiment
1	Design and implement for the insecurity of default passwords, printed passwords and password transmitted in plain text.
2	Write a program for Encryption and Decryption.
3	Write a program to perform encryption and decryption using the following algorithms: Caesar Cipher, Substitution Cipher

4	Study of different wireless network components and features of any one of the Mobile Security Apps
5	Implementation of Symmetric and Asymmetric cryptography
6	Implementation of DES http://cse29-iiith.vlabs.ac.in/
7	Implementation of AES http://cse29-iiith.vlabs.ac.in/
8	Implementation of Hash functions http://cse29-iiith.vlabs.ac.in/
9	<i>Case Study - Mobile Ad-hoc Network, its features/characteristics, applications, and challenges.</i>