SEMESTER–VII

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			IA	ESE	Total	Lec	Tu	Pr
S/ELE/ 701/MJC- 17	MJCT-17: Transmission Lines, Antenna and Wave Propagation MJCP-17: Transmission Lines, Antenna and Wave Propagation Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 702/MJC- 18	MJCT-18: Modern Communication Systems MJCP-18: Modern Communication Systems Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 703/MJE- 19	MJCT-19: Digital Signal Processing MJCP-19: Digital Signal Processing Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 704/MJE- 20	MJCT-20: Applied Physics MJCP-20: Applied Physics Lab	3 1	10	25 15	50	3	NA	2
S/ELE/ 705/MN-7	MNT-7: Communication Systems MNP-7: Communication Systems Lab	3 1	10	25 15	50	3	NA	2
	Total in Semester – VII	20	50	200	250	15		10

MJC-17: Transmission Lines, Antenna and Wave Propagation (Credits: Theory-03)

Course Code: S/ELE/701/MJC-17 **Course ID:** **F.M. = 25**

Course Learning Objectives

This course introduces the basic concepts of electromagnetic wave propagation. It explains different types of transmission lines and their parameters. Students also learn about wave propagation in waveguides and their modes. The course further covers antenna fundamentals, antenna parameters, and different types of antennas used in communication systems.

Course Learning Outcomes: At the end of this course, students will be able to

CO1: Explain the basic principles of electromagnetic wave propagation and related effects.

CO2: Describe different types of transmission lines and analyse their performance parameters such as losses and Standing Wave Ratio (SWR).

CO3: Calculate input impedance and reflection coefficient of transmission lines and use the Smith Chart for related calculations.

CO4: Explain electromagnetic radiation and antenna characteristics, including the half-wave dipole antenna and Radar range equation.

Unit-1: Transmission Lines (15 Lectures)

Types of transmission lines such as coaxial line, two-wire line, microstrip line, coplanar line and slot line, Transmission line parameters and equations, wave propagation in transmission lines, low-loss, lossless and distortion-less lines, input impedance, Standing Wave Ratio (SWR), power in transmission lines, short-circuited, open-circuited and matched lines, Smith Chart, and applications of transmission lines.

Unit-2: Radiation of Electromagnetic Waves (15 Lectures)

Concept of retarded potentials and radiation mechanism, Antenna parameters such as radiation pattern, radiation power density, radiation intensity, beamwidth, directivity, antenna efficiency, gain, beam efficiency, bandwidth, polarization, input impedance, effective length, effective area, maximum directivity, Friis transmission equation, and Radar range equation.

Types of Antennas: Hertzian dipole, half-wave dipole, quarter-wave dipole, Yagi-Uda antenna, microstrip antenna, parabolic antenna, helical antenna, and antenna arrays.

Unit-3: Waveguides and Waveguide Devices (15 Lectures)

Wave propagation in waveguides, parallel-plate waveguides, modes of propagation (TEM, TE, TM modes), rectangular waveguides, power transmission and attenuation, rectangular cavity resonators, and waveguide devices such as directional coupler, isolator and circulator.

Unit-4: Electromagnetic Wave Propagation (15 Lectures)

Propagation of electromagnetic waves in good conductors, skin effect, reflection of plane waves at normal and oblique incidence, propagation in dispersive media, phase velocity and group velocity, different modes of propagation, ionospheric propagation, MUF (Maximum

Usable Frequency), skip distance, critical frequency, plasma frequency, virtual height, and ducting.

Suggested books:

1. Sadiku, M. N. O. (2001). *Principles of electromagnetics*. Oxford University Press.
2. Lonngren, K. E., Savov, S. V., & Jost, R. J. (2007). *Fundamentals of electromagnetics with MATLAB*. Prentice Hall of India.
3. Hayt, W. H., & Buck, J. A. (2006). *Engineering electromagnetics* (7^{th} ed.). Tata McGraw-Hill.
4. Cheng, D. K. (2001). *Field and wave electromagnetics* (2nd ed.). Pearson Education.
5. Edminister, J. A. (2006). *Electromagnetics* (Schaum's Outline Series). Tata McGraw-Hill.
6. Rao, N. N. (2006). *Elements of engineering electromagnetics* (6^{th} ed.). Pearson Education.
7. Raju, G. S. N. (2001). *Antennas and propagation*. Pearson Education.

MJC-17:* Transmission Lines, Antenna and Wave Prop. *Lab (Credits: Practical-01)

Course Code: S/ELE/701/MJC-17 ***Course ID:*** ***F.M: 15***

(Use Scilab/MATLAB/Other Mathematical Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

CLO1: Analyse transmission line behaviour by evaluating line parameters, wave propagation, input impedance, power flow, and Standing Wave Ratio (SWR) under different termination conditions.

CLO2: Apply graphical techniques such as the Smith Chart for solving impedance matching and transmission line problems.

CLO3: Understand the radiation mechanism of electromagnetic waves and analyse various antenna parameters.

CLO4: Evaluate ionospheric propagation parameters such as Maximum Usable Frequency (MUF), critical frequency, skip distance, plasma frequency, and ducting for communication applications.

List of Experiments

1. Program to determine the phasor of a forward propagating field.
2. Program to determine the instantaneous electric field of a plane wave.
3. Program to calculate phase constant, phase velocity, electric field intensity and intrinsic impedance.
4. Program to calculate skin depth, loss tangent and phase velocity.

5. Program to determine total voltage as a function of time and position in a lossless transmission line.
6. Program to calculate characteristic impedance, phase constant and phase velocity.
7. Program to calculate output power and attenuation coefficient.
8. Program to determine power dissipated in a lossless transmission line.
9. Program to calculate total loss in lossy transmission lines.
10. Program to calculate input impedance of a transmission line terminated with a capacitive load.

MJC-18: Modern Communication Systems (Credits: Theory-03)

Course Code: S/ELE/702/MJC-18 **Course ID:** **F.M. = 25**

Course Learning Objectives

This course introduces the basic ideas of modern communication systems. It covers digital modulation and coding techniques, optical fibre communication, cellular mobile communication, and satellite communication. Students will also learn about multiple access methods and basic networking technologies such as LAN, Bluetooth, Wi-Fi and WiMAX.

Course Learning Outcomes: At the end of this course, students will be able to

CO1: Explain digital modulation techniques such as DPCM, DM, ADM and QAM, and understand different line coding methods.

CO2: Describe the working of optical fibre communication systems and understand attenuation and dispersion in optical fibres.

CO3: Explain the basic concepts of cellular communication, including frequency reuse, cell splitting, roaming, handoff, authentication and encryption.

CO4: Explain the basic principles of satellite communication, including satellite orbits, subsystems, transponders and earth stations.

Unit-1 (16 Lectures)

Advanced Digital Modulation Technique: DPCM, DM, ADM, Binary Line Coding Technique, Multi-level coding, QAM (Modulation and Demodulation)

Unit-2 (10 Lectures)

Optical Communication: Introduction of Optical Fiber, Types of Fiber, Guidance in Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors, Block Diagram of optical communication system, optical power budgeting

Unit-3 (17 Lectures)

Cellular Communication: Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

Unit-4 (17 Lectures)

Satellite communication: Introduction, need, satellite orbits, advantages and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, up link, down link, cross link, transponders (C- Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station, Satellite access, TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna), GPS services like SPS & PPS.

Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi and WiMAX.

Suggested Books:

1. Tomasi, W. (2004). *Electronic Communication Systems: Fundamentals Through Advanced* (3rd ed.). Pearson Education.
2. Roden, M. S. (1996). *Analog and Digital Communication Systems* (3rd ed.). Prentice Hall, Englewood Cliffs, New Jersey.
3. Lathi, B. P. (2009). *Modern Digital and Analog Communication Systems* (4th ed.). Oxford University Press.
4. Vishwanathan, T. (1992). *Telecommunication Switching Systems and Networks* (1st ed.). Prentice Hall of India.
5. Rappaport, T. S. (2002). *Wireless Communications: Principles and Practice* (2nd ed.). Pearson Education Asia.

MJC-18: Modern Communication Systems *Lab (Credits: Practical-01)*

Course Code: S/ELE/702/MJC-18 ***Course ID:*** ***F.M: 15***

(Implementation with Hardware and/or SciLab/MATLAB/Any Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

CLO1: Analyse and observe modulation and demodulation techniques for AM and FM signals using practical communication system setups.

CLO2: Implement and study pulse modulation techniques such as PAM, PWM, and PPM.

CLO3: Perform experiments on digital modulation techniques such as ASK, FSK, and PSK and analyse their signal characteristics.

CLO4: Use communication laboratory equipment such as signal generators, oscilloscopes, spectrum analysers, and communication trainers for signal analysis.

CLO5: Analyse experimental results, compare them with theoretical concepts, and prepare systematic laboratory reports.

List of Experiments

1. Study LED modulation and detection using a photodetector.
2. Calculate transmission losses in an optical communication system.
3. Study 16-QAM modulation and detection and generate a constellation diagram.
4. Study DPCM modulation and demodulation.
5. Study Delta Modulation (DM) and Adaptive Delta Modulation (ADM).
6. Study the architecture of a mobile phone.

7. Study the optical fibre communication system.

MJC-19: Digital Signal Processing (Credits: Theory-03)

Course Code: S/ELE/703/MJC-19 **Course ID:** **F.M. = 25**

Course Learning Objectives

The main objectives of this course are to introduce the basic concepts of discrete-time signals and systems and their mathematical representation, understand the principles of signal analysis in time and frequency domains using tools such as DTFT, DFT, and FFT and develop skills in implementing DSP algorithms using computational tools such as MATLAB or similar software.

Course Learning Outcomes: At the end of this course, students will be able to

CO1: Analyse discrete-time signals and systems using difference equations and determine system properties such as stability and causality.

CO2: Apply Z-transform techniques to analyse discrete-time systems and determine system functions and stability.

CO3: Compute and analyse signals using DFT and FFT algorithms for frequency domain representation.

CO4: Design and realize digital filters including FIR and IIR structures and analyse their system functions.

Unit- 1 (15 Lectures)

Discrete Time systems: Discrete sequences, linear coefficient difference equation, Representation of DTS, LSI Systems, Stability and causality, frequency domain representations and Fourier transform of DT sequences.

Unit- 2 (15 Lectures)

Z-Transform: Definition and properties, Inverse Z Transform and stability, Parseval's Theorem and applications.

System Function: signal flow graph, its use in representation and analysis of Discrete Time Systems, Techniques of representations, Matrix generation and solution for DTS evaluations.

Unit- 3 (15 Lectures)

Discrete Fourier Transform: DFT assumptions and Inverse DFT, Matrix relations, relationship with FT and its inverse, circular convolution, DFT theorems, DCT, Computation of DFT, FFT Algorithms and processing gain, Discrimination, interpolation and extrapolation, Gibbs phenomena, FFT of real functions interleaving and resolution improvement, Word length effects.

Unit- 4 (15 Lectures)

Digital Filters: Analog filter review. System function for IIR and FIR filters, network representation, Canonical and decomposition networks, IIR filter realization methods and their limitations, FIR filter realization techniques, Discrete correlation and convolution; Properties and limitations.

Suggested Books:

1. Oppenheim, A. V., & Schafer, R. W. (1989). *Discrete-time signal processing*. Prentice Hall.
2. Proakis, J. G., & Manolakis, D. G. (1997). *Digital signal processing: Principles, algorithms, and applications* (3rd ed.). Prentice Hall.
3. Tan, L., & Jiang, J. (2013). *Digital signal processing: Fundamentals and applications*. Academic Press.
4. Ingle, V. K., & Proakis, J. G. (2012). *Digital signal processing using MATLAB* (3rd ed.). Cengage Learning.

MJC-19: Digital Signal Processing Lab (Credits: Practical-01)

Course Code: S/ELE/703/MJC-19 **Course ID:** **F.M. = 15**

(Use Scilab/MATLAB/Other Mathematical Simulation software)

Course Learning Outcomes: At the end of this course, students will be able to

CLO1: Generate and analyse discrete-time signals and sequences using software tools such as MATLAB/Scilab.

CLO2: Perform fundamental DSP operations such as signal addition, multiplication, time shifting, scaling, and folding.

CLO3: Analyse signals using Discrete-Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) techniques.

CLO4: Study the frequency response and stability of digital filters through simulation and analysis.

List of Experiments

1. Generate basic sequences such as unit sample, unit step, ramp and sinusoidal sequences.
2. Generate and plot discrete-time sequences over a given interval.
3. Write a program to find the Z-transform of a given sequence.
4. Study Fourier Transform, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
5. Design Butterworth analog filters (low-pass and high-pass).
6. Design digital filters.

MJC-20: Applied Physics (Credits: Theory-03)

Course Code: S/ELE/704/MJC-20 **Course ID:** **F.M. = 25**

Course Learning Objectives

The objective of this course is to develop a basic understanding of crystalline solids and different types of bonding in solids. It explains the limitations of classical physics and introduces the need for quantum mechanics. It also discusses the mechanical, thermal, electrical, and magnetic properties of materials, which are important in modern science and technology.

Course Learning Outcomes: At the end of this course, students will be able to

CO1: Explain the structure of crystalline solids and different types of bonding in them
CO2: Apply the basic principles and formalism of quantum mechanics, including wavefunctions, operators, eigenvalues, and Schrödinger equation to simple physical systems.
CO3: Explain the thermal behaviour of solids
CO4: Analyse the electrical properties of metals and semiconductors, including conductivity, carrier concentration, and Fermi level.
CO5: Classify and describe magnetic materials and explain their magnetic properties.

Unit-1 (10 Lectures)

Physics of Crystalline Solids: Crystalline Materials, Crystal Structure in Solids, Concept of Lattice and Basis, Crystal Axes and Planes, Primitive and Unit Cells, Packing Fraction for Simple, Body-Cantered and Face-Cantered Cubic Lattices, Calculation of Interplanar Spacing for Cubic Lattice, Miller Indices, Concept of Reciprocal Lattice, Bragg's Equation in Direct and Reciprocal Lattice (no derivation), Bonding in Solids, Basic ideas of Metallic Bonds, Ionic Bonds, Covalent Bonds, Vander Waal's Bonds.

Unit-2 (20 Lectures)

Quantum Mechanics: Inadequacies of Classical Physics (in Relevance to Electron Diffraction
Experiment), Compton's Effect, Photo-Electric Effect, Blackbody Radiation, Wien's Law, Raleigh Jeans Law, Plank's Law, Introduction to Wave Particle Duality, de Broglie's Hypothesis, Heisenberg's Uncertainty Principle, Probability Density and Bohr Interpretation, Basic Postulates and Formalism of Quantum Mechanics, Wavefunctions, Operators in Quantum Mechanics, Eigenstates, Eigenvalues and Eigenfunctions, Schrodinger Wave Equation, Qualitative Discussion of Phenomenon of Tunnelling, Particle in a One-Dimensional Box, Extension to a Three-Dimensional Box, Potential Barrier Problems (Free Electron, Electron in an Infinite Well), Kronig-Penney Model and Development of Band Structure, E-k Diagram in Solids, Classification of Conductors, Insulators and Semiconductors. **Quantum statistics**: Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein probability distribution functions and their importance.

Unit-3 (10 Lectures)

Thermal Properties: Brief Introduction to Laws of Thermodynamics, Concept of Entropy, Enthalpy and Phonons, Heat Capacity, Debye's Law (concept only), Lattice Specific Heat, Electronic Specific Heat (concept only), Thermal Conductivity, Thermoelectricity, Seebeck Effect, Peltier Effect, Thomson Effect.

Unit-4 (20 Lectures)

Electric Properties: Metals (Conductors), Basic Concept of Free Electron Theory, Conductivity of Metals, Ohm's Law, Relaxation Time, Collision Time and Mean Free Path, Electron Scattering and Resistivity of Metals, Heat Developed in Current Carrying Conductor, Concept of Superconductivity; Insulators, Dielectric Properties, Concepts of Polarization, Permittivity and Dielectric Constant; Semiconductors, Bonding in Elemental and Compound Semiconductors, Intrinsic and Extrinsic Semiconductor, Concept of Holes, Computation of Carrier Concentrations, Fermi Level in Semiconductors, E-k Diagrams to explain Direct and Indirect Bandgap Semiconductors.
Magnetic Properties: Classification of Magnetic Materials, Magnetic Moment, Dia, Para, Ferro and Antiferro Magnetism, Ferrimagnetic Materials, Saturation Magnetisation, Curie Temperature.

Suggested Books:

1. Vijaya, S., & Rangarajan, G. (2003). *Material Science*. Tata McGraw-Hill.
2. Callister, W. E. (2006). *Materials Science and Engineering: An Introduction*. Wiley India.
3. Beiser, A. (1987). *Concepts of Modern Physics*. McGraw-Hill.
4. Ghatak, A., & Lokanathan, S. (2004). *Quantum Mechanics: Theory and Applications*. Macmillan India.

***MJC-20*: Applied Physics (Credits: Practical-01)**

Course Code: S/ELE/704/MJC-20 **Course ID:** **F.M. = 15**

(Implementation with Hardware and/or SciLab/MATLAB/Any Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

CLO1: Determine electrical parameters of materials such as resistivity and conductivity of metals and semiconductors through laboratory experiments.

CLO2: Investigate semiconductor characteristics including carrier concentration, band gap, and the behaviour of intrinsic and extrinsic semiconductors.

CLO3: Use scientific instruments and experimental techniques to collect, analyse, and interpret experimental data.

CLO4: Prepare systematic laboratory reports and interpret results by correlating experimental observations with theoretical concepts.

List of Experiments

1. Measure the resistivity of a germanium crystal with temperature using the four-probe method (from room temperature to 200°C).

2. Determine the Boltzmann constant using the forward characteristics of a diode.

3. Determine Planck's constant using LEDs of different wavelengths.
4. Measure the band gap of a thermistor.

MNT-7: ***Communication Systems*** **(Credits: Theory-03)**

Course Code: S/ELE/705/MNT-7 **Course ID:** **F.M. = 25**

Course Learning Objectives

The objectives of this course are to introduce the fundamental concepts and principles of communication systems and their role in modern communication networks, study the principles and techniques of analog modulation and demodulation (AM, FM, and PM), pulse modulation techniques (PAM, PWM, PPM) and introduce the fundamentals of digital communication systems and digital modulation techniques.

Course Learning Outcomes: At the end of this course, students will be able to

CO1: Understand the basic concept of a communication system and need for modulation

CO2: Evaluate modulated signals in time and frequency domain for various continuous modulation techniques

CO3: Describe working of transmitters and receivers and effect of noise on a communication system

CO4: Understand Baseband Pulse Modulation and optical communication fundamentals

Unit-1 (15 Lectures)

Electronic Communication: Introduction to Communication, Need for Modulation, Block diagram of an Electronic Communication System, Brief idea of Frequency Allocation for Radio Communication System in India (TRAI), Band Designations and Usage, Channels and Base-Band Signals, Noise, Internal and External Noises, Signal-to-Noise (S/N) Ratio and Noise Figure.

Amplitude Modulation: Definition, Representation, Modulation Index, Expression for Instantaneous Voltage, Power Relations, Frequency Spectrum, Concept of DSBFC, DSBSC, SSBSC Generation and Detection, Limitations of AM, AM Detection, Diode Detector Circuit, Principle of Working and Waveforms, Block Diagram of AM Transmitter and Receiver.

Unit-2 (15 Lectures)

Frequency and Phase Modulation: Definition, Representation, Modulation Index, Frequency Spectrum, Bandwidth Requirements, Frequency Deviation and Carrier swing, Equivalence between FM and PM, Generation of FM using VCO, Demodulation, FM Detector, Slope Detector Circuit, Principle of Working and Waveforms, Block Diagram of FM Transmitter and Receiver, Comparison of AM and FM, Qualitative Idea of Super Heterodyne Receiver.

Unit-3 (20 Lectures)

Digital communication: Introduction to pulse and digital communications, digital radio, sampling theorem, types-PAM, PWM, PPM, PCM–quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital communication.

Unit–4 (10 Lectures)

Optical Communication: Introduction of Optical Fiber, Types of Fiber, Guidance in Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors, Block Diagram of optical communication system.

Suggested Books:

1. Kennedy, G. (1993). *Electronic Communication Systems* (3rd ed.). Tata McGraw-Hill.
2. Roddy, D., & Coolen, J. (2002). *Electronic Communications* (4th ed.). Prentice Hall of India.
3. Kennedy, G., & Davis, B. (1992). *Electronic Communication Systems* (4th ed.). Tata McGraw-Hill.
4. Tomasi, W. (2004). *Advanced Electronic Communication Systems* (6th ed.). Pearson Education.

MNP-7: *Communication Systems Lab* (Credits: Practical-01)

Course Code: S/ELE/705/MNP-7 **Course ID:** **F.M. = 15**

(Implementation with Hardware and/or SciLab/MATLAB/Any Circuit Simulation Software)

Course Learning Outcomes: At the end of this course, students will be able to

CLO1: Analyse and observe modulation and demodulation techniques for AM and FM signals using practical communication system setups.

CLO2: Implement and study pulse modulation techniques such as PAM, PWM, and PPM.

CLO3: Perform experiments on digital modulation techniques such as ASK, FSK, and PSK and analyse their signal characteristics.

CLO4: Use communication laboratory equipment such as signal generators, oscilloscopes, spectrum analysers, and communication trainers for signal analysis.

List of Experiments

1. Study of amplitude modulation and demodulation.
2. Study of FM modulator using IC 8038.
3. Study of Voltage Controlled Oscillator (VCO) using IC 566.
4. Study of Time Division Multiplexing (TDM) and demultiplexing.
5. Study of AM transmitter and receiver.
6. Study of FM transmitter and receiver.

7. Study of ASK modulator and demodulator.
8. Study of FSK modulation.
9. Study of PWM and PPM techniques.
10. Study of PAM modulator and demodulator.