Indian Institute of Space Science and Technology

Department of Space, Govt. of India

Thiruvananthapuram

Curriculum and Syllabus for

B.Tech Electronics and Communication - R 2024

[From Academic Period 2024-25]

(Approved by Academic Council on July 18, 2024)

SEMESTER 1

Code	Category	Title	L	T	P	C
MA111C	MC	Calculus	2	1	0	3
PH112C	MC	Mechanics and Electromagnetism	2	1	0	3
AV111C	MC	Basic Electrical Engineering	3	0	0	3
ES111H	HEC	Introduction to Space Science	3	0	0	3
CH112H	HEC	Environmental Science and Engineering	2	0	0	2
HS111H	HEC	Communication Skills I	1	0	2	2
AA131V	VC	Basic Engineering Lab	1	0	2	2
EC11$#	HEC	Extracurricular Activities	0	0	2	1
		Total				19

SEMESTER 2

Code	Category	Title	L	T	P	C
MA121C	MC	Vector Calculus, Integral Transforms, ODE & Special Functions	2	1	0	3
AV121C	MC	Basic Electronics	3	0	0	3
AV122C	MC	Network Analysis	3	0	0	3
CH121C	HEC	Material Science and Engineering	3	0	0	3
HS121C	HEC	Communication Skills II	1	0	0	1
MA122V	VC	Fundamentals of C++ Programming	3	0	2	4
AV141C	MC	Basic Electrical and Electronics Lab	0	0	2	1
EC12$#	HEC	Extracurricular activities	0	0	2	1
		Total				19

SEMESTER 3

Code	Category	Title	L	T	P	C
MA211C	MC	Linear Algebra, Complex Analysis, and Fourier Series	2	1	0	3
AV211C	MC	Semiconductor Devices	3	0	0	3
AV212C	MC	Analog Electronic Circuits	3	0	0	3
AV213C	MC	Digital Electronics and VLSI Design	3	0	0	3
AV214C	MC	Signals and Systems	3	0	0	3
HS211H	HEC	Introduction to Social Science and Ethics	2	0	0	2
AV232C	MC	Analog Electronic Circuits Lab	0	0	2	1
AV233C	MC	Digital Electronics and VLSI Design Lab	0	0	2	1
EC21$#	HEC	Extracurricular activities	0	0	2	(1)
		Total				19 + (1)

SEMESTER 4

Code	Category	Title	L	T	P	C
MA221C	MC	PDE, Probability and Statistics	2	1	0	3
AV221C	MC	Electromagnetic Theory	3	0	0	3
AV222C	MC	Instrumentation and Sensor Electronics	3	0	0	3
AV223C	MC	Control Systems	3	0	0	3
AV224C	MC	Embedded Systems	2	0	0	2
ELEC	HEC	HEC Elective 1	2/3	0	0	2/3
HS221H	HEC	Introduction to Economics	2	0	0	2
AV242C	MC	Instrumentation and Control Lab	0	0	2	1
AV244C	MC	Embedded Systems Lab	0	0	2	1
EC21$#	HEC	Extracurricular activities	0	0	2	(1)
		Total				20/21 + (1)

SEMESTER 5

Code	Category	Title	L	T	P	C
AV311C	MC	Digital Signal Processing	3	0	0	3
AV312C	MC	RF and Microwave Communication	3	0	0	3
AV313C	MC	Computer Architecture and Organization	3	0	0	3
AV314C	MC	Communication System I	3	0	0	3
ELEC	ME	Major Elective 1	3	0	0	3
Minor	MS	Minor Stream 1	3	0	0	3
AV331C	MC	Digital Signal Processing Lab	0	0	2	1
AV332C	MC	RF and Microwave Communication Lab	0	0	2	1
CC31$#	HEC	Co-Curricular activities	0	0	2	(1)
EC31$#	HEC	Extracurricular activities	0	0	2	(1)
		Total				20 + (2)

SEMESTER 6

Code	Category	Title	L	T	P	C
AV321C	MC	Communication System II	3	0	0	3
AV322C	MC	Computer Networks	3	0	0	3
ELEC	ME	Major Elective 2	3	0	0	3
Minor	MS	Minor stream 2	3	0	0	3
Minor	MS	Minor stream 3	3	0	0	3
HS321H	HEC	Principles of Management	3	0	0	3
AV341C	MC	Communication System Lab	0	0	2	1
CC32$#	HEC	Co-Curricular activities	0	0	2	(1)
EC32$#	HEC	Extracurricular activities	0	0	2	(1)
		Total				19 + (2)

SEMESTER 7

Code	Category	Title	L	T	P	C
ELEC	ME	Major Elective 3	3	0	0	3
ELEC	ME	Major Elective 4	3	0	0	3
Minor	MS	Minor 4	3	0	0	3
Minor/ ELEC	MS/ME/ HECE	Minor 5/Major Elective 5/HECE	3	0	0	3
Minor/ ELEC	MS/ME	Minor 6/Major Elective 6 **[Optional]**	3	0	0	3
ELEC	HECE	HEC Elective 2	3	0	0	3
AV451C	Internship	Summer Internship and Training	3	0	0	3
CC41$#	HEC	Co-Curricular activities	0	0	2	(2)
EC41$#	HEC	Extracurricular activities	0	0	2	(1)
		Total				18/21 + (3)

SEMESTER 8

Code	Category	Title	L	T	P	C
AV462C	Project	Research Project	0	0	0	15
	HEC	Co-Curricular activities	0	0	0	4
		Total				19

SEMESTER 1

MA111C Calculus (2-1-0) 3 Credits

Sequence and Series of Real Numbers : sequence – convergence – limit of sequence – non-decreasing sequence theorem – sandwich theorem (applications) – L'Hopital's rule – infinite series – convergence –geometric series – tests of convergence (nth term test, integral test, comparison test, ratio and root test) –alternating series and conditional convergence – power series.

Differential Calculus : functions of one variable – limits, continuity and derivatives – Taylor's theorem– applications of derivatives– curvature and asymptotes– functions of two variables– limits and continuity–partial derivatives– differentiability, linearization and differentials–extremum of functions – Lagrange multipliers.

Integral Calculus : lower and upper integral – Riemann integral and its properties – the fundamental theorem of integral calculus – mean value theorems – differentiation under integral sign – double and triple integrals – change of variable in double integrals – polar and spherical transforms – Jacobian of transformations.

Text Books:

1. Stewart, J., Calculus: Early Transcendentals, 5th ed., Brooks/ Cole (2007).
2. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Alpha Science International Ltd (2014).

References:

1. Greenberg, M.D., Advanced Engineering Mathematics, Pearson Education (2007).
2. James, G., Advanced Modern Engineering Mathematics, Pearson Education (2004).
3. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
4. Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, 9th ed., Pearson Education (2003).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand the importance of convergence of sequences and series to learn the solutions of some physical systems that are governed by Mathematical rules.
CO2	Enable students to use these notions to choose an appropriate model that is ideal for some real life situations and solve them.
CO3	Realize the importance of the concepts like limit, continuity and differentiability in modelling and solving many practical problems.
CO4	Evaluate definite integrals, areas of curved regions, arc length of a curve, volume and the surface area of revolution, and the center of mass in various dimensions

PH112C Mechanics and Electromagnetism (2-1-0) 3 Credits

Mechanics:

Introduction to vectors: linear independence – completeness – basis – dimensionality – inner product – orthogonality – displacement – derivatives of a vector – velocity – acceleration – plane polar coordinates.

Angular momentum: angular momentum and torque on a single particle – angular momentum and torque on a system of particles – moment of inertia – angular momentum of a rigid body.

Vector Calculus - Introduction: Vector calculus — gradient, curl, divergence, curvilinear coordinates, Dirac-delta function, Gauss' theorem, Stokes' theorem

Electricity and Magnetism:

Electricity: Electrostatic potential and field due to discrete and continuous charge distributions, energy density in an electric field.

Magnetism: Currents, Biot-Savert law, magnetic induction due to configurations of current-carrying conductors – energy density in a magnetic field, force on a charged particle in electric and magnetic fields, electromotive force, Faraday's law of electromagnetic induction – self and mutual inductance, displacement current.

Text Books/References:

1. Kleppner, D. and Kolenkow, R. J., An Introduction to Mechanics, 2nd ed., Cambridge Univ. Press (2013).
2. Griffith, D. J., Introduction to Electrodynamics, 3rd ed., Prentice Hall (1999).

Course Outcomes	Statements
CO1	Understanding the necessary mathematical framework to study discrete and continuum mechanics
CO2	Formulating the rotational motion of both a single particle and a system of particles, and subsequently that of a rigid body in the presence of forces and torques
CO3	Formulating the differential form of laws governing electric charges, currents, and the associated electric and Magnetic fields
CO4	Realizing the unified nature of Electric and Magnetic fields by way of electrodynamics.

AV111C Basic Electrical Engineering (3-0-0) 3 Credits

Introduction: Introduction to Electrical Engineering –Basic elements in electrical circuits – Passive elements: Behavior of resistor, inductor, and capacitor. Active elements: Characteristics of voltage source and current source – independent and dependent sources.
AC Fundamentals: Introduction to Alternating Current – Basic concepts of AC circuits – RMS value and average value – Behavior of resistor, capacitor and inductor in AC circuits – concepts of reactance and impedance - Sinusoidal steady state analysis of AC circuits – Phasor analysis - Power in AC circuits – Power factor - Resonance in AC circuits- Three-phase systems – Basic concepts of balanced three-phase systems-Star and Delta connections – Power in three-phase systems.

AC Circuit Analysis & Network Theorems: AC circuit analysis – mesh current method – node voltage method. Network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem, superposition theorem.

Electrical Machines: Basic concepts of magnetic circuits – coupled circuits. Transformers: Principle of operation – Phasor diagram - Equivalent circuit of Transformer –Regulation and efficiency – Autotransformer. Rotating electrical machines: Classification - principle of operation - constructional features and characteristics of different types of DC machines and AC machines.

Text Books/References:

1. Vincent Del Toro : 'Electrical Engineering Fundamentals', Pearson Education
2. A.E.Fitzgerald, David E Higginbothom, Arvin Grabel: 'Basic Electrical Engineering', Tata McGraw-Hill
3. Hughes, E. : 'Electrical and Electronic Technology', Pearson Education .
4. Charles K Alexander, Mathew N O Sadiku: 'Electric Circuits'
5. Fitzgerald, Kingsley, Umans, 'Electric Machinery', TMH
6. M.G.Say, ' Performance and Design of AC Machines'.
7. Mittle, V. N. and Mittal, A., Basic Electrical Engineering, 2nd ed., TataMcgraw-Hill
8. Cotton, H., Principles of Electrical Engineering, Sir Isaac Pitman & Sons

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Apply Network Theorems to DC Circuit Analysis:
CO2	Analyze and Solve AC Circuits
CO3	Perform Impedance Calculations in AC Circuits
CO4	Understand and Analyze Transformers

ES111H Introduction to Space Sciences (3-0-0) 3 Credits

Astrophysics: Electromagnetic spectrum, Basics of Electromagnetic radiation, Blackbody radiation and laws - overview of solar system - Introduction to Stars, Interstellar Medium, Compact Objects, Galaxies - Basics of Telescopes - Effects of atmosphere on observations - Need for space-based observatories and missions, Overview of Astronomy space missions.

Atmospheric Science: Earth's atmosphere, Introduction to radiation budget and differential heating, Basics of General circulation and Indian monsoon, Introduction to radiometric quantities, Electromagnetic laws, Basics of scattering, absorption, and polarization of radiation, Basics of Spectrometer, Radiometer (Imager), Light Detection and Ranging (LIDAR), Radar Detection and Ranging (RADAR).

Remote Sensing & Geoinformatics: Electromagnetic radiation and its interaction with matter, Spectral Reflectance, Spectral signatures, Image formation, Resolutions and sensing platforms, Types and modes of remote sensors, Perspectives of remote sensing data analysis, Remote sensing applications.

Text Books/References :

1. Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press
2. Airborne Measurements for Environmental Research, Methods and Instruments, Manfred Wendisch and Jean-Louis Brenguier, Wiley-vch Verlag, GmbH & Co. KGaA
3. Remote Sensing Digital Image analysis by John A. Richards and Xiuping Jia, Springer

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Introducing engineering students to the core concepts of space science and its practical uses.
CO2	Gaining basic knowledge of the solar system, stars, optical telescopes and space astronomy missions
CO3	Understanding the fundamental principles and uses of remote sensing for managing natural resources
CO4	Gaining an overview of the methods used to observe and study the Earth's atmosphere.

CH112H Environmental Science and Engineering (2-0-0) 3 Credits

Awareness of the impact of environment on quality of life – natural resources – biological systems – bio-geo chemical cycles – chemical processes; water treatment operations, water sampling, storage, quality measurement – oxygen demand – detection of pollutants – current environmental issues; pollutants, global warming, causes and consequences, air pollution, organic and inorganic air pollutants, smog-acid mine drainage, accumulation of salts in water– soil formation; micro and macro nutrients in soil, pollutants in soil – green chemistry: an alternative tool for reducing pollution – engineering interventions; flow sheets, waste minimization, e-waste management, ASP, reverse osmosis, trickling filter – environmental management; solid, liquid waste management, hazardous wastes, ISO standards – Kyoto protocol, Montreal protocol, Euro norms.

Text Books:

1. Rao, V., Textbook of Environmental Engineering, Prentice Hall of India (2002).

References:

1. Baird, C. and Cann, M., Environmental Chemistry, 3rd ed., W. H. Freeman and Company (2005).
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, GOI (1999).
3. Manual on Sewerage and Sewage Development, CPHEEO, Ministry of Urban Development, GOI (1993).
4. Hauser, B. A., Practical Hydraulics Hand Book, Lewis Publishers (1991).
5. Hammer, M. J., Water and Wastewater Technology, Regents/Prentice Hall (1991).
6. Sharma, J. P., Comprehensive Environmental Studies, Laxmi Publications (2004).
7. Garg, S. K., Environmental Engineering (vol. 1 and 2), Khanna Publishers (2004).
8. Kiely, G., Environmental Engineering, McGraw-Hill (1997).
9. Bharucha, E., Textbook of Environmental Studies, University Grants Commission (2004).
10. Vanloon, G. W. and Duffy, S. J., Environmental Chemistry: A Global Perspective, Oxford Univ. Press (2000).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand biological, physical, and industrial processes relevant to environmental problems
CO2	Understand the causes and effects of environmental problems, and explain engineering solutions.
CO3	Apply their knowledge of environmental science and engineering to specific scenarios or problems and analyze case studies related to environmental challenges, design sustainable engineering solutions, or implement eco-friendly practices within their organizations/society.
CO4	Analyse the ethical reflection regarding environmental problems in local, regional, national, and global communities and the importance of systemic study and evaluation of the environment during any initiative or plans.
CO5	Enable to make judgments and critique the effectiveness of environmental policies, strategies, and solutions.
CO6	Enable to nurture knowledge, respect, and protect the environmental resources and design solutions in the realm of environmental science and engineering.

HS111H COMMUNICATIONS SKILLS I (1-0-2) 2 Credits

Module 1- Functional English
Conversation Skills: Asking questions, requests, doubts, engage in conversation, Different, Types of Communication-verbal and non-verbal, body language
Module 2: Teaching Grammar
Grammar Games, Exercise
Module 3: Teaching Vocabulary
Language Games, Exercise
Module 4: Presentation Skills
Module 5: Role Plays, debates, extempores, group presentations

References:

1. Alan Garner. Conversationally Speaking: Tested New Ways to Increase Your Personal and Social Effectiveness.
2. Mike Bechtle. Confident Conversation: How to Communicate Successfully in Any Situation
3. Ronald carter, Rebecca Hughes. Exploring Grammar in Context
4. Baker, Ann and S. Goldstein, Pronunciation Pairs, Cambridge Univ Press, Cmbridge.2002.
5. Brown and D. Smith, Active Listening. Cambridge, CUP. 2004.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand and learn the significance of effective communication skills through learning life skills which are not hinged on traditional pedagogy.
CO2	Improved listening, speaking, reading and writing skills and confidence to become successful English speakers.
CO3	Understand significance of verbal and non-verbal communication in their personal and professional life
CO4	Enhance the students body language, social etiquette, presentation skills, interview skills, assertive communication skills, active listening and technical writing skills.
CO5	Develop critical and creative thinking by becoming active components in the nation building

AA131V Basic Engineering Lab (1-0-2) 2 Credits

Part A: Introduction to sketching- Introduction to Computer-Aided Drawing - Orthographic/ Isometric / sectional views- Development of surfaces.
Part B: Electrical wiring practice, Soldering practice**,** Identification and testing of electronic components, Circuit simulation using LT SPICE, PCB Design, PCB Fabrication, Soldering of components on PCB, and testing.

Text Books / References:

1. Bhatt, N. D., Engineering Drawing: Plane and Solid Geometry, 50th ed., Charotar Publishing House (2010).
2. Varghese, P. I., Engineering Graphics with AutoCAD, 26th ed., VIP Publishers (2012).
3. Bethune, J. D., Engineering Graphics with AutoCAD 2014, Pearson Education (2014).
4. Lab Manual

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Familiarization of basic mechanical elements, assemblies and mechanisms
CO2	Familiarization of hand tools, cutting tools and measuring instruments used in engineering workshop
CO3	Familiarization of general purpose machines and processes in engineering workshops.
CO4	Familiarization of soldering and wiring

SEMESTER 2

MA121C Vector Calculus, Integral Transforms, ODE & Special Functions (2-1-0) 3 Credits

Vector Calculus: scalar and vector fields – level surfaces – directional derivatives, gradient, curl, divergence – Laplacian – line and surface integrals – theorems of Green, Gauss, and Stokes.

Ordinary Differential Equations & Special Functions: first order ordinary differential equations – classification of differential equations – Picard's existence and uniqueness of solution of initial value problem – higher order linear differential equations with constant coefficients – method of variation of parameters and method of undetermined coefficients – power series solutions – regular and irregular singular point – Frobenius method to solve variable coefficient homogeneous differential equation –Legendre polynomials, Bessel's function, gamma function and their properties – Sturm-Liouville boundary-value-problem.

Integral Transforms: The Fourier transform pair, inverse Fourier transforms – linearity property, modulation, translation of Fourier transform– Fourier Convolution theorem – transforms of derivatives and derivatives of transform– applications of Fourier transform in solving ordinary differential equations – Laplace transforms of elementary functions, inverse Laplace transforms– linearity property–exponential order of a function and existence of Laplace transform– first and second shifting theorem– Laplace transforms of derivatives and integrals– Laplace Convolution theorem – applications of Laplace transform in solving ordinary differential equations.

Text Books:

1. Stewart, J., Calculus: Early Transcendentals, 5th ed., Brooks/Cole (2007).
2. Ross, S. L., Differential Equations, 3d ed., Wiley India Pvt. Ltd. (2007).
3. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Alpha science international Ltd (2014).

References:

4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India (1995).
5. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
6. Greenberg, M.D., Advanced Engineering Mathematics, Pearson Education (2007).
7. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press Inc.(2001).
8. James Ward Brown and Ruel V. Churchill, Fourier Series and Boundary Value Problems, 8th ed., McGraw-Hill (2011).
9. George Bachmann, Lawrence Narici, Edward Beckenstein, Fourier and Wavelet Analysis, 1st ed., Springer-Verlag New York Inc. (2000).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Differentiate between pointwise and uniform convergence, check whether a given series is pointwise or uniformly convergent series, and apply the techniques to integral and differential calculus.
CO2	Analyze and solve ODEs, confirm existence and uniqueness of solutions of IVP. Find power series solution of linear homogeneous ODE with variable coefficients and Frobenius method for equations with regular singular point. Know the special functions like Legendre polynomial, Bessel function etc. and properties. Finding eigenvalues and eigenfunctions for Sturm-Liouville problems.
CO3	Verify continuity/differentiability of scalar/vector-valued function. Calculate line/surface integration of scalar/vector-valued functions. Apply fundamental theorems to understand the nature of vector fields and check if a given vector field is conservative.

AV121C	Basic Electronics (3-0-0)	3 Credits

Introduction of Electronics and Semiconductors: Semiconductor Properties, energy bands, direct-indirect band gap semiconductors, intrinsic and extrinsic semiconductors, drift & diffusion, mobility, and resistivity.
PN Junction Diode and Applications: Diode characteristics , diode clipping and clamping circuits, rectifying circuits, DC power supplies, Zener diode, voltage regulators and basics of filter circuits.
Transistors: Fundamentals of BJT and its configurations, different Bias cconfigurations and stabilisation technique. Small-signal low-frequency h- parameter model.
Amplifiers: DC analysis and AC analysis of BJT. The application of BJT as amplifiers/switches, CE, CB and CC amplifiers.
Fundamentals of FET, (JFET and MOSFET), Concept of FET amplifiers
Introduction to Linear Integrated Circuits: Operational amplifiers, concept of the differential amplifier, Op-amp Specifications-CMRR, Slew rate, Op-Amp Characteristics, concept of negative feedback, inverting and non-inverting configurations, Basic Op-amp circuits-Differentiator & Integrator, summing and difference amplifiers, instrumentation amplifier
Digital circuits: Number systems, Boolean logic – basic gates – truth tables – logic minimisation using K maps, combinatorial (Multiplexer, De-Multiplexer) and sequential circuit (Flip Flop)

Text Books:

1. Boylestad, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
2. Robert F. Coughlin & Frederick F. Driscol, Operational Amplifiers and Linear
3. Integrated Circuits Prentice Hall of India Private Limited
4. Mano, M. M., Digital Design, Prentice Hall

References:

1. Paul Horowitz & Winfield Hill, The Art of Electronics Cambridge University press
2. Mottershed, Allen., Electronic Devices and Circuits: An Introduction, EEE Publication, 12th Indian ed.
3. Malvino, A. P., Electronic Principles, 12th ed., 3rd TMH ed., Tata McGraw-Hill

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Differentiate between pointwise and uniform convergence, check whether a given series is pointwise or uniformly convergent series, and apply the techniques to integral and differential calculus.
CO2	Analyze and solve ODEs, confirm existence and uniqueness of solutions of IVP. Find power series solution of linear homogeneous ODE with variable coefficients and Frobenius method for equations with regular singular point. Know the special functions like Legendre polynomial, Bessel function etc. and properties. Finding eigenvalues and eigenfunctions for Sturm-Liouville problems.
CO3	Verify continuity/differentiability of scalar/vector-valued function. Calculate line/surface integration of scalar/vector-valued functions. Apply fundamental theorems to understand the nature of vector fields and check if a given vector field is conservative.

AV122C Network Analyasis (3-0-0) 3 Credits

Time domain analyses: Transients in electrical circuits - RL, RC and RLC circuits, DC and AC circuits, switched capacitor circuits, conservation of charge, passive filters, resonance in networks, magnetic circuits and magnetically coupled circuits.

Laplace domain analyses: Laplace transform basics, initial and final value theorems, properties of Laplace transforms, initial value problems, applications of Laplace transforms for networks solving.

Two-port networks, graph theory and network synthesis.

Text Books:

1. Van Valkenbarg, M.E., "Network Analysis", 3rd Ed., Prentice-Hall. 2007
2. Van Valkenbarg, M.E., "Network Synthesis", 3rd Ed., Prentice-Hall. 2007
3. Kuo, F.F., " Network Analysis and Synthesis", 2nd Ed., Wiley India. 2008

References:

1. Murthy, K.V.V. and Kamath, M.S., "Basic Circuit Analysis", Tata McGraw-Hill. 1989
2. DeCarlo, R.A. and Lin, P.M., "Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches", Oxford University Press. 2003
3. Ramakalyan, A., "Linear Circuit Analysis and Synthesis", Oxford University Press.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Learning signals, conventions and definitions used in steady state and transient analysis of electrical networks
CO2	Analysis of transients in 1st and 2nd order networks in time domain for different excitations and circuit configurations for standalone as well as coupled circuits
CO3	Understanding the fundamentals of Laplace transform and application of LT in network analysis.
CO4	Analysis of network in frequency domain and designing 1st and 2nd order analog passive and active filters as a precursor to network synthesis.

CH121C Material Science and Engineering (3-0-0) 3 Credits

Atomic bonding: attractive and repulsive forces, Chemical bonding in solids, free electron model, the quantum- mechanical free electron theory; zone or band model, Kronig Penney model, Crystal structure: lattice, basis, unit cell, crystal structures, miller indices of directions and planes, interstitial sites, ionic and covalent crystal structures, Defects; point and lattice defects, Crystal growth: Czochralski method, Bridgman and Stockbarger Methods Metals and alloys, structure-property relations, strain hardening; Semiconductor materials; Ceramics, synthesis and processing; Semiconducting polymers, classification, mechanism of formation, structure-property relations, Material characterization, Braggs law, X-ray diffraction, electron microscopies; scanning electron microscopy, principles, applications.

Text Books/ References:

1. Donald R. Askeland, Wendelin J. Wright, The Science and Engineering of Materials, 7th ed., Cengage Learning India Pvt Ltd (2016).
2. Prathap Haridoss, Physics of Materials: Essential Concepts of Solid-State Physics, Wiley India (2015)
3. Billmeyer, F. W., Textbook of Polymer Science, 3rd ed., Wiley India (1984).
4. W.D. Kingery, Introduction to Ceramics, 2nd ed., John Wiley & Sons, (1999).
5. Y. Leng, Materials Characterisation: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia), (2008).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand the fundamental principles of materials science.
CO2	Appreciate the applications of different classes of materials in day today life as well as in strategic sectors
CO3	Evaluate the properties of materials for and applying in different applications

HS121C COMMUNICATIONS SKILLS II (1-0-0) 1 Credits

Module 1: Audience analysis and adaptation
Module 2: Technical writing formats and styles (e.g., reports, minutes, posters, proposals, manuals, instructions), Writing style and tone, Clarity, conciseness, and coherence, Introduction to Technical Writing: Document planning and organiztion
Module 3: Reading and appreciating stories, poems, essays, Comprehensive questions and answers, Listening and note taking video lectures
Module 4: short plays, individual presentations, group discussions, debates

References:

1. Buzan, Tony. Use Your Head, Guild Publishing, 1974.
2. G. Maugur, The English Language Laboratory Drills for Students of Science and Technology, Oxford, OUP. 2005.
3. Mc Carthy, Carter. Cambridge Grammar of English. Cambridge, CUP.2006
4. Yule, George. Oxford Practice Grammar. Oxford, OUP. 2006.
5. Anderson, Kenneth. Et al. Study Speaking. CUP, Cambridge.2004.
6. Freeman, Sarah. Written Communication in English. Orient Longman, Chennai. 2005.
7. Hancock, Mark. English Pronunciation in Use. CUP, UK. 2003.
8. Swales, J. M., & Feak, C. B. Academic writing for graduate students: Essential tasks and skills (Vol. 1). Ann Arbor, MI: University of Michigan Press. 2004.
9. Belcher, W. L.Writing your journal article in twelve weeks: A guide to academic publishing success. University of Chicago Press.2019

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand the significance of professional communication and technical writing
CO2	Create an awareness regarding body language, facial expressions, and gestures to enhance communication and convey messages effectively.
CO3	Learn Interpersonal Communication skills to develop and maintain relationships, to resolve conflicts, and to be empathetic to others.
CO4	Keeping the NEP goals in mind, the course endeavours to be holistic, educational, integrated, enjoyable and engaging.

MA122V Fundamentals of C++ Programming (3-0-2) 4 Credits

Module 1: Introduction to Computers and programming

Computers-Hardware and software; Program and Programming languages; Input processing, and output;Procedural and object oriented programming.

Module 2: Introduction to C++

Components of a C++ program; cout object;#include directive; Variables and literals; Identifiers; Integer data types; char data type; Floating-point data types; bool data type; Variables, assignment and initialization; Scope; Arithmetic, Relational, Logical Operators; comments

Module 3: Expressions, statements

cin object; Mathematical expressions; Type conversion; Overflow and underflow; Type casting; Compound assignments; Formatting output; Char and string objects; Mathematical library functions; Debugging

Module 4: Making Decisions and loops

Assignment statements; Compound assignment; Increments and decrements; Conditional statements-if/else; Nested if/else; Conditional operator; switch statement; while loop; do-while loop; for loop

Module 5: Functions and Arrays

Defining and calling functions; function prototypes; Passing data by value; return statement; local and global variables; static local variables; Default arguments; Reference variables as parameters; Overloading functions; exit() function; Array initialization; Processing array contents; Arrays as function arguments; Two dimensional arrays.

Module 6: Pointers and Strings

Getting the address of a variable; Pointer variables; Pointer arithmetic; Initializing pointers; Comparing pointers; Pointers as function parameters; Dynamic memory allocation; Character case conversion; C-Strings; Library functions for working with C-Strings; C++ string class.

Module 7: Errors, Convergence, Speed and Nonlinear equations

Truncation; Rounding errors; Quadratic equations; floating point equality; conditioning and stability; Local and global errors; Rates of convergence; Reciprocals without division; Speed of computation; Speed and Recursion; Fixed point method; Choice of fixed point function and Newton's method; C++ implementation of fixed point and Newton's method.

Module 8: Classes and File stream

Introduction to classes; Private members; member functions; constructors; destructors; Overloading constructors; Private member functions; Array of objects; Friends of classes; copy constructors; Operator overloading; File operations; Passing file stream objects to functions; Member functions for reading and writing files; Opening a file for input and output.

Module 9: Numerical methods for differential equations

Euler's method; Modified Euler method; Runge-Kutta methods with C++ implementation; Solution of Laplace equation by Finite differences; Liebmann iterative method for solving Laplace equation; Bender-Schmidt difference equation for the parabolic equation; Crank-Nicholson difference equation for the parabolic equation with C++ implementation; Solution to hyperbolic equation; Lax-Friedrich method; Leap-frog method; Lax-wendroff method; C++ implementation.

Text Books / References:

1. Stanley B. Lipmann, Josee Lajoie, Barbara E. Moo, C++ Primer, Addison-Wesley.
2. Ulla Kirch-Prinz, Peter Prinz, A Complete Guide to Programming in C++, Jones and Barlett publishers.
3. K. W. Morton, D. F. Mayers, Numerical solution of Partial differential equations, Cambridge University Press, UK

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Learn the procedural and object oriented paradigm with conditional statements, looping constructs and functions.
CO2	Understand the concepts of streams, classes, functions, data and objects.
CO3	Understand dynamic memory management techniques using pointers, constructors, destructors, etc
CO4	Apply the concept of function overloading, operator overloading, virtual functions and polymorphism.

AV141C Basic Electrical and Electronics Lab (0-0-2) 1 Credits

Electrical Engineering Lab
o Verification of network theorems.
o Open circuit and short circuit tests on transformer.
o Load test on transformer.
o Three-phase power measurements.
o Characteristic of electrical machines (AC and DC).
Electronics Engineering Lab
o Implementation of digital circuits
o Design of electronic system using operational amplifiers
o Device characteristic
o Power supply design
o Wave shaping circuits: clippers and clampers
o Biasing of transistor

TextBooks/References:

- **Lab Manual**

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand basic operations and learn how to use bread boards, components, oscilloscopes, function generators, multimeters, etc.
CO2	Learn the practical operation of diode-based circuits for various applications
CO3	Learn basic electronic circuit measurement techniques
CO4	Verify Network Theorems
CO5	Conduct SC and OC tests on single phase transformers

SEMESTER 3

MA211C Linear Algebra, Complex Analysis, and Fourier Series (2-1-0) 3 Credits

Linear Algebra: elementary row-operations, row-echelon form and reduced-row-echelon form of matrices, rank of matrices – solution of system of equations Ax=b by Gauss-elimination method, and Gauss-Jordan method – eigenvalues and eigenvectors, Cayley-Hamilton theorem – vector spaces over real field, subspaces, linear dependence, independence, basis, dimension – linear transformation, null space and nullity, range and rank of a linear transformation– inner product, Gram-Schmidt orthogonalization process.
Complex Analysis: Complex numbers and elementary properties, Complex functions - limits, continuity and differentiation, Cauchy-Riemann equations, analytic and harmonic functions, elementary analytic functions – anti-derivatives and line (contour) integrals, Cauchy-Goursat theorem, Cauchy's integral formula – Morera's theorem, Liouville's theorem –Power series, Taylor series, zeros of analytic functions, singularities and
Laurent series, residues, Cauchy's Residue theorem – applications of Cauchy's Residue theorem to evaluate improper integral.
Fourier Series and Integra: Fourier series of periodic functions with period "2pi" – Fourier series of even and odd functions – half-range series – Fourier series of functions with arbitrary period "T" – point-wise convergence of Fourier series – Fourier integral–pointwise convergence of Fourier integrals.

Text Books:

1. Howard Anton, Elementary Linear Algebra, 10th ed., John Wiley & Sons Inc (2010).
2. Mathews, J. H. and Howell, R., Complex Analysis for Mathematics and Engineering, Narosa (2005).Reference: References:
3. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, 4th ed., Alpha science international Ltd (2014).

References:

1. Gilbert Strang, Linear Algebra and its Applications, Cengage learning, 4th edition, 2006.
2. Brown, J. W. and Churchill, R. V., Complex Variables and Applications, 9th ed., McGraw-Hill (2013).
3. Greenberg, M.D., Advanced Engineering Mathematics, Pearson Education (2007).
4. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).

Course Outcomes (CO) :

Course Outcomes	Statements
CO1	Understand the basic concepts of vector space and subspaces
CO2	Determine rank and nullity of space and matrix of linear Transformation
CO3	Understand basic concepts of analytic functions and harmonic functions
CO4	Evaluate integrals of features using Cauchy's theorem and Cauchy integral formula
CO5	Apply Taylor's and Laurent's series expansion and find singularities of function
CO6	Understand the convergence of Fourier series and evaluate Fourier series of periodic and even functions

AV211C	Semiconductor Devices (3-0-0)	3 Credits

Semiconductor fundamentals, crystal structure, concept of effective-mass, Fermi level, energy-band diagram, concept of holes, intrinsic and extrinsic semiconductors, carrier concentration, carrier transport, scattering and drift of electrons and holes, drift and diffusion, generation and recombination, quasi- Fermi levels.

Semiconductor junctions, Physical description of p-n junction, p-n junction under forward and reverse bias, current – voltage characteristics and temperature dependence, tunneling current and tunnel diode, small signal ac analysis.

Hetero junctions and Schottky junctions, Bipolar Junction Transistors, base width modulation, frequency limitations, pnpn diode, SCR, MOS capacitor, flat-band and threshold voltages, MOSFETs, scaling laws of MOS transistors.

Optical absorption in a semiconductor, photovoltaic effect, solar cell, photoconductors, PIN photodiode, avalanche photodiode, LED, semiconductor LASER, negative conductance in semiconductors, transit time devices, IMPATT, Gunn device, IGBT.

Text books / References:

1. S. M. SZE, Semiconductor Physics and Devices, Wiley Student Edition, 2007.
2. Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Devices, Dorling Kindersley, 2007.
3. Robert.F. Pierret, Semiconductor Device Fundamentals, Prentice Hall of India, 2007.
4. Donald Neamen, Semiconductor Physics and Devices, McGraw publisher

Course Outcomes (COs)

Course Outcomes	Statements
CO1	Understand basic concepts of semiconductor theory including band diagrams, carrier transport, carrier concentrations, doping and continuity equation. Analyze continuity equations for various scenarios.
CO2	Understanding basic steps of fabricating p-n junction, depletion region, built-in voltage, energy band diagrams and operation of diodes
CO3	Analyze the operation of Tunnel diode and Metal-Semiconductor junctions. Apply energy band concepts to Heterojunctions, Alloyed semiconductors and Bandgap engineering
CO4	Formation of bipolar junction transistors and operation, Early effect, MOS capacitor, CV characteristics

AV212C Analog Electronic Circuits (3-0-0) 3 Credits

Basic stability and device stabilization techniques (BJT). Small signal low & high frequency models for (BJT, FET, MOSFET), Large signal amplifiers, Differential Amplifier, Instrumental amplifiers, Integrated circuits, Tuned amplifiers, Feedback amplifiers, Oscillators, Multivibrators, Wave shaping circuits, Filter design.
Basic stability and device stabilization techniques (BJT). Small signal low & high frequency models for (BJT, FET, MOSFET). Large signal amplifiers - Multistage amplifiers - Differential amplifier - Tuned amplifiers - Feedback amplifiers – Power amplifiers - Instrumental amplifiers. Oscillators – Multivibrator - Wave shaping circuits - Active Filter design- Integrated circuits (PLL, Timers, A/D converters)

Textbooks:

1. J. Millman and C.C. Halkias, Integrated Electronics - Analog and Digital circuit system, McGraw Hill, 1996.

References:

1. David A.Bell, Electronic Devices and Circuits, Prentice Hall of India, 2006.
2. Donal L. Schilling and Charles Beloue, Electronic Circuits , Third Edition, McGraw Hill, 2005.
3. David A. Bell, Solid State Pulse Circuits , Prentice Hall of India, 1992.
4. John D. Ryder, Electronic Fundamental and Applications - Integrated and Discrete system , Prentice Hall of India, 1999.
5. J. Millman and H. Taub, Pulse Digital and Switching waveform-Devices and circuits , McGraw Hill International, 1965.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understanding the concept of small signal operation and biasing techniques for BJTs and MOSFETs
CO2	Analysis and design of amplifiers using BJTs and MOSFETs
CO3	Understanding concepts of frequency response, noise, feedback, non-linearity in electronic systems
CO4	Analysis and design of differential amplifiers, instrumentation amplifiers, tuned amplifiers and power amplifiers
CO5	Design of wave-shaping circuits, oscillators and multivibrators using transistors, opamps and timer ICs
CO6	Design of a complete analog electronic system with real-world component variation and temperature dependence

AV213C Digital Electronics and VLSI Design (3-0-0) 3 Credits

Boolean Algebra, standard representation and Minimization Procedures. Logic families, combinational circuits, asynchronous and synchronous sequential circuits, Memories, PROMs AND PLAs. Introduction to VLSI systems- CMOS logic - MOS transistor theory- Layout design rules- Circuit characterization and performance estimation- Circuit simulation- Combinational and sequential circuit design- Static and dynamic CMOS gates- Memory system design- Design methodology and tools-HDL. Design of FPRG, Complex CMOS design.

Textbooks:

1. Morris Mano, Digital Design, 4th ed., Prentice-Hall of India, 2006.
2. John.F.Wakerly, Digital Design Principles and Practice, 3rd edition, Pearson Education, 1990.

References:

1. William I. Fletcher, An Engineering Approach to Digital Design, Prentice-Hall of India, 1980.
2. T.L. Floyd, Digital Fundamentals, Charles E. Merrill publishing Company, 1982.
3. R.L. Tokheim, Digital Electronics - Principles and Applications, Tata McGraw Hill, 1999.
4. R.P. Jain, Modern Digital Electronics, Tata McGraw Hill, 1999.
5. N. Weste and D. Harris, CMOS VLSI Design: Circuits and Systems Perspective, Addison Wesley, 2004.
6. Wayne Wolf, Modern VLSI Design, Prentice Hall,1998.
7. Peter J. Ashenden, The Designer's Guide to VHDL, Harcourt Asia private Limited & Morgan Kauffman, 1996.
8. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design Systems and Circuits, Prentice Hall of India, 1993.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand basics of logic gates, and minimization of Boolean equations and its combinational circuit implementation
CO2	Design combinational logic circuits for adder, subtractor and other arithmetic/control functionality
CO3	Design and analyze the synchronous sequential circuits and asynchronous sequential circuits, timing parameters and its implementation
CO4	Understand basics of VLSI Design, TTL logic family, electrical characteristics of digital logic gate, CMOS implementation of logic gate and fundamentals of CMOS device characteristics of inverter, layout rules and design .
CO5	Learning to design and analyze CMOS static and dynamic circuits
CO6	Learning to design digital circuits using hardware description Language

AV214C SIGNALS AND SYSTEMS (3-0-0) 3 Credits

Classification of signals and systems, Types of signals, Transformation of independent variable, Periodic signals and Periodicity, Types of systems, Analysis of Continuous Time Signals and LTI systems: Convolution, Impulse response, Trigonometric and exponential Fourier series, Eigen functions of LTI systems, Fourier Transform, Magnitude and Phase Spectra, Properties of Fourier Transform, Laplace Transform, Region of Convergence, Properties, Linear Constant coefficient Differential Equations, State Space Matrix for continuous time systems.
Anlaysis of Discrete Time Signals and LTI DT systems: Periodicity, Discrete Convolution, DFT, Properties, Z Transform, ROC, Properties, Difference Equations, State variable equation and matrix, some applications – signal processing, communication, control systems etc.

Textbooks:

1. R.F. Ziemer, W.H. Tranter and D.R. Fannin, Signals and Systems - Continuous and Discrete, Prentice Hall, 2006.
2. B.P. Lathi, Linear Systems and signals, 2nd edition, Oxford University Press, 1998.
3. Simon Haykin, Barry Van Veen, Signals and Systems, John Wiley and Sons (Asia) Private Limited, 2005.
4. A.V. Oppenheim, A.S. Willsky and I.T. Young, Signals and Systems, Prentice Hall, 2006.

References:

1. Douglas K. Lindner, Introduction to Signals and Systems, Mc-Graw Hill International,1999.
2. Robert A. Gabel, Richard A. Roberts, Signals and Linear Systems, John Wiley and Sons (SEA) Private Limited, 1995.
3. M. J. Roberts, Signals and Systems - Analysis using Transform methods and MATLAB, Tata McGraw Hill, 2003.
4. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, Signals and Systems, Tata McGraw Hill, New Delhi, 2001.
5. Ashok Ambardar, Analog and Digital Signal Processing, 2nd Ed., Brooks/ Cole Publishing Company, 2006.
6. A. Papoulis, Circuits and Systems: A Modern Approach, HRW, 1980.
7. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press, 1998

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Interpret discrete time and continuous time linear time invariant systems in time domain.
CO2	Analyze Continuous time signals and system applying Fourier and Laplace concepts.
CO3	Analyze Discrete time signals and system applying DTFT and Z transforms.
CO4	Apply the significance of discrete systems in signal processing, communication and control systems.

HS211H Introduction to Social Science and Ethics (2-0-0) 2 Credits

Social Science: Introduction to sociology, anthropology – social science research design and sampling. Ethics: Professional and personal ethics – values & norms and human rights.

Textbooks:

1. **Lecture Notes.**

References:

1. Perry, J. and Perry, Contemporary Society: An Introduction to Social Science, 11th ed., Allyn & Bacon (2005).
2. Giddens, A., Sociology, 5th Edition. Wiley (2006).
3. Flyvberg, B, Making Social Science Matter, Cambridge Univ. Press (2001).
4. Singer, P., A Companion to Ethics, Wiley-Blackwell (1993).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Holistic understanding about society and awareness of humanitarian and social issues
CO2	Application of the sciences for the improvement of the quality of life
CO3	Enhancing the analytical capabilities of students and cultivate critical thinking
CO4	Understand ethics and values of life and its application in professional and personal life

AV232C Analog Electronic Circuits Lab (0-0-2) 1 Credits

- **Analog Electronics**
  - Feedback amplifier and multistage amplifiers.
  - LC and RC oscillators.
  - Tuned amplifier and stage tuned amplifiers.
  - Multivibrators.
  - Schmitt Trigger.
  - Wave shaping circuits.
  - Differential Amplifiers, CMRR measurements

Textbooks/References:

- **Lab Manual**

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Designing DC circuits using transistors - applying biasing techniques
CO2	Designing amplifiers for a given specifications and measuring frequency response of amplifiers
CO3	Design of wave-shaping circuits, oscillators and multivibrators using opamps and timer IC
CO4	Design of a complete analog electronic system with real-world component variation and temperature dependence

AV233C Digital Electronics and VLSI Design Lab (0-0-2) 1 Credits

1. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters, parity generator / checker, magnitude comparator etc.
2. Design and implementation of application using multiplexers, Decoders/encoders.
3. Design and implementation of synchronous & asynchronous sequential circuit.
4. FPGA and Programming.

Text Books / References:

1. Lab Manual

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Learning to design, analyze and realizing logic gates of transistor Level circuits using discrete level components, static and dynamic performance parameters of the gates
CO2	Hands on training on designing and realizing (i) combinational logic circuits of parallel adders, multiplexers using discrete components and SSI/MSI chips (ii) sequential circuits realizing flip flops, registers, counters using IC chips
CO3	Simulate and analyze Logic circuits using HDL language
CO4	Design simulate and analyze logic circuits-adders, ALU, memories, sequence detector using HDL and implement it in FPGA
CO5	Design simulate and analyze controller designs/FSM for interfaces in FPGA
CO6	Design of digital system using Verilog and implement in FPGA

SEMESTER 4

MA221C PDE, Probability and Statistics (2-1-0) 3 Credits

Partial Differential Equations: Introduction to PDEs and modelling –first order partial differential equations, solutions of linear and quasilinear first order PDEs, method of characteristics, Charpit method – classification of second-order PDEs, canonical form – solution of Initial and boundary value problems involving Laplace, heat and wave equations by the method of separation of variables and Fourier series.

Probability: Elementary concepts on probability – axiomatic definition of probability –conditional probability – Bayes' theorem – random variables – standard discrete and continuous distributions – moments of random variables – moment generating functions – multivariate random variables – joint distributions of random variables – conditional and marginal distributions – conditional expectation – distributions of functions of random variables – t and $\chi2$ distributions – Schwartz and Chebyshev inequalities – weak law of large numbers for finite variance case – central limit theorem for iid finite variance case.

Statistics: Elementary concepts on populations, samples, statistics – sampling distributions of sample mean and sample variance – point estimators and its important properties – point estimator for mean and variance and proportion – confidence interval for sample mean – tests of hypotheses – Chi-squared test of goodness of fit.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th ed., John Wiley (2005).
2. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press Inc.(2001).
3. Walpole, W. E., Myers, R. H., Myers, S. L., and Ye, K., Probability & Statistics for Engineers & Scientists, 9th ed., Pearson Education (2012).

References:

1. Greenberg, M.D., Advanced Engineering Mathematics, Pearson Education (2007).
2. Sneddon, I.N., Elements of Partial Differential Equations, McGraw-Hill (1986).
3. K. Sankara Rao, Introduction to Partial Differential Equations, 3rd Ed., Prentice Hall of India (2011).
4. A.K. Nandakumaran and P. S. Datti, Partial Differential Equations: Classical Theory with a Modern Touch, Cambridge University Press; First Edition (2020).
5. McOwen, R.C., Partial Differential Equations: Methods and Applications, 2nd ed., Pearson Education (2003).
6. Johnson, R. A., Miller & Freund's Probability and Statistics for Engineers, 6th ed., PrenticeHall (2000).
7. Milton, J. S. and Arnold, J. C., Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences, 4th ed., McGraw-Hill (2002).
8. Ross, S. M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd ed.,

Academic Press (2004).
9. Hogg, R. V. and Tanis, E. A., Probability and Statistical Inference, 7th ed., Prentice Hall(2005).
10. Larsen, R. J. and Marx, M. L., An Introduction to Mathematical Statistics and Its Applications, 4th ed., Prentice Hall (2005)

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Learn fundamental concepts of probability, statistics and numerical methods in detail to enable students to identify the relevance of these concepts and apply them in the modelling and performance analysis of several electronics and communication systems.
CO2	Understand random variables and their probability distributions chosen to model various random phenomena arising in models of systems.
CO3	Analyse sampling theory to understand the information in a sample to estimate system parameters.
CO4	Understand various standard numerical techniques to apply them appropriately in the modelling and analysis of several engineering systems.

AV221C   Electromagnetic Theory (3-0-0)   3 Credits

Review of Maxwell's Equations – Boundary Conditions – Pointing Vector.
Electromagnetic Waves: Wave equation & Uniform Plane waves – Plane waves in lossy and lossless mediums – Normal and oblique incidences of plane waves.

Transmission line theory: LCR model for transmission lines – Analogy with wave equations – characteristics of lossless lines – VSWR, Impedance matching – Smith chart – Case study.

Waveguides: TEM, TE, TM Waves – wave propagation in Rectangular, Circular & Planar wave guides. Fundamentals of Antenna: Radiation – Wire antenna – Gain and Directivity. Introduction to antenna arrays.

Textbooks:

1. D. K. Cheng, Field and Wave Electromagnetics, Pearson Education.
2. R K Shevgaonkar, Electromagnetic Waves, Tata McGraw-Hill Education
3. C. A. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons

References:

1. E.C. Jordan & K.G. Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India 2nd edition 2003.
2. M.N.O.Sadiku, Elements of Engineering Electromagnetics, Oxford University Press, Third edition.
3. Ramo, Whinnery and Van Duzer, Fields and Waves in Communications Electronics, John Wiley & Sons (3rd edition 2003).
4. William H.Hayt, Engineering Electromagnetics, Tata McGraw Hill 7th edition.
5. J. D. Kraus, Antennas, McGraw-Hill, 2nd Edition

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand and apply the fundamental concept of electrostatics and magnetostatics
CO2	Understand the wave equations & boundary conditions and apply the same in different cases
CO3	Familarize the characteristics of EM wave and its propagation in various mediums and apply the same in various applications and practical scenarios
CO4	Familiarize and understand the concept of transmission lines and its in depth analysis
CO5	Analyze, understand and design rectangular and circular waveguides
CO6	Understand the overview & basics of antennas and propagation

AV222C Instrumentation and Sensor Electronics (3-0-0) 3 Credits

Introduction to instrumentation systems, Static and dynamic characteristics of instruments, Error Analysis, Sensor Reliability.

Typical Sensor-Electronic Circuits: Differential and Instrumentation Amplifier, Bridge-based measurements, Linearization Circuits, Filters, Phase Detectors, Current Sources, Precision Rectifiers, V-to-f converters, Aspect of guarding and shielding, remotely located sensors and conditioning.

Elements of Digital Instrumentation: Frequency, time-period measurement, Digital voltage measurement, DMM, Sample & Hold Circuits, D/A circuits, Different ADC Architectures (Flash, SAR)

Sensor & Sensor-Electronics: Resistive Sensors & Electronics, Inductive transducers & Demodulator Electronics, Capacitive transducers and charge-amplifier based circuits, Self-generating Sensors, Magnetic Sensors, Medical instrumentation systems.

Textbooks:

.1. Doebelin, E.O., Measurement systems: Application and Design, 5th ed., McGraw hill, 2003.

2. Ramón Pallás-Areny, John G. Webster, Sensors and Signal Conditioning, 2nd Edition, Wiley, 2003

References:

1. J. G. Webster, The Measurement, Instrumentation and Sensors Handbook, Vol 1 and 2, CRC Press, 1999
2. John P. Bentley, Principle of Measurement Systems, Pearson Education; 3rd Edition, 2006
3. Capacitive Sensors – Design and Applications, L. K. Baxter, IEEE Press Series on Electronic Technology, NJ (1997)
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3rd Edition, McGraw hill, 2002
5. George Clayton, Steve Winder, "Operational Amplifiers", 5th Edition, Elsevier Newnes, 2003
6. John G. Webster, "Medical Instrumentation: Application and Design"

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understanding the various (static, dynamic, long-term) specifications and characteristics of sensors and instrumentation systems.
CO2	Understanding the principles of various analog meters and measurement strategies for voltage, current, power and impedance estimation.
CO3	Analyze typical measurement/interface circuits used to build instrumentation systems
CO4	Understanding the principles of digital instrumentation and internal architecture of standard equipment such as digital multimeters, function generators, oscilloscopes, etc.
CO5	Analyze various transduction principles andoperation of typical sensors and specific design guidelines and practical issues in sensors, interface electronics and instrumentation systems.

AV223C	Control Systems (3-0-0)	3 Credits

Control Systems: Introduction to Control Theory - Control System Components, Modeling of Physical Systems - Transfer Function, Block Diagram, Signal-Flow Graph, and State-Space Representation. Time Domain and Frequency Domain Response - Relationship between the Time and Frequency Domain Responses. Stability - Concept of Pole and Zero - Routh-Hurwitz Criteria, Nyquist Criteria, Root Locus, and Bode Plot; P-I, P-D, P-I-D Controller Design, Tuning of Controllers; Lead and Lag Compensators. State Variable Representation and Solution of State Equations of LTI Control Systems.

Textbooks:

1. Control Systems Engineering, 8/e – Norman S Nise, Wiley India, 2024
2. Feedback Control of Dynamic Systems, 8/e – Franklin, Powell, Pearson Education India, 2024

References:

1. Modern Control Engineering, 5/e – K Ogata, Pearson Education India
2. Automatic Control Systems , 10/e – F Golnaraghi, BC Kuo, MC Graw Hill Education Gopal I and Nagrath N, Control systems, Wiley Eastern Ltd, NewDelhi, 1985.
4. D'Azzo, Houpis, Feedback Control System Analysis and Synthesis, CRC Press, 2007.
5. M.Gopal, Control systems, Principle and Design, Tata McGraw Hill publishing Co,m NewDelhi, 1997.
6. Kuo B.C., Automatic control systems, Prentice Hall India ltd, New Dehli, 1995.
7. Mutambara, Design and Analysis of Control Systems, CRC Press, 2008
8. Xue, Chen, Atherton, Linear Feedback Control Analysis and Design with MATLAB, SIAM Publications, 2006.
9. Qiu, Zhou, Introduction to Feedback Control, Prentice Hall, 2009.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand and differentiate between open loop and closed loop control systems
CO2	Model a physical system and analyse its transient behaviour and steady state characteristics
CO3	Analyse stability of linear time invariant systems and familiarise with stability concept
CO4	Design simple controllers like PID and lag-lead compensators for LTI systems

AV224C Embedded Systems (2-0-0) 2 Credits

Microcontroller Based Embedded System Design: Salient Features of Modern microcontrollers. Elements of the Microcontroller Ecosystem and their significance.

Introduction to Embedded Systems and Computer Systems Terminology: Modular approach to Embedded System Design, input devices, output devices, embedded computer, communication block, host and storage elements and power supply. Introduction to ARM Microcontroller and Architecture. Programming Methods for ARM. Introduction to IDE/ debug Platform.

Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Fundamentals of Physical Interfacing. Connecting Input Devices: Switches, Output devices: LEDs, Seven Segment Displays(SSD). Writing efficient Interrupt Service Routine (ISR). Introduction to Timer Module and its Modes of Operation. Generating Pulse Width Modulation (PWM) using Timer Capture Mode. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface Module. DAC and custom Waveform generation. ADC operation in and interfacing analog inputs. Liquid Crystal Displays.

Textbooks / References:

1. Designing Embedded Hardware, John Catsoulis. 2nd edition. Shroff Publishers and Distributors. ISBN-10: 9788184042597

2. Embedded System Design: A Unified Hardware / Software Introduction. Tony Givargis and Frank Vahid. Wiley. ISBN-10: 812650837X

3. F. Vahid and T. Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India Pvt. Ltd., 2002.

4. A.N. Sloss, D. Symes and C. Wright, "ARM System Developer's Guide: Design and Optimizing System Software", Morgan Kaufman Publishers, 2004.

5. W. Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Analyze and compare the salient features of modern microcontrollers (e.g., ARM-based MCUs), and explain the roles of ecosystem elements (power supply, storage, host interface, communication blocks) in a modular embedded-system design.
CO2	Demonstrate proficiency in programming ARM microcontrollers by setting up an IDE/debug platform, writing, compiling, and debugging firmware using both polling and interrupt-driven methods.
CO3	Design and implement efficient hardware interfaces—driving loads (high-side, low-side, H-bridge), multiplexing and Charlieplexing displays, handling switches and LEDs—and write optimized Interrupt Service Routines (ISRs) and timer-based PWM generators.
CO4	Integrate and program serial communication protocols and analog peripherals (ADC, DAC), and develop applications that drive LCDs and custom waveform outputs through the MCU's universal serial interface and analog modules.

HS221H Introduction to Economics (2-0-0) 2 Credits

Exploring the subject matter of Economics: why we study economics – types - definitions – economic systems – economics as a science.
Principles and Concepts of Micro Economics: demand – supply – production – costs – markets-equilibrium.
Basics of Macro Economics: Role of government – national income concepts – inflation concepts– classical vs. Keynesianism.
Economic Problems and Policies: meaning of development – problems of growth – population– agriculture and industry – balance of payments – planning – study report related to economics of space program.

Textbooks:

1. Samuelson, Paul A. and William D. Nordhaus, Economics, 17th ed., McGraw-Hill (2005).
2. Dewett, K. K., Modern Economic Theory, 22nd ed., S. Chand & Co.
3. Thirlwall, A. P., Growth and Development with Special Reference to Developing Economies, Palgrave (2003).

References:

1. Gardner, A., Macroeconomic Theory, Surjeet Publications (1998).
2. Koutsoyiannis, A., Modern Microeconomics, 2nd ed., Palgrave Macmillan (2003).
3. Black, J., A Dictionary of Economics, Oxford Univ. Press (2003).
4. Meir, J. M. and Rauch, J. E., Leading Issues in Economic Development, 7th ed., Oxford Univ. Press (2005).
5. Todaro, M. P. and Smith, S. C., Economic Development, 8th ed., Pearson Education Ltd. (2008).
6. Economic Survey 2008, Government of India, Ministry of Finance.
7. O'Connor, D. E., The Basics of Economics, Greenwood Press (2004).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand economic problems for better development of technology
CO2	Develop theoretical and analytical skills to make firm level decisions using various principles of economics.
CO3	Equip to handle the dynamics of production and business to understand and handle the dynamics of economics and business of the changing world economy
CO4	Solve economic problems through engineering and scientific solutions for development challenges of the country
CO5	Understand real-life problems and technology solutions, strengths and weaknesses of the economy, sensitize about real life issues and become better engineers and scientists.

AV242C Instrumentation and Control Lab (0-0-2) 1 Credits

1. Study of sensors (e. g., LVDT, Temperature and Optical Sensors, Strain gauge) and their signal conditioning techniques
2. Illustration of measurement of process-variables such as pressure, flow, level, etc., and various calibration principles.
3. Evaluation of different filter circuits (e. g., Sallen-Key Low-Pass filter, Twin-T notch filter, All-Pass filters) and phase detector schemes.
4. Typical Measurement Circuits - Instrumentation amplifier and CMRR studies, Low current measurement techniques, Precision rectifiers, Charge amplifiers
5. Virtual Instrumentation Using LABVIEW and Data Acquisition. Direct-Digital converters for sensors
6. Introduction to Open Loop and Close Loop Simulation using Matlab /Simulink
7. Controller Design
   - Time domain Specifications
     - Root locus Method
   - Frequency Domain Specifications
     - Bode Plot
     - Nyquist Stability Method
8. Modeling, Simulation, Control of Physical Systems – Matlab/Simulink based Simulation
9. Control design and Hardware in Loop Simulation for
   - Inverted Pendulum
   - Magnetic Levitation System
10. Modeling and Simulation of Engine Gimbal Control Systems for Launch Vehicle

Text Books / References:

- **Lab Manual**

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Interpreting and evaluation of commonly used sensors and their signal conditioning circuits
CO2	Design and experimentation of different electronic circuits used for measurement and instrumentation
CO3	Design and evaluation of digital instrumentation techniques
CO4	Analyze and evaluate control system design techniques
CO5	Apply control design principles to physical systems
CO6	Synthesize control solutions for complex systems

AV244C Embedded Systems Lab (0-0-2) 1 Credits

1. Blinking of LED - different T_on and Toff, patterns
2. 7 segment displays - display sequence of numbers
3. PWM and brightness control, experiments with tri colour- led
4. Interfacing LCD - SPI protocol
5. Interfacing LCD - display of characters
6. Waveform generation - square wave (duty cycle change), trapezoid (rise-time and fall-time change),
7. Waveform generation - sine wave (frequency and amplitude change)
8. Temperature sensing and display on LCD
9. Mini project

Text Books / References:

- **Lab Manual**

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Design embedded systems using a modular approach, incorporating input devices (e.g., switches), output devices (e.g., LEDs, SSDs), and communication protocols (e.g., UART, SPI, I2C).
CO2	Apply techniques to interface with hardware components, including driving loads (high side, low side, H-bridge), multiplexing displays (e.g., Charlieplexing), and connecting analog inputs using ADC and DAC
CO3	Implement efficient Interrupt Service Routines (ISRs) and evaluate the use of timer modules for various modes of operation
CO4	Gain hands-on for the practical implementation with mini project

SEMESTER 5

AV311C Digital Signal Processing (3-0-0) 3 Credits

Discrete time signals and systems, Properties of LTI Systems, DTFT, Z-T/F; Minimum phase-All pass decomposition, Generalized linear phase; DFS, Frequency sampling and Time aliasing, DFT, Periodic & Circular convolutions; FFT computations using DIT and DIF algorithms; Infinite Impulse Response Digital Filter design: Impulse invariant and Bilinear transformation approaches, Finite Impulse Response Digital filter design: Windowing and Optimal Equiv.-ripple filter design; Filter structures and realization: Signal flow graph representation, Direct form I & II, Cascade and Parallel forms, Finite Word length effect; Introduction to Multirate Signal Processing: Fractional sampling rate conversion, Poly-phase decomposition; Importance of Short-time Fourier transform; Introduction to programmable DSPs-Architecture of TMS 320C5X.

Textbook:

1. Alan V Oppenheim, Ronald W Schafer, John R Back, Discrete Time Signal Processing, PHI,
2. John G Proakis, Dimtris G Manolakis, Digital Signal Processing Principles, Algorithms and Application, PHI, 3rd Edition, 2000.
3. B.Venkataramani & M. Bhaskar, Digital Signal Processor Architecture, Programming and Application, TMH 2002.

References:

1. Avtar singh, S.Srinivasan, DSP Implementation using DSP microprocessor with Examples from TMS32C54XX, Thamson / Brooks cole Publishers, 2003
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill / TMH, 2000.
3. Johny R.Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1984.
4. S.K.Mitra, Digital Signal Processing- A Computer based approach, Tata McGraw-Hill,1998, New Delhi.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Analyze the discrete time systems and signals in transform domain
CO2	Design and realize the filter with minimum hardware resources
CO3	Apply the adaptive algorithm to vary the coefficient of the filter in variable environment
CO4	Implement the discrete time system with different sampling rate
CO5	Apply the signal processing technique or concepts in the various fields like biomedical, communication, control, machine learning etc.

AV312C RF and Microwave Communication (3-0-0) 3 Credits

Scattering matrix parameters, Transmission matrix, Signal flow graph, Impedance matching, Single and double stub tuning, problems. Microwave wave-guide and planar-based passive devices, Microwave resonators, Power dividers, directional couplers and filters, Isolator, Circulator, phase shifter, Microwave signal generators: Klystron, magnetron and TWT. Microwave systems design, Microwave Amplifier design, Gain and stability, Oscillator design, Broadband systems, noise figure and link budget.

Textbooks:

1. David M. Pozar, David M. Pozar, 2nd Ed., John Wiley & Sons, Inc. 2004.

References:

1. R.E. Collin, Foundations for Microwave Engineering, McGraw-Hill, 1992.
2. S.M. Liao, Microwave Devices and Circuits, Prentice Hall Of India Private Limited.
3. P.A. Rizzi, Microwave Engineering, Prentice-Hall, Englewood Cliffs, NJ, 1988.
4. T.S. Laverghetta, Modern Microwave Measurements and Techniques, Artech House, Norwood, MA, 1988

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Analyze microwave networks using S parameter.
CO2	Designing different types of matching circuits using concept of lumped, distributed circuit matching.
CO3	Design and realization of different microwave passive devices- importance of odd and even mode analysis to realize different passive devices.
CO4	Understand concepts of microwave filter design, different design principle, filter trnasformation technique, Butterworth and Chebyshev design lumped filter, stepped impedance filter design.

AV313C Computer Architecture and Organization (3-0-0) 3 Credits

Introduction to computer organization: Structure and function of a computer - Processing unit: Characteristics of CISC and RISC processors - Performance of a processing unit. Memory subsystem : Memory hierarchy - Main memory unit - Internal organization of a memory chip - Organization of a main memory unit - Error correction memories - Interleaved memory units - Cache memory unit - Concept of cache memory - Mapping functions - organization of a cache memory unit - Fetch and Write mechanisms - Memory management unit - Concept of virtual memory - Address translation - hardware support for memory management. Input / Output subsystem: Access of I/O devices - I/O ports. - I/O control mechanisms - Program controlled I/O - Interrupt controlled I/O - DMA controlled I/O - I/O interfaces - System buses - peripherals -Terminals - Video displays - Magnetic storage disks - magnetic tapes - CD ROMs. High-Performance processors: Instruction pipe lining - Pipe line - Hazards - Super scalar processors -Performance considerations. Multi processor systems: Shared memory systems - Interconnection networks - Caches in multi processor systems.

Textbook/ References:

1. Tanenbaum A.S., Structured computer organization, 4th edition, PHI, 1999.
2. Hayes, J.P, Computer architecture and Organisation, McGraw Hill, 1998.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understanding the architecture and organization of modern digital computers
CO2	Design of computer architectures, memory subsystem, Input/Output subsystem, and the whole system.
CO3	Understanding the Design and operation of multicore computer architectures and high performance processors
CO4	Conducting research literature review and preparation of literature survey writeups for computing architecture and organization
CO5	Develop innovative thinking process in the area of advanced computer architectures and organization

AV314C	Communication System I (3-0-0)	3 Credits

Fundamental of communication systems, signals and information, system block diagram, performance metrics and data rate limits. Review of Fourier series and Transforms – Energy/Power Spectral Density.
Introduction to carrier modulation - Amplitude modulation, AM spectrum, power relations, double sideband suppressed carrier (DSBSC) and single sideband modulation (SSB) schemes, DSBSC/SSBSC spectrum, Vestigial sideband modulation and spectrum. Generation of AM signals, modulators and transmitters, product modulators, square-law modulators and balanced modulators. Frequency translation and frequency division multiplexing, Propagation characteristics of AM signals.
Frequency modulation (FM), Narrowband FM, Wideband FM, FM spectrum, Transmission bandwidth, Generation of FM signals: direct and indirect methods. Phase modulation-relationship between FM and PM signals. Radio Receivers - TRF and super-heterodyne receivers, Image frequency, Intermediate frequency (IF), Automatic gain control. AM demodulation - coherent detection, envelope (non-coherent) detection of AM signals, DSB-SC and SSB demodulation. FM demodulation - Basic FM demodulators, Amplitude limiting, ratio detector, PLL based FM detection, Pre-emphasis and de-emphasis in FM.

Textbooks / References:

1. Lathi BP. Modern Digital and Analog Communication Systems 3e. Oxford University Press, 1998
2. John G Proakis and M. Salehi, Communication systems engineering, Prentice Hall, 1994.
3. Rodger E. Ziemer, and William H. Tranter. Principles of communications. John Wiley & Sons, 2014.
4. Simon Haykin. Communication systems. John Wiley & Sons, 2008.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand and apply linear system theory, Fourier transforms, Laplace transforms for mathematical modelling and performance analysis of analog communication systems without noise
CO2	Understand subsystems in baseband and passband analog communication systems
CO3	Apply probability theory and stochastic processes for mathematical modelling and performance evaluation of analog communication systems
CO4	Create a functional design of an analog communication system which meets given requirements by a proper choice of different subsystems and their parameters, and by doing link analysis
CO5	Apply the knowledge gained from this course for understanding current analog communication systems and challenges

AV331C Digital Signal Processing Lab (0-0-2) 1 Credits

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1. Study of DFT
2. IIR Filter Design
3. FIR Filter Design
4. FIR Kaiser and Equiripple Filter Design
5. Comparison of FIR and IIR Filter Design
6. Study of Simulink and Signal Processing Tool Box
7. Multirate Signal processing
8. DSP Processor,TMS 320C6713,DSK Experiments
9. TMS 320C6713-Real Time Processing

Textbooks/References:

- Lab Manual

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Skills to analyze the discrete time systems and signals in transform domain
CO2	Ability to formulate the specification for the given application and able to design and realize the filter with minimum hardware resources
CO3	Ability to apply the adaptive algorithm in the design of adaptive filter
CO4	Implement the discrete time system with different sampling rate

AV332C RF and Microwave Communication Lab (0-0-3) 1 Credits

RF Experiments

1. Analyze the radiation patterns of the different antennas.
2. Experiments on Coaxial Line Section:
    a. Measurement of VSWR
    b. Measurement of unknown impedance
    c. Stub matching
    d. Measurement of Gain and Noise figure
3. Simulation and Testing of RF Circuits:
    a. RF Tuned Amplifier
    b. RF Oscillator
    c. RF Crystal Oscillator
    d. IF Amplifier
    e. RF Mixer
    f. RF Filters (LP, HP, BP, Notch Filter)
4. Stability

Microwave Experiments

1. Characteristics of Reflex Klystron Oscillator
2. Characteristics of Gunn Diode Oscillator
3. Study of Power Distribution in directional coupler, E / H Plane Tee, Magic Tee.
4. Radiation pattern of Horn Antenna.
5. Frequency Measurement
6. Impedance measurement by Slotted Line Method.

Text Books / References:

- Lab Manual

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Basic Familiarization with the Microwave Waveguide based bench set-up and their individual blocks/subsystems. Performance study of high power microwave sources such as Gunn and Klystron and the study of standing waves in the bench and its different parameters.
CO2	Time Domain reflectometry (TDR) to characterize different cables suitable for different frequency.
CO3	Study of frequency response in spectrum analyzer and vector network analyzer. Familiarization of different antenna patterns through experiment.
CO4	Hands on training about working with ADS (Advanced design software) to complement the understanding of theory course AV 313.

SEMESTER 6

AV321C — Communication System II (3-0-0) — 3 Credits

Signal space concepts: Geometric structure of the signal space, vector representation, distance, norm and inner product, orthogonality, Gram-Schmidt orthogonalization procedure. Matched filter receiver, Inter symbol interference, Pulse Shaping, Nyquist criterion for zero ISI, Signaling with duobinary pulses, Eye diagram, Equalizer, Scrambling and descrambling.

Review of Gaussian random process, Optimum threshold detection, Optimum Receiver for AWGN channel, Matched filter and Correlation receivers, Decision Procedure: Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signaling.

Digital band pass modulation schemes: ASK, FSK, PSK, MSK – Digital M-ary modulation schemes – signal space representation Detection of signals in Gaussian noise - Coherent & non-coherent detection– Differential modulation schemes – Error performance of binary and M-ary modulation schemes – Probability of error of binary DPSK – Performance of M-ary signaling schemes in AWGN channels - Power spectra of digitally modulated signals, Performance comparison of digital modulation schemes.

Textbooks / References:

1. Lathi BP. Modern Digital and Analog Communication Systems 3e. Oxford University Press, 1998
2. John G Proakis and M. Salehi, Communication systems engineering, Prentice Hall, 1994.
3. Rodger E. Ziemer, and William H. Tranter. Principles of communications. John Wiley & Sons, 2014.
4. Simon Haykin. Communication systems. John Wiley & Sons, 2008.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand discrete time system theory, DTFT, DFT, FFT, z- transforms for mathematical modelling of discrete time communication systems
CO2	Understand and apply probability theory and stochastic processes for mathematical modelling and performance analysis of SNR, bit error rate, power spectral density of point to point digital communication systems
CO3	Analyze various subsystems for baseband and passband processing of digital communication systems such as equalizers, synchronizers, modulation and demodulation schemes
CO4	Evaluate given requirements for a digital communication system and apply that for designing parameters for various subsystems via link budget analysis
CO5	Apply the knowledge gained from this course for understanding modern wired and wireless digital communication systems

AV322C Computer Networks (3-0-0) 3 Credits

Introduction to Computer Networks: History of evolution of the Internet, Network Topology, Layered Protocol Stack, Point-to - point and broadcast communications, LAN, WAN, MAN, and the Internet. Delay analysis in circuit switching, message switching, and packet switching. Queuing models.
Application Layer Protocols: Responsibilities of application layer. Domain Name System, services offered by DNs, Hyper Text Transfer Protocol (HTTP), File Transfer Protocol (FTP), SMTP/E-mail Applications, Voice over IP, and P2P protocols. Transport Layer protocols:
Transport layer: Responsibilities of the transport layer, transport protocol design, Congestion control, flow control, reliability, quality of service, TCP, UDP, (optional SCTP) protocols, and throughput analysis.
Network Layer Protocols: Responsibilities of network layer. Routing process, Link state and distance vector protocols, time complexity of algorithms, routing metrics, Routing in the Internet, RIP, BGP, Addressing in the Internet, IPV4, IPV6.
Data link layer: Objectives of the data link layer. Sublayers in Data link layer. Framing. Medium access protocols: –Aloha, CSMA and its variations, Ethernet; Token Ring; Framing and Error Control Techniques; Throughput analysis of MAC protocols. Error Control Techniques; Flow control; Bridges, Repeaters, Switches and the spanning tree protocol. Software defined networks. Recent advances in networks.

Text Books:

1. James Kurose and Keith Ross, Computer Networking: A Topdown Approach, 6th Edition, Pearson Education, 2012.

References:

1. Andrew S. Tannenbaum and D. J. Wetherall, Computer Networks, PHI, 5th Edition, 2010
2. William Stallings, Data and Computer Communications, 10th Edition, Pearson Education, 2013.
3. Dimitry Bertsakes and Robert Gallager, Data Networks, 2nd edition, Pearson Education, 1992.

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understanding the basics of Internet, its operations, and delay analysis
CO2	Understand the layered protocol stack and its operation. Understand the protocols in application, transport, network, and datalink layers and their design objectives
CO3	Conduct experiments to capture packets, analyze them, understand them, and interpret them
CO4	Conducting research literature review/documentation/writeups for computer networks
CO5	Develop innovative thinking process in the area of computer networks, Internet-enabled devices, or services over the internet

HS321H Principles of Management (3-0-0) 3 Credits

Personnel Management: Introduction – changing role of personnel manager – new people management – manpower planning – recruitment and selection – performance appraisal – workers participation in management – grievance handling.

Industrial Management: Management Functions – organization – principles of planning – management by objectives – organization structures – principles of organizing – span of control –delegation, leadership, directing, and controlling.

Project Management: Development of project network – project representation – project scheduling – linear time-cost trade-offs in projects: a heuristic approach – project monitoring and control with PERT.

Textbooks / References:

1. Koontz H., O'Donnel, C., and Weihrich, H., Essentials of Management, McGraw-Hill (1990).
2. Venkataratnam, C. S. and Srivastava, B. K., Personnel Management and Human Resources, Tata McGraw-Hill (1991).
3. Mazda F., Engineering Management, Prentice Hall (1997).
4. Gido, J. and Clements, J. P., Successful Project Management, 2nd ed., South-Western College Publishing (2003).
5. Khanna, O. P., Industrial Engineering and Management, Dhanpat Rai Publications (P) Ltd. (2003).
6. Memoria, C. B. and Gankar, S. V., Personnel Management - Text and Cases, Himalaya Publishing House (2007).

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Understand the scope, objectives, and functions of management in theoretical and practical settings.
CO2	Understand the roles and apply the skills needed by a manager to do the jobs efficiently and effectively
CO3	Apply CPM and PERT techniques for planning, scheduling and controlling of projects
CO4	Apply quantitative techniques in management to solve real-world problems for improved decision-making

AV341C Communication System Lab (0-0-2) 1 Credits

1. Design and implementation of Pulse Amplitude Modulator and Demodulator.
2. Design and implementation of ASK, FSK, and PSK modulators and demodulators
3. Design and implementation of PWM and PCM modulators and demodulators
4. Design and implementation of DM and ADM modulators and demodulators
5. Design and study Time Division Multiplexer.
6. Design and study Frequency Division Multiplexer.
7. Eye Diagram -for studying the effects of intersymbol interference and other channel impairments.
8. Analysis of signal space constellation of different modulation schemes.
9. Comparison of different modulations with Bit Error rate using Simulink

Text Books / References:

- **Lab Manual**

Course Outcomes (COs):

Course Outcomes	Statements
CO1	Apply basic programming techniques in Matlab or Python to simulate signal processing operations (including spectral analysis, filtering, convolution)
CO2	Apply Matlab or Python to simulate baseband and passband communication systems and evaluate their performance via bit error rate and other performance metrics.
CO3	Design and then apply Matlab or Python to simulate various subsystems for baseband and passband processing of digital communication systems such as equalizers, synchronizers, modulation and demodulation schemes
CO4	Create an end to end simulation in Matlab or Python for a digital communication system and evaluate its performance.