College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra, Permanently Affiliated to S.P. Pune University)

Department of Electronics and Telecommunication

Curriculum Structure & Detailed Syllabus (UG Program)

Second Year B. Tech.

(Revision: A.Y. 2019-20, Effective from: A.Y. 2020-21)

Program Education Objectives (PEOs):

Graduates will demonstrate ability to:

1. Solve real-life engineering problems, design and development of innovative and cost-effective products exhibiting a solid foundation in Electronics and Communication Engineering fundamentals to cater needs of society.
2. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.
3. Exhibit professional ethics and values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader social context.

Program Outcomes (POs):

Graduates of Electronics & Telecommunication Engineering by the time of graduation will demonstrate:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program specific outcomes (PSOs)

PSO 1: Development of Hardware/Software Co-designs: An ability to apply electronic design principles in the development of hardware/software prototypes and systems with progressive depth of complexity.

PSO 2: Development of Electronics Communication Systems: An ability to deploy conventional & next-gen. techniques/tools for analysis & design of Information and Communication systems.

PSO 3: Development of Signal Processing Applications: An ability to apply algorithmic knowledge of signal processing towards analysis, Recognition, and synthesis of multi-dimensional data.

PEO/ PO-PSO Correlation Matrix

3- High, 2- Medium, 1- Low

PEO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
PEO-1	√	√	√	√	√	√	√	-	-	-	√	√	√	√	√
PEO-2	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO-3	-	-	√	-	-	-	√	√	√	√	√	√	√	√	√

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	BSC	Basic Science Course
2	MLC	Mandatory Learning Course
3	HSMC	Humanities/Social Sciences/Management Course
4	SBC	Skill Based Course
5	IFC	Interdisciplinary Foundation Course
6	PCC	Program Core Course
7	LC	Laboratory Course

CURRICULUM STRUCTURE OF S. Y. B. TECH (E & TC)

Effective from A. Y. 2020-2021

III-Semester [For Regular students]:

Sr. No	Course Type/Code	Subject Title	Contact Hours			Credits
			L	T	P	
01	BSC/ MA 20001	Ordinary Differential Equations and Multivariate Calculus	2	1	0	3
02	MLC/ ML 20002	Professional Laws, Ethics, Values and Harmony	1	0	0	0
03	HSMC/ HS 20002	Innovation and Creativity	1	0	0	1
04	SBC/ ET 20001	Circuit Simulation Lab	0	0	2	1
05	IFC/ ICE(IF) 20002	Sensors and Automation	1	0	2	2
06	PCC/ ET 20002	Electronic Devices and Circuits	3	0	0	3
07	PCC/ ET 20003	Digital System Design	3	0	0	3
08	PCC/ ET 20004	Signals and Systems	2	1	0	3
09	PCC/ ET 20005	Network Synthesis and Analog Filters	3	0	0	3
10	LC/ ET 20006	Electronic Devices and Circuits Lab	0	0	2	1
11	LC/ ET 20007	Digital System Design Lab	0	0	2	1
12	LC/ ET 20008	Network Synthesis and Analog Filters Lab	0	0	2	1
			16	**2**	**10**	
		Total Academic Engagement and Credits				**22**

III-Semester [For Lateral entry students]:

Sr. No	Course Type/Code	Subject Title	Contact Hours			Credits
			L	T	P	
01	BSC/ MA 20002	Linear Algebra and Univariate Calculus	4	1	0	5
02	MLC/ ML 20002	Professional Laws, Ethics, Values and Harmony	1	0	0	0
03	HSMC/ HS 20002	Innovation and Creativity	1	0	0	1
04	SBC/ ET 20001	Circuit Simulation Lab	0	0	2	1
05	IFC/ ICE(IF) 20002	Sensors and Automation	1	0	2	2
06	PCC/ ET 20002	Electronic Devices and Circuits	3	0	0	3
07	PCC/ ET 20003	Digital System Design	3	0	0	3
08	PCC/ ET 20004	Signals and Systems	2	1	0	3

09	PCC/ ET 20005	Network Synthesis and Analog Filters	3	0	0	3
10	LC/ ET 20006	Electronic Devices and Circuits Lab	0	0	2	1
11	LC/ ET 20007	Digital System Design Lab	0	0	2	1
12	LC/ ET 20008	Network Synthesis and Analog Filters Lab	0	0	2	1
13	BSC/ PH 20001	Foundation of Physics	3	0	0	3
			21	**2**	**10**	
		Total Academic Engagement and Credits				**27**

IV-Semester [For Regular students]:

Sr. No.	Course Type/ Code	Course Name	Contact Hours			Credits
			L	**T**	**P**	
1	BSC/ MA 2004	Vector Calculus and Partial Differential Equation	2	1	0	3
2	BSC/ AS 20001	Biology for Engineers	3	0	0	3
3	SBC/ ET 20009	Micro-Project	0	0	2	1
4	IFC/ CT (IF) 20002	Data Structures	1	1	0	2
5	PCC/ ET 20010	Analog Communications Systems	3	0	0	3
6	PCC/ ET 20011	Microcontrollers and Applications	3	1	0	4
7	PCC/ ET 20012	Integrated Circuits and Applications	3	0	0	3
8	LC/ ET 20013	Analog Communications Systems Lab	0	0	2	1
9	LC/ ET 20014	Microcontrollers and Applications Lab	0	0	2	1
10	LC/ ET 20015	Integrated Circuits and Applications Lab	0	0	2	1
			15	**3**	**8**	
		Total Academic Engagement and Credits				**22**

IV-Semester [For Lateral entry students]:

Sr. No.	Course Type/ Code	Course Name	Contact Hours			Credits
			L	T	P	
1	BSC/ MA 20005	Multivariate Calculus and Differential Equations	4	1	0	5
2	BSC/ AS 20001	Biology for Engineers	3	0	0	3
3	SBC ET 20009	Micro-Project	0	0	2	1
4	IFC CT (IF) 20002	Data Structures	1	1	0	2
5	PCC/ ET 20010	Analog Communications Systems	3	0	0	3
6	PCC/ ET 20011	Microcontrollers and Applications	3	1	0	4
7	PCC/ ET 20012	Integrated Circuits and Applications	3	0	0	3
8	LC/ ET 20013	Analog Communications Systems Lab	0	0	2	1
9	LC/ ET 20014	Microcontrollers and Applications Lab	0	0	2	1
10	LC/ ET 20015	Integrated Circuits and Applications Lab	0	0	2	1
			17	**3**	**8**	
		Total Academic Engagement and Credits				**24**

MA 20001 Ordinary Differential Equations and Multivariate Calculus

Teaching Scheme
Lectures: 2 hrs/week
Tutorial: 1 hrs/week

Examination Scheme
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Objectives: Basic necessity for the foundation of Engineering and Technology being mathematics, the main aim is, to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
- Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

Unit 1 **(11 hrs)**

Review of first order differential equations, Reduction of order, linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential equations with constant coefficients and reducible to differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters), systems of differential equations, applications to orthogonal trajectories, mass spring systems and electrical circuits.

Unit 2 **(8 hrs)**

Laplace Transforms, its properties, Unit step function, Dirac delta functions, Convolution Theorem, periodic functions, solving differential equations using Laplace transform.

Unit 3 **(7 hrs)**

Functions of several variables, level curves and level surfaces, partial and directional derivatives differentiability, chain rule, local extreme values and saddle points, constrained optimization

Text Books

- Thomas' Calculus (14th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books

- Calculus for Scientists and Engineers by K.D Joshi, CRC Press. Simon Haykins, "Digital Communication", Edition II, Wiley.
- A Course in Multivariate Calculus and Analysis by Sudhir Ghorpade and Balmohan Limaye, Springer Science and Business Media.
- Differential Equations with Applications and Historical notes by George Simmons, Tata Mc-Graw Hill publishing company Ltd, New Delhi.
- Advanced Engineering Mathematics by C.R. Wylie, McGraw Hill Publications, New Delhi.
- Advanced Engineering Mathematics (7th edition) by Peter V. O' Neil, Thomson. Brooks / Cole, Singapore
- Advanced Engineering Mathematics (2ndedition) by Michael D. Greenberg, Pearson Education.
- Advanced Engineering Mathematics by Chandrika Prasad and Reena Garg, Khanna Publishing Company Private limited, New Delhi.

ML 20002 Professional Laws, Ethics, Values and Harmony

Teaching Scheme
Lectures: 1 hrs/week

Examination Scheme
Total: 100 marks
Continuous Evaluation:
Assignments/ presentations/ Test

Course Outcomes:

At the end of this course students will able to:

- Grasp the meaning of the concept – Law
- Get an overview of the laws relating to Engineers
- Apprehend the importance of being a law-abiding person
- Self-explore by using different techniques to live in harmony at various level
- Analyze themselves and understand their position with respect to the moral and ethical character needed for a successful and satisfactory work life

Unit 1 **(02 hrs)**

Concept of Law

Understanding Essentials of a Valid Contract and the basics of contract law protecting rights and obligations

Unit 2 **(03 hrs)**

Law of Torts

Introduction to the Law of Torts and the basics to protect oneself and the company Law affecting the Workplace Employers Responsibilities / Duties Hiring Practices
Introduction to Intellectual Property Law

Unit 3 **(02 hrs)**

Professional Code of Conduct for Engineers Relationship between Law and Ethics

Unit 4 **(02 hrs)**

Self-Awareness

Understanding oneself and others; Johari Window- Concept, explanation, implementation

Unit 5 **(02 hrs)**

Needs & Self

Needs and its importance; Understanding harmony and its relevance in actualization at personal and professional levels

Unit 6 **(02 hrs)**

Ethics and values

Professional ethics and their importance for students; Understanding the importance of values & their application in everyday life

References

- Business Law- By Saroj Kumar
- Law of Contract- By Avtar Singh
- Business Law- By G K Kapoor
- Business & Commercial Laws – By Sen & Mitra
- Business Law for Engineers- by Calvin Frank Allen
- Hilgard, E. R.; Atkinson, R. C. & Atkinson, R.L. (1975). *Introduction to Psychology*. 6th Edition. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd.
- Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). *Professional Ethics & Human Values*. Prentice Hall: New Delhi
- Gogate, S. B. (2011). Human Values & Professional Ethics. Vikas Publishing: New Delhi.
- Govindarajan, M; Natarajan, G. M. & Senthilkumar, V.S. (2013). Professional Ethics & Human Values. Prentice Hall: New Delhi
- Jayshree Suresh, Raghavan B.S.(2016). Human Values & Professional Ethics: S Chand & Company. Pvt. Ltd: New Delhi.

HS 20002 Innovation and Creativity

Teaching Scheme	**Examination Scheme**
Lectures: 1 hrs/week	"To be declared by the Instructor"

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Understand to creativity and innovation terminologies
- Explore personal and organizational roadblocks in participating in the creative process
- Apply practical tips to discover the innovative / creative potential within the human being.
- Study frameworks, strategies, techniques for conceiving ideas.
- Develop new ways of thinking and Learn the entire innovation cycle.
- Understand different ways to protect innovation, basics on Patents and process
- Apply techniques learnt in the course to articulate, refine and pitch a new product or service project

Unit 1

Introduction to concepts of creativity / invention / innovation and their importance in present knowledge world. Components of the creative process, Analogy/model to represent the creative process.

Unit 2

Understanding persons' Creative potential. Blockages in practicing creative process – Mindset and belief systems. Myths and misconceptions about creativity.

Unit 3

Practical Tips to discover and apply one's creative potential, remove blockages, deal with external factors. Importance of synergistically working in a team. Harnessing creativity from nature.

Unit 4

Idea conception, Idea Brainstorming sessions, Idea Evaluation, Protection/Patent review, Principles of innovation, Review of systematic strategies and methods for innovation, Innovation case study, Review of Idea/Prototype /Product and Market Plan.

Unit 5

Applications Exercise / Assignment: at the end of the course, the student will create teams, presents their innovative ideas, and applies their learning in practice.

Reference Books

- Paul B. Paulus, Bernard A. Nijstad, The Oxford Handbook of Group Creativity and Innovation, Oxford University Press, 2019.
- Jeff Dyer, Hal Gregersen, Clayton M. Christensen, " The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators, Harvard Business Review Press, 2011.
- Paddy Miller, Thomas Wedell- Wedellsborg, "Innovation as Usual: How to Help Your People Bring Great Ideas to Life, Harvard Business Review Press, 2013.

ET 20001 Circuit Simulation Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation: 50 marks
Exam: 50 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

- Simulate signals and systems using MATLAB and Simulink
- Analyze signals with the help of Fourier analysis
- Simulate the circuits and analyze the results using Multisim.

List of Practicals:

A. Assignments using MATLAB and Simulink

1. Defining and Plotting of standard signals.
2. Sampling of continuous time signals and Aliasing.
3. Fourier Series analysis of periodic signals.
4. Fourier Transform analysis of aperiodic signals.
5. Circuit Analysis using KVL,KCL
6. Verification of Maximum power transfer theorem.
7. Realization of AM, DSBFC, DSBSC building blocks using Simulink.

B. Assignment using Multisim

1. Simulation of inverting, non-inverting, voltage follower circuits using opamp.
2. Simulation of regulated power supply.
3. Simulation of Digital circuits.
4. Simulation of Data Acquisition System.

ICE(IF) 20002 Sensors and Automation

Teaching Scheme	**Examination Scheme**
Lectures : 1 hr/week	T1 and T2: 20 marks
Practical : 2 hrs/week	End Sem: 100 marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Interpret the characteristics of the transducers/sensors
- Select transducers/sensors for specific applications
- Understanding of working principle of Programmable Logic Controller (PLC) and Distributed Control Systems
- Understanding the concept of Industrial Automation

Unit 1

Basics of Sensors

Concepts and terminology of transducer, sensor, sensor classifications and characteristics (Static and dynamic), Working principle, characterization and applications of: strain gauges, LVDT, capacitive, RTD, thermocouple, thermistor, Solid-State, pressure, optical, chemical sensors, integration of sensors for IOT and Industry 4.0 applications.

Unit 2

Industrial automation

Industrial Automation: concept, automation components, necessity and working principle, block schematic of Programmable Logic Controller (PLC). Input & Output modules (AI, DI, AO, DO), Introduction to Ladder Programming, introduction to Distributed Control Systems (DCS). Industrial automation leads to Industrial IOT and Industry 4.0.

List of Practicals:

1. Case study /Characterization of RTD/ semiconductor Temp IC
2. Characterization of level sensors
3. Characterization of strain gauge/ Displacement measurement using LVDT/ Encoders
4. Characterization of PH, Conductivity, color sensor
5. Introduction to PLC programming languages (ladder programming)
6. Ladder Programming for relay, coil, On/OFF, Sequencing of motors,
7. Ladder Programming with Timers/Counters
8. Ladder Programming for Pick and Place type of robotics application

Text Books:

- B. C. Nakra and K. K. Choudhari, "Instrumentation Measurements and Analysis" by, Tata McGraw Hill Education, Second ed., 2004.
- C.D. Johnson, "Process Control Instrumentation Technology" by, Pearson Education Limited , eighth ed., 2014

ET 20002 Electronic Devices and Circuits

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1 and T2: 20 marks each
End Sem: 60 marks

Course outcomes:

At the end of this course students will demonstrate the ability to

- Analyze different types of Semiconductor devices, their operation and characteristics.
- Design and Analyze Analog sub-circuits using BJT and FET.
- Analyze Frequency response of circuits.
- Apply feedback to stabilize the circuits.
- Analyze and Design oscillators and power amplifiers.

Unit 1 **(10 hrs)**

Foundation:
Physics of Bipolar Junction Transistors: Structure of NPN and PNP Transistors, Energy-Band Diagram, Ebers-Moll Model, Operation of BJT in Cutoff, saturation and Active mode, I/V characteristics, Large Signal model, Small signal model, Concept of transconductance, Early Effect.

Physics of MOS Transistors: Structure of N and P MOSFET, Energy-Band Diagram, Operation of MOSFET, Channel Length Modulation, Back Gate Effect and some second order effects, MOS Device Models – Large Signal model and small signal model, CMOS Technology, Comparison of Bipolar and MOS Devices.

Unit 2 **(10 hrs)**

Analog Sub-Circuits:
Bipolar Amplifiers: Operating Point Analysis and Design, Input and Output Impedances, Biasing, DC and Small signal Analysis, Bipolar amplifier Topologies – Common Emitter with and without emitter degeneration, Common Base, Emitter Follower.

CMOS Amplifiers: MOS Amplifier Topologies, Biasing, Realization of Current Sources, Common Source stage with and without source degeneration, Diode connected load, Common Gate stage, Source Follower.
Cascaded stages and Cascode stages using BJT and MOS Transistors.

Unit 3 **(06 hrs)**

Frequency Response
Fundamental Concepts, square wave testing, effect of coupling, bypass, junction and stray capacitances, Relationship between Transfer function and Frequency Response, Bode's Rules, Miller's Theorem, Concept of Frequency Response, High frequency Model of Transistor.

Unit 4 **(06 hrs)**

Feedback System and Circuits
Loop gain, properties of Negative feedback – Gain Desensitization, Bandwidth Extension, Modification of I/O impedances, Linearity improvement, Sense and Return Techniques, Feedback Topologies – Voltage Voltage Feedback, Voltage Current Feedback, Current Voltage Feedback, Current Current Feedback.

Unit 5 **(04 hrs)**

Oscillators
Ring Oscillators, Phase Shift Oscillator, Wien bridge oscillator, LC Oscillators, Crystal oscillator.

Unit 6 **(04 hrs)**

Output Stages and Power Amplifiers
Emitter follower as Power Amplifier, Push pull stage, Large signal considerations, Short circuit protection, Heat Dissipation, Efficiency, Class-A, B, AB.

Text Books:

- "Fundamentals of Microelectronics" by Behzad Razavi, Second Edition; Wiley
- "Microelectronics Circuits" by Adel Sedra, Kenneth Smith, Seventh Edition, Oxford University Press

Reference Books:

- "Solid State Electronic Devices", Ben G Streetman, Sanjay Kumar Banerjee, Sixth Edition, PHI.
- "Microelectronics Circuit Analysis and Design", Donald A. Neamen, Fourth Edition, Mc-Graw Hill.
- "Electronic Devices", Thomas L Floyd, 10^{th} edition, Pearson

ET 20003 Digital System Design

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1 and T2: 20 marks each
End Sem: 60 marks

Course outcomes:
At the end of this course students will demonstrate the ability to:

- Design & analyze combinational logic circuits using basic, Universal and derived gates
- Design & analyze modular combinational circuits with MSI devices like MUX/DEMUX, Decoder, Encoder, etc.
- Design & analyze synchronous sequential logic circuits with FFs and combinatorial circuit.
- Use HDL & appropriate EDA tool for logic design and simulation.

Unit 1 **(06 hrs)**

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

Unit 2 **(06 hrs)**

MSI devices like Multiplexers, Encoder, Decoder, Comparators, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU

Unit 3 **(06 hrs)**

Sequential Logic Design: Building blocks like S-R, JK and D latch, Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Designing synchronous circuits like Pulse train generator

Unit 4 **(08 hrs)**

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of PLDs like PAL, PLA, CPLDs, FPGA etc. Logic implementation using Programmable Devices (ROM, PLA)

Unit 5 **(08 hrs)**

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation

Unit 6 **(04 hrs)**

VHDL constructs and codes for combinational and sequential Circuits

Text Books:

- R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, fourth edition
- Douglas Perry, "VHDL programming", McGraw Hill, fourth editio

Reference Books:

- Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL Design" McGraw Hill, Third edition
- M. Morris Mano, Michael D. Ciletti, "Digital Design" Pearson, Fourth edition
- A. Anand Kumar, "Fundamentals of Digital circuits", PHI, Fourth edition
- Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill

ET 20004 Signals and Systems

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs/week	T1 and T2: 20 marks each
Tutorial: 1 hrs/week	End Sem: 60 marks

Course outcomes:

At the end of this course students will demonstrate the ability to:

- Classify signals and systems based on their characteristics and study basic operations on signals.
- Evaluate time domain response of LTI systems.
- Analyse the spectral properties of signals using Fourier analysis.
- Apply Z- transform to study discrete-time signals and systems.

Unit 1 **(04 hrs)**

Introduction and Classification of Signals and Systems, Elementary Operations on Signals, Properties of System.

Unit 2 **(05 hrs)**

Time Domain Representations of Linear Time Invariant (LTI) Systems, Impulse Response, Convolution, Differential and Difference Equation Representation, Block Diagram and State Variable Representation of the System.

Unit 3 **(05 hrs)**

Fourier Representation of the Signals: Signal Analysis - Discrete and Continuous, Periodic and Non-Periodic, and Synthesis in Fourier Domain, Properties of Fourier Representations, Application of Fourier Representations.

Unit 4 **(05 hrs)**

Representation of Signals Using Discrete-Time Complex Exponentials: Z-Transform, Significance and Properties of Region of Convergence, Properties of Z-Transform, Inverse Z-Transform, Analysis of Linear Time Invariant (LTI) System, Computational Structures for Implementing Discrete Time Systems.

Unit 5 **(06 hrs)**

Study of Systems with Differential and Difference Equations, Transfer Function, Poles and Zeros, Stability Consideration in Z Domain.

Text Books:

- Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley and sons.
- B. P. Lathi, "Linear Systems and Signals", OXFORD University Press.

Reference Books:

- Alan V. Oppenheim, Alan S. Willsky with IAN T. Young, "Signals and Systems", Prentice-Hall.
- S.S. Soliman & M.D. Srinath, "Continuous and Discrete Signals and System"s, Prentice- Hall, 1990
- Shaila Dinkar Apte "Signals and Systems: Principles and Applications", Cambridge University Press.

ET 20005 Network Synthesis and Analog Filters

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs/week	T1 and T2: 20 marks each End Sem: 60 marks

Course outcomes:

At the end of this course students will demonstrate the ability to:

- Analyze electrical networks in the Laplace domain and to understand concepts of network functions, poles and zeroes of network functions and their stability.
- Evaluate two port parameters of a two-port network.
- Synthesize a network using passive elements, given the driving point immittance function or transfer function.
- Design analog active and passive filters

Unit 1 **(05 hrs)**

Laplace Transform, Concept of Poles-Zeros, Pole -Zero plot, Stability, Network functions. Analysis of circuit in s domain, analysis of ladder networks

Unit 2 **(07 hrs)**

Over view of Attenuators, Two port parameters, Relationships between two port parameters, transfer function using two port parameters, interconnection of two-ports.

Unit 3 **(08 hrs)**

Realizability theory and synthesis of one-port networks: Causality & stability, Hurwitz polynomials, positive real functions, elementary synthesis procedures, properties & synthesis of L-C, R-C, & R-L one port circuits, synthesis of certain R-L-C functions.

Unit 4 **(08 hrs)**

Synthesis of two-port networks: Properties of transfer functions, zeros of transmission, synthesis of Y_{21} & Z_{21} with a 1 Ω termination, synthesis of constant resistance networks, Impedance and Frequency Denormalization to required values.

Unit 5 **(07 hrs)**

Aspects of filter design problem, approximation problem in network theory, maximally flat low pass filter approximation (Butterworth), Chebyshev approximations.

Unit 6 **(05 hrs)**

Synthesis of Active filters: Low Pass, Band Pass, RC-CR Transformation, Sensitivity, Biquad Circuits.

Text Books:

- Franklin Kuo, "Network Analysis & Synthesis", Wiley International, 2nd Edition.
- Govind Daryanani, "Analysis and Synthesis of Filters", 2nd Edition.

Reference Books:

- Kendall Su, "Analog Filters", Kluwer Academic Publisher, 2nd Edition, 2002.
- John O' Malley, "Basic Circuit Analysis", Schaum's series,4th Edition
- Van Valkenberg, "Network Analysis", Pearson Education, 2nd Edition

ET 20006 Electronic Devices and Circuits Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous Evaluation: 40 marks
End-sem Exam: 60 marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

- Identify and characterize basic devices such as BJT and FET from their package information by referring to manufacturers' data sheets.
- Design, Build, Test and Analyze performance of Linear Applications of above-mentioned active devices using equipment set-up like Power Supply, Signal generators, Oscilloscope.
- Simulate a few of the circuit applications using appropriate Circuit Simulation package.

List of Experiments:

1. Input and Output Characteristics of BJT in CE configuration. (Find h parameters from characteristics.)
2. Transfer and Drain Characteristics of MOSFET. (Find gm, rd and μ from characteristics.)
3. Single stage MOSFET CS amplifier. (Find performance parameters - Av, Ri, Ro & Bandwidth for JFET CS amplifier.)
4. Single stage BJT CE amplifier. (Find performance parameters - Av, Ri, Ro & Bandwidth for BJT CE amplifier.)
5. Comparison of CE, CC, CB configurations for Av, Ri, Ro.
6. Simulate frequency response of single stage BJT CE / FET CS amplifier. (Effect of coupling and bypass capacitors.)
7. Design and simulate Voltage Shunt Feedback Amplifiers. (Compare performance of voltage shunt circuit under with and without feedback conditions.)
8. Design and simulate current series Feedback Amplifiers. (Compare performance of current series circuit under with and without feedback conditions.)
9. Design and simulate LC and RC oscillators. (Compare practical and theoretical oscillation frequency.)
10. Build and test LC or RC oscillator.
11. Design and simulate Power Amplifiers - Class A, Class AB complementary symmetry. (Efficiency calculations and comparison)

ET 20007 Digital System Design Laboratory

Teaching Scheme:
Practical: 2 hrs/week

Examination Scheme:
Continuous Evaluation: 40 marks
End-sem Exam: 60 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

- Design, simulate, built and debug complex combinational circuits based on an abstract functional specification
- Design, simulate, built and debug complex sequential circuits based on an abstract functional specification
- Develop and simulate VHDL architectural representations of digital systems and components using structure, behavior, or data flow concepts

List of Practical:

1. Simplification and implementation of a Boolean function using k -map technique e.g. code converter
2. Binary and BCD adders and Subtractor using IC 7483 and gates
3. Comparator using IC 7485 and Parity generator and checker using X-OR gate
4. Use of Multiplexers, Encoders, Demultiplexer and decoders for implementing logic
5. Counters
    a. Design and implementation of ripple and synchronous counters using JK and D FF and additional gates
    b. Design of counter using ICs like 7490/93 (ripple) and 74192/193(synchronous)
6. Design and implementations of random sequence counter using D FF or JK FF ICs
7. Study of shift registers IC 7495 for different modes. Design of pulse train generator, ring counter and Johnson' s counter using shift register and decoder circuit
8. Understanding VLSI Design flow using EDA tools
9. Writing VHDL codes of simple combinational and sequential circuits, Simulation and synthesis of the written codes using the EDA tool
10. Study of characteristics of typical TTL and CMOS IC's like fan out, noise margin, propagation delay

ET 20008 Network Synthesis and Analog Filters Laboratory

Teaching Scheme
Practical : 2 hrs/week

Examination Scheme
Continuous Evaluation: 40 marks
End Exam: 60 marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

- Verify network theorems
- Evaluate two port parameters for a particular two port network
- Design various types of attenuator circuits
- Design active and passive filters with the given specifications

List of Practical:

1. Verification of Network theorems (Superposition, Thevenin's, Nortons, Reciprocity, Maximum Power Transfer)
2. Two-port network parameters: Determination of z, y, h, T parameters
3. Attenuators: T –type, Ladder, Lattice type attenuators.
4. Passive filters I: Low-pass & high-pass filter.
5. Passive Filters-II: Band-pass & Band-stop filter.
6. Active filters I: Low-pass & high-pass filter. (1st order and 2nd order)
7. Active Filters-II: Band-pass & Band-stop filter. (1st order and 2nd order)

MA 20002 Linear Algebra and Univariate Calculus

(for Direct Second Year Students)

Teaching Scheme
Lectures: 4 hrs/week
Tutorial: 1 hr/ week

Examination Scheme
T1 and T2: 20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Know matrices, linear equations, and determinants, recall basic vector algebra, differentiability of functions of single variable, and mean value theorems.
- Understand basic concepts such as vector spaces, linear dependence / independence of vectors, basis.
- Analyze and calculate Eigen values, Eigen vectors, rank nullity of a matrix, sketch function graphs, evaluate improper integrals, calculate integrals using special techniques, apply various tests of convergence.

- Prove theorems; evaluate length / area / volume using single integrals.
- Apply concepts of linear algebra and Univariate calculus to various applications including real life problems.

Unit 1 **(15 hrs)**

Matrices and linear equations: basic properties of matrices, row operations and Gauss elimination, Determinants and their basic properties. Basic concepts in linear algebra: vector spaces, subspaces, linear independence and dependence of vectors, bases, dimensions. Rank of a matrix. Applications to systems of linear equations.

Unit 2 **(12 hrs)**

Rank-nullity theorem, Eigen values, Eigen vectors and their basic properties, diagonalization**.**

Unit 3 **(12 hrs)**

Review of limits, continuity and differentiability, Mean value theorems, Taylor's theorem, local extrema, increasing and decreasing functions, concavity, points of inflection.

Unit 4 **(13 hrs)**

Surface area, integrals by special techniques: reduction formulae, arc length, solids of revolution, improper integrals, tests for convergence, Gamma and Beta functions.

Text Books

- Thomas' Calculus (14th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books

- Introduction to Linear Algebra (2nd edition) by Serge Lang, Springer.
- Elementary Linear Algebra (10th edition) by Howard Anton and Chris Rorres, John Wiley and sons.
- Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
- A Course in Calculus and Real Analysis (1st edition) by Sudhir Ghorpade and Balmohan Limaye, Springer-Verlag, New York.
- Advanced Engineering Mathematics by C.R. Wylie, McGraw Hill Publications, New Delhi.
- Advanced Engineering Mathematics (7th edition) by Peter V. O' Neil, Thomson.Brooks / Cole, Singapore.
- Differential Calculus by Shanti Narayan, S. Chand and company, New Delhi.
- Applied Mathematics Vol. I (Reprint July 2014) by P.N. Wartikar and J.N. Wartikar, Pune Vidyarthi Griha Prakashan Pune.
- Advanced Engineering Mathematics by Chandrika Prasad and Reena Garg, Khanna Publishing Company Private Limited, New Delhi.

PH 20001 Foundation of Physics

(For Direct Second Year Students)

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1 and T2: 20 marks each
End-Sem exam: 60 marks

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Understand classical and wave mechanics to implement for the problems.
- Understand of the laws of thermodynamics to implement in various thermodynamic systems and processes.
- Understand the basic principles of Electromagnetism and formulate it to solve the engineering problems.
- Aware of limits of classical physics and will be able to use it in the appropriate field in order to solve the problems.

Unit 1 **(7 Hrs)**

Oscillations, Waves & Light
SHM, characteristics of SHM, Waves, Travelling waves and its equation**,** Types of waves, Principle of Superposition, Stationary waves**,** Light as an EM Wave, graphical representation of EM wave, Interference of light due to thin film (uniform thickness), Antireflection coating, Total Internal reflection, Introduction to Optical fiber and its design.

Unit 2 **(7 Hrs)**

Atomic Nucleus and Nuclear energy
Atomic Nucleus, Nuclear force, Static properties of nucleus, Mass defect and Binding energy, Law of radioactive decay, Half-life, Applications of radioactivity, Nuclear reactions, Q-value of nuclear reaction, Nuclear fission, chain reaction and Nuclear energy.

Unit 3 **(7 Hrs)**

Electrostatics
Coulomb's law in vector form, the electric field, Continuous charge distribution (Line, Surface& Volume)**,** Divergence of E, application of Gauss's law (simple 2 D problems)**,** The curl of E (Faraday's Law), the concept of electric potential V, Potential due to continuous charge distribution.

Unit 4 **(7 Hrs)**

Magneto statics

Steady state current (line current, Surface current and volume current), current densities, Magnetic field due to steady current (Biot-Savart's law), divergence and curl of B, Statement of Ampere's Law (with simple examples).

Unit 5 **(7 Hrs)**

Elements of Thermodynamics

Concept of Temperature, Terminology in Thermodynamics, Thermodynamic work, Caparison for Heat and Work, First Law and its applications, Heat engine and Thermal efficiency, Second law, Entropy, Disorder of system, Third law and Principle of Unattainability Absolute Zero (Nernst's Theorem).

Unit 6 **(7 Hrs)**

Modern physics

Drawbacks of Classical Mechanics, Plank's quantum hypothesis, Dual nature of matter, De-Broglie's hypothesis, light as a particle(Compton's experiment), De-Broglie's wavelength, Heisenberg's uncertainty principle(position and momentum), Wave function, its properties, conditions and its physical significance, Free particle solution of wave function.

Reference Books:

- Engineering Physics, Avadhanulu and Kshirsagar.
- Halliday-Resnick (Sixth edition) "Optics", Brij Lal (S. Chand publication)
- Classical Electrodynamics, David Griffith (Pearson India limited)
- H .C. Verma & Halliday-Resnick (Sixth edition), B. B. Laud
- Modern Physics, S. Chand Publication.
- Concepts of Modern Physics, Arthur Beiser, Tata McGraw – Hill Edition.

Semester IV

MA 20004 Vector Calculus and Partial Differential Equations

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs / week	T1 and T2: 20 marks each
Tutorials: 1 hr / week	End-Sem Exam: 60 marks

Objective: Basic necessity for the foundation of Engineering and Technology being mathematics, the main aim is, to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
- Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages)

Unit 1 **(10 hrs)**

Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates, substitutions in multiple integrals, Applications to Area, Volume, Moments and Center of Mass.

Unit 2 **(7 hrs)**

Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, statements and illustrations of theorems of Green, Stokes and Gauss, arc length parameterization, applications

Unit 3 **(9 hrs)**

Partial differential equations with separation of variables, boundary value problems: vibrations of a string, heat equation, potential equation, vibrations of circular membranes.

Text Books:

- Thomas' Calculus (14th edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley eastern Ltd.
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Reference Books:

- Advanced Engineering Mathematics by C.R. Wylie, McGraw Hill Publications, New Delhi.
- Functions of several variables by Wendell Fleming, Springer-Verlag, New York.
- Partial Differential Equations (4th edition) by Fritz John, Springer.
- Advanced Engineering Mathematics (7th edition) by Peter V. O' Neil, Thomson. Brooks / Cole, Singapore.
- Advanced Engineering Mathematics (2nd edition) by Michael D. Greenberg, Pearson Education.
- Advanced Engineering Mathematics by Chandrika Prasad and Reena Garg, Khanna Publishing Company Private Limited, New Delhi.

Note: All the Course outcomes 1 to 3 will be judged by 75% of the questions and outcomes 4 and 5 will be judged by 25 % of questions.

AS 20001 Biology for Engineers

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/ week	T 1 and T2: 20 marks each End Sem Exam: 60 marks

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Understand basic biological principles and organizational structure of living systems at molecular level comprehend basic biological principles and organizational structure of living systems at cellular level.
- Know Energy transformations and information processing in biological system.
- Appreciate biological process with engineering perspective
- Impart knowledge about the common corridors of biology and engineering and biologically inspired technologies

Unit 1 **(06 hrs)**

Biomolecules and biopolymers: Structure and Function

Organic and inorganic molecules; Unique Properties of water, Vitamins and Minerals, Carbohydrates, Lipids, Amino Acids and proteins, Nucleic Acids (DNA and RNA)

Unit 2 **(06 hrs)**

Levels of organization of life: Cell as a basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Cell membrane
Levels of organization: cells, tissues, organs, systems & organism

Unit 3 **(06Hrs)**

Energy transformations in Chloroplast: Photosynthesis (photochemical & biochemical phase) and ATP generation, Aerobic and anaerobic systems
Energy transformations in Mitochondria: Cellular respiration (glycolysis and Kreb cycle) and ATP generation
Bioenergetics: Thermodynamic principles applied to biology, negative entropy changes in biological systems, Free Energy, Chemical Equilibrium

Unit 4 **(06Hrs)**

Expression and Transmission of Genetic Information: DNA replication, Enzyme driven process of DNA cloning, Protein synthesis- Transcription & translation
Techniques for optimization:
At molecular level: Recombinant DNA Technology, DNA hybridization, PCR, DNA microarray

Unit 5 **(06Hrs)**

Transport Phenomena in Biological Systems: Membrane channels and ion channels; Fluid flow and mass transfer (nutrients & ions); In plants: Xylem and Phloem; In animals: Blood and Lymph Transport of gases: Oxygen and Carbon dioxide Heat Transport - Body temperature regulation.
Communication: Cell junctions, Cell-cell communications– cell signaling, Hormones, Pheromones and cell behavior

Defense mechanisms:

In plants: Herbivory, secondary metabolites
In animals: Innate and Adaptive immune systems

Unit 6 **(06 hrs)**

Engineering perspectives of biological sciences:

Biology and engineering crosstalk- At cell Level: Hybrioma technology
At tissue level: Plant Tissue culture, Animal Tissue Culture; Tissue Engineering: Principles, methods and applications. Introduction to Biometrics and Biomimicry, nanobiotechnology

Reference Books:

- Lodish H, Berk A, Zipursky SL, et al. (2000) Molecular Cell Biology. W. H. Freeman.
- Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). Lehninger principles of biochemistry. New York: Worth Publishers.
- Rao CNR, et.al. Chemistry of Nanomaterials: Synthesis, Properties and Applications.
- Eggins BR. (1006) Biosensors: An Introduction. John Wiley & Sons Publishers.
- Palsson B.O. and Bhatia S.N. (2009) Tissue Engineering. Pearson.
- Yoseph Bar-Cohen (2005). Biomimetics- Biologically Inspired Technologies
- Joseph D. Bronzino, John Enderle, Susan M. Blanchard (1999) Introduction to Biomedical Engineering.
- Routledge Taylor and Francis group (2012). Introduction to Bio-medical Engineeering technologies.

Table 1.1: For Teachers: Additional topics to be discussed with students in accordance with relevant biological topics (in branch-wise manner)

Disease/ Disorder	Physiology	Diagnosis	Therapeutics		Medical procedure
			Biomaterials	Instrumentation	
Cardiovascular disease	Heart – electrical stimulation and mechanical pumping	ECG, Angiography	Stentsfor angioplasty	Heart lung machines	Angioplasty, By-pass surgery
Bone/skull injuries	Biomechanics of musculo-skeletal system	Medical imaging technologies Arthroscopy	Prosthetics	Arthroscope Biomechanics Prosthetics	Joint replacement Total hip Replacement reh abilitation engg
Kidney disorders	Functioning of Kidney	Medical imaging technologies	Filtration membranes	Dialyser	Dialysis

ET 20009 Micro Project

Teaching Scheme:
Practical: 2 hrs/week

Examination Scheme:
Continuous evaluation: 40 marks
Exam: 60 Marks

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

- Identify and define a problem statement from the requirements raised from literature survey /need analysis
- Build and Test electronic circuits/prototype for developing real life small electronic applications.
- Work in teams, write comprehensive report and effective presentation of the project work
- Rapid prototyping which will lead them towards entrepreneurship.

The micro-project is a team activity having 3-4 students in a team. This is electronic circuit building and testing for developing real life small electronic applications. The micro-project may be a complete hardware or hardware with small programming aspect. It should encompass electronics components, devices, analog or digital ICs, micro controller etc. Micro- Project should cater to a small system required in laboratory or real-life application. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of Micro-project. Student is expected to detail out circuit specifications, resources required, critical issues involved in implementation and submit the proposal within first week of the semester.

The student is expected to build and test the proposed work in PCB fabrication Lab. The Lab sessions should be used for discussion on standard practice used for electronic circuit development, PCB design using suitable simulation software, others aspects of the circuit development, and guidelines for documentation /report writing. Completed micro-project and documentation in the form of micro- project report is to be submitted at the end of semester.

CT(IF) 20002 Data Structures

Teaching Scheme	**Examination Scheme**
Lectures: 1 Hr / Week	Assignment/Quizzes: 40 marks
Laboratory: 2 Hrs/ Week	End Sem Exam: 60 marks

Course Outcomes

Students will be able to

- Define a data structure for a given real life data
- Illustrate the difference between the abstract data structure definition and its implementation.
- Implement operations on linked lists, stack and queue.
- Demonstrate with diagrams, operations on binary trees.
- Implement a few simple real-life applications such as matrix operations, processing students' data, etc.

Unit 1 **(2 hrs)**

Introduction to imperative programming

Basic syntax of languages like C or C++: Data types, variables, limitations of data types, control statements, functions, compilation and execution as independent steps, global, static, local variables, structures, user defined types, pointer, recursion.

Unit 2 **(3 hrs)**

Arrays, Searching and Sorting

Searching: linear and binary search algorithm, sorting techniques such as insertion sort, bubble sort, selection sort, merge sort and quick sort

Unit 3 **(2 hrs)**

Linked Lists

Implementation of singly linked list, doubly linked list, circular list (implementation should have operations such creation of list, deletion of entire list, insertion to and deletion from arbitrary positions, traversal etc) using pointers

Unit 4 **(3 hrs)**

Stack and Queue

Abstract definitions of stack and queue, implementations using pointers and arrays, applications of stack (e.g. expression evaluation), applications of queue (e.g. allocation of CPU in FCFS algorithm)

Unit 5 **(2 hrs)**

Trees: Binary tree, Binary search tree, traversal operations on binary tree

Unit 6 **(2 hrs)**

File Handling: Working with text files and binary files, a simple application using files

Suggested List of Assignments:

1. A few practice programming problems can be given in C / C++ like: Perform arithmetic/logical/relational operations, Fibonacci Series, Operations on Strings etc.
2. Finding maximum/minimum number of an array
3. Linear search and binary search in sorted array
4. Matrix addition, Matrix multiplication
5. Sorting integers using insertion sort, bubble sort, selection sort, merge sort, quick sort
6. Implementation of singly linked list, doubly linked list and circular list using pointers (the implementation should support the standard operations associated with each type of the list)
7. Linked implementation of stack
8. Array implementation of stack
9. Linked implementation of queue
10. Array implementation of queue
11. Binary search tree implementation using pointers
12. DFS and BFS of a binary tree
13. Creating a file containing student data (roll no, name, marks etc), processing the data in memory (assuming the entire file contents fit in memory) and creating output file using the processed data

Text Books

- E. Horowitz, S. Sahni, S.Anderson-freed, "Fundamentals of Data Structures in C", Second Edition, University Press, ISBN 978-81-7371-605-8
- B. Kernighan, D. Ritchie, "The C Programming Language", Prentice Hall of India, Second Edition, ISBN 81-203-0596-5

Reference Books:

- Y. Langsam, M. Augenstin and A. Tannenbaum, "Data Structures using C", Pearson Education Asia, First Edition, 2002, ISBN 978-81-317-0229-1
- Programming in ANSI C, E. Balagurusamy, McGrawHill, 8th edition, ISBN-13: 978-9351343202

ET 20010 Analog Communication Systems

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2-20 marks each
End-Sem Exam: 60 marks

Course Outcomes:

At the end of this course, the students should be able to

- Understand and analyse different components of analog communication systems such as modulator, demodulator, mixer, receiver, etc. in time and frequency domain.
- Compare analog communication systems on the basis of bandwidth, power requirement and performance in the presence of noise.
- Design modulators, demodulators for amplitude and frequency modulated systems.
- Differentiate between different modulation and demodulation techniques and signal multiplexing for various applications.

Unit 1 **(4 hrs)**

Introduction
Overview: Elements of a Communication System, Classification of electronic communication systems, Baseband and bandpass signals, Need for modulation, Types of analog modulation. Concept and types of multiplexing

Unit 2 **(10 hrs)**

Amplitude modulation

DSB-FC, DSB-SC, SSB, VSB and ISB transmissions: mathematical Analysis-time and frequency domain analysis, modulation index, generation and detection methods, power requirement of these systems, Comparison of AM modulation schemes, Quadrature Carrier Multiplexing(QAM), frequency division multiplexing.

Unit 3 **(10 hrs)**

Angle Modulation
Frequency Modulation (FM), Single Tone Frequency Modulation, Spectrum Analysis, Narrowband FM, Wideband FM, Transmission Bandwidth of FM Waves, Generation of FM waves: Direct and Indirect Methods, Demodulation of FM, Phase Locked Loops, Limiting of FM waves, comparison between AM & FM, Phase Modulation, Relation between FM and PM.

Unit 4 **(7 hrs)**

Radio Receivers and performance in the noise
Basic receiver (TRF), Super heterodyne receiver for AM and FM, performance parameters for receiver such as sensitivity, selectivity, fidelity, image frequency rejection etc., AGC technique,

Sources of noise, Types of noise, Signal to Noise Ratios, Noise factor, Noise Temperature. Noise in AM, Pre emphasis and De-emphasis in FM, Comparison of Noise Performance of different modulation schemes.

Unit 5 **(6 hrs)**

Pulse Analog Modulation
Band limited & time limited signals, Narrowband signals and systems, Sampling theorem in time domain, Nyquist criteria, Types of sampling- ideal, natural, flat top, Aliasing & Aperture effect. PAM PWM & PPM.

Unit 6 **(3 hrs)**

Applications of AM and FM
AM Radio, Television: Video Bandwidth, Choice of Modulation, Colour Television, HDTV, FM Radio, FM Stereo Multiplexing.

Text Books:
- B.P. Lathi, "Communication Systems", BS publications.
- George Kennedy, "Electronic Communications", McGraw Hill Kennedy.

Reference Books:
- Simon Haykin, "An introduction to analog & digital communications", John Wiley & Sons
- Roddy and Coolen, "Electronic Communication Systems", Pearson Education.
- Frank R. Dungan, "Electronic Communication Systems", Delmar Publishers.

ET 20011 Micro-controllers and Applications

Teaching Scheme:
Lectures: 3 hrs/week
Tutotial:1 hr/week

Examination Scheme:
T1 and T2:-20 marks each
End-Sem Exam: 60 marks

Course outcomes:
At the end of this course students will demonstrate the ability to

- Analyze the internal architecture of 8-bit and 16-bit Microcontrollers
- Apply the knowledge to interface and program different peripherals to the microcontroller
- Understand the design aspects of Microcontroller based system
- Understand the concept of embedded systems

Unit 1 **(4 hrs)**

8051 Processor Architecture, signals and Instruction Set: The CPU, addressing modes, internal and external memory addressing, interrupt handling, Instruction execution, Instruction set – data transfer, arithmetic and logical instructions, bit operators, branch instructions, Software development tools like assemblers; simulators; cross-compilers, O/P file formats

Unit 2 **(10 hrs)**

Hardware Features of 8051 microcontroller – port structure, timer and counter features, serial interface logic, interrupt handling, device packaging, Chip technology, Power considerations, Reset, System clock/oscillators, Parallel I/O, Timers, Interrupts, Serial I/O.

Unit 3 **(10 hrs)**

8 bit Microprocessor and Microcontroller architecture, comparison, advantages and applications of Harward and Von Neumann architecture, RISC and CISC comparison. Definition of embedded system and its characteristics, Role of microcontroller in embedded System. Limitation of 8 bit microcontrollers, Study of RS232, RS485, I2C, and SPI protocols

Unit 4 **(7 hrs)**

PIC Microcontrollers and Instruction Set: PIC Micro-controllers – overview, PIC18F architecture, file selection register, Memory organization, Addressing modes, Instruction set, interrupt handling. Introduction to high performance microcontrollers: performance improvement to maximize flexibility of application, and minimize cost through elimination of external components over 8-bit microcontrollers, application areas for high-performance microcontrollers

Unit 5 **(6 hrs)**

MSP 430 architectural features, PWM generation UART, Interfacing of switches, LED, LCD, Keypad, Interfacing serial port, ADC, RTC with I2C and EEPROM with SPI.

Unit 6 **(3 hrs)**

Case studies with PIC, Design of DAS system, Design offrequency counter with display on LCD, Design of Digital Multimeter, Design of DC Motor control using PWM.

Text Books:

- Mazidi, "8051 microcontroller & embedded system" 3rdEdition ,Pearson
- Mazidi, " PIC microcontroller & embedded system" 3rdEdition ,Pearson

Reference Books:

- Kenneth J. Ayala, "The 8051 Micro-controller – Architecture, Programming & Applications", Penram International & Thomson Asia, Second Edition.
- John B. Peatman, "Design with PIC Micro-controllers", Pearson Education Asia, Low Price Edition
- Technical references from www.microchip.com

ET 20012 Integrated Circuits and Applications

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2-20 marks each
End-Sem Exam: 60 marks

Course outcomes:
At the end of this course students will demonstrate the ability to

- Design the linear and non-linear applications of Op-Amp.
- Compare the working of multivibrators using IC 555 and Op-Amp
- Classify and comprehend the working principle of data converters.
- Understand the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Unit 1 **(08 Hrs)**

Advanced Circuit Topologies**:** Cascode stages, Current Mirrors, Differential Signals, Differential Pair, Bipolar Differential Pair, MOS Differential Pair, Cascade current mirror. Op-Amp Fundamentals: Op-Amp parameters Circuits with resistive feedback: Concept of feedback & their types, Inverting & non inverting configurations, current to voltage converters, voltage to current converters, summing amplifier, difference amplifier, instrumentation amplifier.

Unit 2 **(06 Hrs)**

Active Filters: Transfer Function, First order active filters, Standard second order responses, KRC filters, Biquad Filters, audio Filter applications, Sensitivity

Unit 3 **(08 Hrs)**

Non-linear circuits: Schmitt trigger, Voltage comparators, comparator applications, precision rectifiers, analog switches, peak detectors, sample & hold circuits, Integrators & differentiators, log/antilog amplifiers.

Unit 4 **(06 Hrs)**

Signal Generators: Sine wave generators, Multi vibrators, Monolithic timers, Triangular wave generators, Saw tooth generators, V to F and F to V converters, function generator IC

Unit 5 **(06 Hrs)**

D-A and A-D Converters & regulators: Performance specifications, D-A conversion techniques, A-D Conversion techniques, single chip implementation of DAC and ADC. Performance specifications

of regulators, linear regulators, modifications for variable voltage, current boost & protection circuits

Unit 6 **(06 Hrs)**

Phase Locked Loops & multipliers: Block diagram of PLL free running frequency, lock range, capture range and Sample circuits for each block. Applications of PLL - Frequency synthesizer FM demodulator, AM demodulator, FSK demodulator, Analog multiplier, Multiplier IC

Text Books:

- Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 4th edition
- D.Roy Choudhary, Shail Jain, "Linear Integrated Circuits", New Age Int, 4th Edition

Reference Books:

- Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw Hill., Third Edition
- Ramakant Gaikwad, "OP-AMP and Integrated Circuits", Pearson Education, 3rd Edition
- G.B.Clayton, "Operational Amplifiers", International Edition, 2nd Edition.

ET 20013 Analog Communication Systems Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous Evaluation: 40 marks
Exam: 60 Marks

Laboratory Outcomes:
At the end of the laboratory work, students will demonstrate the ability to:

- Observe and analyze the function of different modulators and demodulators of Amplitude and angle modulated systems.
- Observe and analyze multiplexing systems such as FDM, TDM and QAM.
- Compare different communication systems by analyzing in time and frequency domain using oscilloscope and spectrum analyzer.

List of Practicals:

1. Fourier analysis & synthesis using hardware & software.
2. DSB-FC Amplitude Modulation and demodulation.
3. DSB-SC modulation and demodulation.
4. Frequency Division Multiplexing and De-multiplexing
5. Quadrature Amplitude Modulation and Demodulation.
6. Study of Ceramic bandpass filter characteristics.
7. SSB modulation and Demodulation.
8. Time Division Multiplexing and De-multiplexing.
9. Frequency Modulation using reactance modulator, computation of modulation index.
10. Study of phase modulator.

ET 20014 Micro-controllers and Applications Laboratory

Teaching Scheme:
Practical: 2 hrs/week

Examination Scheme:
Continuous evaluation: 40 marks
Exam: 60 Marks

Laboratory Outcomes:
At the end of the laboratory work, students will demonstrate the ability to:

- Understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller.
- Work with microcontroller real time interfaces including GPIO, serial ports, digital-to-analog converters and analog-to-digital converters.
- Analyze problems and apply a combination of hardware and software to address the problem.

List of Practicals:
Based on 8051 and PIC micro-controller mini-cards/kits by downloading the binary file in flash memory:

1. Assignment exploiting the various addressing modes for accessing internal as well as external memory and unconditional/conditional branch, loop control instructions.
2. Stack and Stack arithmetic operations, Subroutines and parameter passing via register, stack.
3. Timers and its applications , PWM generation
4. Serial Communication
5. Interfacing – Push buttons LEDs Key Matrix Seven segment display LCD ADC/DAC Stepper motor

ET 20015 Integrated Circuits and Applications Laboratory

Teaching Scheme:
Practical: 2 hrs/week

Examination Scheme:
Continuous evaluation: 40 marks
Exam: 60 Marks

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

- Analyze and design various applications of Op-Amp.
- Design and construct waveform generation circuits.
- Design timer and data converter circuits using op amps.
- Design a PLL circuit and study special purpose ICs.

List of Practicals:

1. Op-amp applications-I: Integrator, Differentiators.
2. Op-amp applications-II: Comparator (LM 339), Schmitt trigger.
3. Design build and test Precision rectifier.
4. Design, Build and Test a Square wave generator using op-amp.
5. Study of function generator IC8038.
6. Design, build and test different types DAC & study ADC IC.
7. To study the operation of IC 565 as PLL (Measurement of lock range, capture range & one application.

MA 20005 Multivariate Calculus and Differential Equations

(For Direct Second Year Students)

Teaching Scheme	**Examination Scheme**
Lectures: 4 hrs/week	T1 and T2: 20 marks
Tutorials: 1 hr/week	End Sem. Exam: 60 marks

Objectives: Basic necessity for the foundation of Engineering and Technology being mathematics, the main aim is, to teach mathematical methodologies and models, develop mathematical skills and enhance thinking power of students.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

- Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
- Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
- Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
- Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, prove implications or corollaries of theorems, etc.)
- Apply core concepts to new situations. (To measure this outcome, some questions will be based on self-study topics and also comprehension of unseen passages.)

Unit 1 **(10 hrs)**

Review of first order differential equations, linear differential equations, homogeneous higher order linear differential equations, non-homogeneous higher order linear differential equations with constant coefficients (method of undetermined coefficients and method of variation of parameters).

Unit 2 **(7 hrs)**

Laplace Transforms, its properties, Unit step function, Dirac delta functions, Convolution Theorem, periodic functions, solving differential equations using Laplace transform.

Unit 3 **(7 hrs)**

Functions of several variables, level curves and level surfaces, partial and directional derivatives, differentiability, chain rule, local extreme values and saddle points.

Unit 4 **(12 hrs)**

Double integrals in Cartesian and polar co-ordinates, iterated integrals, change of variables, triple integrals in Cartesian, spherical and cylindrical co-ordinates.

Unit 5 **(10 hrs)**

Vector differentiation, gradient, divergence and curl, line and surface integrals, path independence, statements and illustrations of theorems of Green, Stokes and Gauss.

Unit 6 **(7 hrs)**

Partial differential equations with separation of variables, boundary value problems: vibrations of a string, one dimensional heat equation.

Text Books:

- Thomas' Calculus (14^{th} edition) by Maurice D. Weir, Joel Hass, Frank R. Giordano, Pearson Education.
- Advanced Engineering Mathematics (10^{th} edition) by Erwin Kreyszig, Wiley eastern Ltd.

Reference Books:

- Calculus for Scientists and Engineers by K.D Joshi, CRC Press.
- A Course in Multivariate Calculus and Analysis by Sudhir Ghorpade and Balmohan Limaye, Springer Science and Business Media.
- Differential Equations with Applications and Historical notes by George Simmons, Tata Mc-Graw Hill publishing company Ltd, New Delhi.
- Functions of several variables by Wendell Fleming, Springer-Verlag, New York.
- Partial Differential Equations (4^{th} edition) by Fritz John, Springer.
- Advanced Engineering Mathematics by C.R. Wylie, McGraw Hill Publications, New Delhi.
- Advanced Engineering Mathematics (7^{th}edition) by Peter V. O' Neil, Thomson.Brooks / Cole, Singapore.
- Advanced Engineering Mathematics (2^{nd} edition) by Michael D. Greenberg, Pearson Education.
- Advanced Engineering Mathematics by Chandrika Prasad and Reena Garg, Khanna Publishing Company Private Limited, New Delhi.