VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)
MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum
(Scheme of Instruction & Evaluation and Course contents)

For
Second Year Undergraduate Programme Leading to
Bachelor of Technology (B. Tech.) Degree
in
Electronics Engineering

Implemented from the batch admitted in Academic Year 2023-2024

[NEP 2020 Based Syllabus]

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(106)

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Institute Vision

- To establish global leadership in the field of Technology and develop competent human resources for providing service to society

Institute Mission

- To provide students with comprehensive knowledge of principles of engineering with a multi-disciplinary approach that is challenging
- To create an intellectually stimulating environment for research, scholarship, creativity, innovation, and professional activity.
- To foster relationship with other leading institutes of learning and research, alumni, and industries in order to contribute to National and International development.

Department Vision

- To establish global leadership in the field of Electrical, Electronics & Communication Engineering and to develop competent human resources for providing service to society.

Department Mission

- To provide student with comprehensive knowledge for taking up challenges in the field of Electrical Engineering with a multi-disciplinary approach.
- To create an intellectually stimulating environment for research, industry interaction, creativity, innovation and professional activity.
- To foster relationship with renowned institutes of learning and research, alumni and industries in order to contribute to National and International development.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

Electronics Engineering Graduates will have ability to

1. Apply analysis, design, optimization and implementation skills in order to formulate and solve Electronics Engineering and multidisciplinary problems.
2. Take up higher studies, innovation, research & development and other such creative efforts in technology.
3. Use their skills in professional manner to raise the satisfaction level of stake holders.

PROGRAMME OUTCOMES

Engineering Graduate will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOS)

Electronics and Telecommunication Engineering Graduate will be able to:

1. Design, develop and test electronic systems in the areas related to analog and digital electronics, electronic instrumentation, signal processing and VLSI design.
2. Analyze, design and implement electronic systems to strive balance between increasing complexity, robustness and performance of systems.
3. Design electronic software and hardware systems, components or process to meet desired needs within realistic constraints.

Credit Framework for Multidisciplinary UG Programme in Electronics Engineering (Level 5.0)

Semester - III

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %			Ownership
									TA	MST	ESE	
1	PCC	R5MA2006T	Mathematics for Electronics Engineers	3	0	0	3	3	20	30	50	Mathematics
2	PCC	R5EL2001T	Electronic Circuit Analysis and Design	3	0	0	3	3	20	30	50	Electronics
3	PCC	R5EL2002T	Electrical Networks Analysis	3	0	0	3	3	20	30	50	Electronics
4	PCC	R5EL2003T	Principles of Communication Systems	3	0	0	3	3	20	30	50	Electronics
5	PCC	R5EL2004T	Digital System Design	3	0	0	3	3	20	30	50	Electronics
6	MDM	R5XX22XXT	Multi-Disciplinary Minor-I	2	0	0	2	2	20	30	50	Respective Department
7	PCC	R5EL2004L	Digital System Design Lab	0	0	2	2	1	ISCE:60		40	Electronics
8	PCC	R5EL2003L	Principles of Communication Systems Lab	0	0	2	2	1	ISCE:60		40	Electronics
9	VSEC	R5EL2001L	Electronic Circuit Analysis and Design Lab	0	0	2	2	1	ISCE:60		40	Electronics
10	VEC	R5HS2401O	Universal Human Values	2	0	0	2	2	ISCE: 60		40	Humanities
11	VSEC	R5EL2005L	Python Programming Lab	0	0	2	2	1	ISCE:60		40	Electronics
			Total	19	0	8	27	23				

Semester - IV

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %			Ownership
									TA	MST	ESE	
1	PCC	R5EL2006T	Signals and Systems	3	0	0	3	3	20	30	50	Electronics
2	PCC	R5EL2007T	Microprocessor and Microcontroller	3	0	0	3	3	20	30	50	Electronics
3	PCC	R5EL2008T	Analog Integrated Circuits	3	0	0	3	3	20	30	50	Electronics
4	PCC	R5EL2009T	Digital Communication	3	0	0	3	3	20	30	50	Electronics
5	MDM	R5XX	Multi-disciplinary Minor-II	2	0	0	2	2	20	30	50	Respective Department
6	VEC	R5CH2402T	Environmental Science	2	0	0	2	2	ISCE:60		40	Chemistry
7	PCC	R5EL2009L	Digital Communication Lab	0	0	2	2	1	ISCE:60		40	Electronics
8	PCC	R5EL2008L	Analog Integrated Circuits Lab	0	0	2	2	1	ISCE:60		40	Electronics
9	PCC	R5EL2007L	Microprocessor and Microcontroller Lab	0	0	2	2	1	ISCE:60		40	Electronics
10	AEC	R5HS25XXO	Modern Indian Language	2	0	0	0	2	ISCE:60		40	Humanities
11	CEP/FP	R5EL2601P	Comm. Engg. Project / Field Project	0	0	4	4	2	ISCE:60		40	Electronics
			Total	18	0	8	28	23				

MDM Course Code offered by Electronics Engineering

Sr. No.	Course code	Name of MDM	Name of the MDM Course	Semester
1	R5EL2201T	Internet of things	Basics of Electronic Circuits	III
2	R5EL2202T	Signal and Image Processing	Signals and Systems	III
3	R5EL2203T	Internet of things	Digital Electronics	IV
4	R5EL2204T	Signal and Image Processing	Digital Signal Processing	IV

Abbreviations: **L** Lecture, **T** Tutorial, **P** Practical, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination, **ISCE** In-semester Continuous Evaluation, **PCC** Program Core, **MDM** Multi-Disciplinary Minor **VSEC** Vocational and Skill Enhancement Course, **OE** Open Elective, **VEC** Value Education Course.

MIL Courses offered (AEC)

Sr. No.	Course code	Name of the MIL Course	Semester
1.	R5HS2501O	Marathi	IV
2.	R5HS2502O	Hindi	IV
3.	R5HS2503O	Sanskrit	IV
4.	R5HS2504O	Kannada	IV
5.	R5HS2505O	Gujarati	IV
6.	R5HS2506O	Panjabi	IV

List of Exit Courses after completion of Semester III and IV

1. The exit option is available for students who have earned a total of 88 credits at the End of the Second Semester.
2. Students who want to avail of the exit option after the Second year have to earn an additional 6-8 credits from the list of courses shown below.
3. These courses students have to complete within summer vacation after the Second Year.
4. After fulfillment as mentioned in 1 to 3 above, Students can earn U.G Diploma and the Institute will issue the same.

List of Exit Courses after completion of Semesters III and IV: Electronics Engineering

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
									TA	MST	ESE
1	EC	R5EL2901I	Internship (6-8 weeks)					6	ISCE:60		40
2	EC	R5EL2902P	Project / Mini-Project	0	0	12	12	6	ISCE:60		40
3	EC	R5EL2903L	Electronic Engineering Practice	2	0	0	2	2	ISCE:60		40
5	EC	R5EL2904L	Electronic Instrumentation	2	0	0	2	2	ISCE:60		40
			Total								

S. Y. B. Tech. Electronics Engineering

Course code	R5MA2006T	**Semester**	III	**Credits**	3	Scheme	3L:0T:0P
Course	MATHEMATICS FOR ELECTRONICS ENGINEERS						**Category**: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Compute the Laplace transform of various functions
2. Evaluate the Fourier components of various functions.
3. Understand Probability and conditional distribution.
4. Understand Bessel function.
5. Apply properties of Z transform and its inverse to solve engineering problems.

Module	**Content**	**Hrs.**
1	**Laplace Transform** 1. Functions of bounded variation 2. Linear property of Laplace transforms. 3. Laplace transforms of standard functions such as 4. Change of scale property , First shifting theorem, Second shifting theorem 5. Inverse Laplace transform using linear property, theorems, partial fractions, and convolution theorem. 6. Unit step functions, Heaviside, Dirac delta functions, Periodic functions, and their Laplace transforms. 7. Application to solve ordinary differential equations with one dependent variable.	12
2	**Fourier Series** 1. Orthogonal, Orthonormal sets, Expressions of a Function in Series of Orthogonal Functions. 2. Dirchlet's conditions. 3. Fourier series of periodic functions with period 2π, 2l. 4. Dirchlet's theorem, even and odd functions. 5. Half range expansions, Parseval's relations. 6. Complex form of Fourier series. 7. Fourier integral and Fourier transform.	8
3	**Bessel Functions** 1. Bessel's Equation, Solutions of Bessel's function, Bessel's Function Of Jn(x). 2. Recurrence formula Jn(x), Equation Reducible to Bessel's equation	3
4	**Z-Transform** 1. Z-Transform, Properties of z-transform, Theorem, change of Scale, Shifting property. 2. Inverse Z-Transform solution of Difference Equation, Multiplication by k, Division by k, Initial value, Final value, Partial sum, Inversion by residue method, Solution of Difference Equation 3. Convolution, Convolution property of Causal Sequence, Inverse of Z Transform by Division, By Binomial Expansion and partial fraction,	9
5	**Probability Theory**	10

	1. Review of introduction to probability, concept of random variable, probability density function, cumulative distribution function 2. Moments, characteristic functions, Two random variables: Bi-variate distribution, functions of random variables 3. Joint moments, Joint Characteristic functions, Conditional distribution	

Text Book:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Ltd, 10th edition, 2015
2. B S Grewal, Higher Engineering Mathematics, Khanna Publications, 39th Edition, 2005

Reference:

1. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill India, 1 st edition, 2006.

Course code	R5EL2001T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	ELECTRONIC CIRCUITS ANALYSIS AND DESIGN						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Design various diode-based circuits
2. Analyse BJT and FET transistor circuits for their DC and AC characteristics.
3. Analyse the frequency response of BJT and FET amplifiers
4. Analyse AC & DC analysis of power amplifier
5. Understand the concept of feedback for amplifiers and oscillators.

Module	Content	Hrs.
1	**Diode Application** 1. Application of rectifier with filter 2. Voltage doubler circuit 3. Clipper & clamper circuit 4. Multiple Diode circuit 5. Zener diode: Series and shunt voltage regulator	4
2	**Bipolar junction transistor** 1. Review of BJT amplifiers 2. Bipolar transistor Biasing, single base resistor biasing, voltage divider biasing and bias stability, 3. AC analysis using r-π model and h-parameter	6
3	**Field Effect Transistor** 1. Junction Field-effect Transistor. 2. MOS Field effect transistor, DC Circuit analysis. 3. Basic MOSFET Application: Switch, Digital Logic Gate and Amplifier. 4. MOSFET Amplifier, basic Transistor amplifier, common gate configuration. 5. Three basic amplifier configurations: single-stage MOSFET amplifiers and basic JFET Amplifiers.	8
4	**Frequency Response of Amplifiers** 1. Frequency response analysis of BJT amplifier with Circuit Capacitors. 2. Frequency response analysis of FET amplifier with Circuit Capacitors. 3. High Frequency Response of BJT & FET Circuits.	6
5	**Multistage Amplifiers** 1. The Darlington Amplifier 2. Cascade amplifier 3. Cascode amplifier 4. RC coupled amplifier	6
6	**Power Amplifiers** 1. Power Amplifiers, Power Transistors - Power BJTs, Power MOSFETs, Heat Sinks	6

	2. Classes Of Amplifiers - Class-A Operation, Class-B Operation, Class-AB Operation, Class-C Operation, Class-A Power Amplifiers, Class-AB Push Pull Complementary Output Stages.	
7	**Feedback and Oscillators** 1. Introduction to Feedback, Basic Feedback Concepts, 2. Ideal Close-Loop Gain, Gain Sensitivity Bandwidth Extension, Reduction of Nonlinear Distortion, Noise Sensitivity 3. Ideal Feedback Topologies, Series-Shunt, Shunt-Series, Series-Series, Shunt-Shunt Configurations, Loop Gain, 4. Oscillator: Barkhausen's criteria, Wein bridge oscillator RC phase shift Oscillator, Hartley and Colpitts Oscillator.	6

Text Book:

1. Robert L. Boylestad, Electronic Devices and Circuit Theory, 11th edition, Pearson Education India.
2. Donald A. Naeman, Electronic Circuit Analysis and Design, Second Edition, McGraw Hill International Edition 2001.

Reference:

1. Donald Schilling and Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International Edition, 1989
2. Adel Sedra and Kenneth Smith, Microelectronic Circuits, Fifth edition, Oxford University Press, 2004.
3. Martin Roden, Gordon Carpenter, William Wieserman, Electronic Design, Fourth edition, Shroff Publishers,2002.

Course code	R5EL2001L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	ELECTRONIC CIRCUITS ANALYSIS AND DESIGN LAB						Category: VSEC

Course Outcomes:

After the completion of course, the student should be able to

1. Analyse and design wave-shaping circuits.
2. Perform basic analog electronic circuit design techniques using BJT & FET.
3. Differentiate the response of BJT and FET at low frequency and High frequency.
4. Design and implement BJT-based amplifier circuits utilizing various negative feedback topologies
5. Design and implement oscillators.

LIST OF TOPICS FOR ELECTRONIC CIRCUITS ANALYSIS AND DESIGN LAB

Sr.No.	Topics	
1	Clipper circuits	
2	Clamper circuits	
3	BJT bias circuits - Design, assemble and test.BJT common-emitter circuit - D.C and A.C performance:	
4	FET characteristics	
5	JFET bias circuits - Design, assemble and test.	
6	Frequency response of a BJT amplifier: low frequency, high frequency, and mid-frequency response.	
7	Frequency response of a FET amplifier: low frequency, high frequency, and mid-frequency response.	
8	Ac & DC analysis of Multistage amplifier	
9	Design of RC Phase Shift Oscillator	
10	Design of Wien Bridge Oscillator	

Course code	R5EL2002T	Semester	III	Credits	3	Scheme	2L:1T:0P
Course	ELECTRICAL NETWORKS ANALYSIS						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Analyze electrical networks using various Theorems.
2. Analyze electrical networks using time and frequency domain techniques.
3. Represent a network in terms of its two port network parameters.
4. Obtain the frequency domain representations using Fourier analysis.

Module	Content	Hrs.
1	**Circuit analysis of Dependent sources** 1. Mesh and Node Analysis of circuits with dependent sources. 2. Linearity, Superposition, Current AND Voltage Source Transformation 3. Thevenin's and Norton's Theorem 4. Maximum power transfer theorem	8
2	**Time and Frequency domain analysis** 1. First and second Order Differential equations, initial conditions. 2. Evaluation and analysis of Transient and Steady state responses using Classical Technique as well as by Laplace Transform for I & II order system. 3. Transfer function, Concept of poles and zeros. Frequency response of a system (concepts only).	10
3	**Two - port Networks** 1. Concept of two- port network. 2. Driving point and Transfer Functions. 3. Open Circuit impedance (Z) parameters, Short Circuit admittance (Y) parameters, Transmission (ABCD) parameters. 4. Inverse Transmission (A'B'C'D') parameters. Hybrid (h) parameters. 5. Inter Relationships of different parameters. 6. Interconnections of two - port networks. 7. T and Pi representation. 8. Terminated two - port networks	8
4	**Circuit analysis using Graph Theory** 1. Introduction to Graph Theory. Tree, link currents, branch voltages, cut set and tie set. 2. Mesh and Node Analysis. 3. Gauss Elimination Technique, Duality.	8
5	**Fourier Series in Network Analysis** 1. Orthogonal basis functions, Representation of a signal in terms of weighted Orthogonal basis functions, 2. Calculation of weights (coefficients) in the MSE sense, 3. Extension to periodic signal in terms of Fourier Series Representation. 4. Complex and Trigonometric Fourier series 5. Properties of Fourier series, Power Spectrum 6. Circuit Analysis using Fourier Series	8

Text Book:

1. A Sudhakar and S P Shyammohan, Circuits and Networks, Tata McGraw Hill, thirteenth reprint, 2000.

2. M. E. Van Valkenburg, Network Analysis, Prentice Hall of India, third edition. 2006

3. William H Hayt, Jack E Kemmerly and Steven M Durbin, Engineering Circuit Analysis, McGraw Hill International, sixth edition, 2002.

Reference:

1. Artice M Davis, Linear Circuit Analysis, Thomson Asia Pvt. Ltd., Singapore, first edition, 2001

2. Raymond A DeCarlo and Pen-Min Lin, Linear Circuit Analysis, Oxford University Press, second edition, 2001.

Course code	R5EL2003T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	PRINCIPLES OF COMMUNICATION SYSTEMS						Category: PCC

Course Outcomes:

After the completion of the course, the student should be able to

1. Describe basic analog communication processes.
2. Describe and solve problems on modulation.
3. Analyze transmitter and receiver circuits.
4. Analyze and interpret pulse analog techniques.

Module	Content	Hrs
1	**Basics of Communication System** Block diagram, electromagnetic spectrum, signal bandwidth, and power, types of communication channels, Introduction to time and frequency domain, Types of noise, signal to noise ratio, noise figure and noise temperature, Friis Equation.	6
2	**Amplitude Modulation and Demodulation** DSB Full carrier AM – principles, modulator circuits, transmitters, different types of AM modulators, Suppressed – carrier AM, SSB, ISB – Principles, transmitters. Receiver characteristics, TRF and Super-heterodyne receivers, AM detectors.	10
3	**Angle Modulation and Demodulation** Frequency modulation, Phase modulation, Effect of noise, FM modulators, Transmitters, FM detectors, Receiver circuits	10
4	**Radio Receivers** TRF, Super - heterodyne receiver, receiver parameters and choice of IF, AM receiver circuits and analysis, simple AGC, delayed AGC, forward AGC, and communication receiver, FM receiver circuits, comparison with AM receiver	8
5	**Analog Pulse Modulation** Sampling Theorem for Low – pass, and Band – pass signals – proof with spectrum Aliasing. Sampling Techniques principle, generation, Demodulation, spectrum. PAM, PWM, PPM – generation and detection.	8

Text Books

1. Roy Blake, Electronic Communication Systems, Thomson Asia Pte. Ltd., Singapore, 2nd edition.
2. Kennedy and Davis, Electronics communication system, Tata McGraw Hill, 5th Edition,2011.

Reference:

1. B.P. Lathi, Modern Digital And Analog Communication Systems, Oxford,4th Edition,2011.
2. Herbert Taub and Donald Schilling, Principles of Communication Systems, Tata McGraw-Hill, 3rd edition.

Course code	R5EL2003L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	PRINCIPLE OF COMMUNICATION SYSTEM LAB						Category: PCC

Course Outcomes:

After the completion of the course, the student should be able to

1. Implement the generation of various types of signals
2. Generate and demodulate various modulation schemes.
3. Learn practical methods of real communication in communication systems.

Sr.No.	Topics	
1	RF Amplifier Characteristic	
2	Generation of AM	
3	Detection of AM	
4	Generation of FM.	
5	Detection of FM	
6	Study of AM superheterodyne receiver.	
7	Generation and detection of PM	
8	Generation and detection of PAM, PPM, and PWM.	
9	Radio Receiver Characteristics	

Course code	R5EL2004T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	DIGITAL SYSTEM DESIGN						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Numerically analyze various logic circuits and perform Boolean reduction
2. Design various combinational circuits as per different specifications.
3. Design various sequential circuits as per different specifications.
4. Analyze the behavior of various logic families.
5. Explain principles of sequential circuits and their applications

Module	Content	Hrs
1	**Logic Circuits** Boolean Algebra, theorems, SOP and POS minimization, Karnaugh Maps minimization, programmed minimization methods – Quine-McCluskey minimization algorithm, timing hazards – static and dynamic hazards.	8
2	**Combinational Logic Design** Introduction to combinational circuit: Realization of basic combinational functions like comparison, codeconversion, decoding, multiplexing, de-multiplexing, addition, subtraction. Delays and hazards in combinational circuits	8
3	**Sequential Logic system**s Basic sequential circuits- latches and flip-flops: Latches , SR flip-flop, JK flip-flop, M-S flip-flop, D flip-flop,T flip-flop; Multi-bit latches and registers, counters, shift register, application examples.	10
4	**Logic Families** CMOS logic; MOS transistors, basic CMOS inverter circuit, CMOS NAND and NOR gates, fan – in, fan – out, Electrical behavior of CMOS circuits, propagation delay, power consumption, CMOS logic families, bipolar logic introduction, BJT, TTL NAND and NOR gates, fan – in, fan – out, Electrical behavior of TTL circuits, propagation delay, power consumption. CMOS / TTL interfacing, Introduction to Emitter – coupled logic.	8
5	**State machine design approac**h Design of state machines – state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Designing state machine using ASM charts; Designing state machine using state diagram; Design examples	8

Text Book:

1. John F. Wakerley, Digital Design Principles and Practices, fourth edition, Pearson Education India, 2008.
2. Stephen Brown & ZvonkoVranesic, Fundamentals of Digital logic with VHDL design, third edition, McGraw Hill edition, 2014.

Reference:

1. G K Kharate , Digital Electronics, Oxford University Press 2015.

Course code	R5EL2004L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	DIGITAL SYSTEM DESIGN LAB						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Design and implement combinational circuits using gates.
2. Design combinational circuits using ICs
3. Implement digital sequential circuits using ICs.

Sr.No.	Topics	
1	Design of combinational logic circuits (Half Adder, Full Adder, Half Subtractor, Full Subtractor) using fundamental and Universal Logic gates	
2	Design of Multiplexer, Demultiplexer	
3	Design of Encoder and Decoder circuits	
4	Design of Code Converters	
5	Implementing 8 bit ALU	
6	Study of various parameters of logical families and comparative study of TTL and CMOS.	
7	Truth Table verification of RS, T, D,JK flip flop	
8	JK Master Slave Flip Flop. To simplify the given expression and to realize it using Basic gates and Universal gates	
9	To realize and study of Shift Register: SISO, SIPO,PIPO, PISO	
10	To realize and study Ring Counter and Johnson counter	
11	To realize synchronous and asynchronous counter.	

Course code	R5EL2005L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	PYTHON PROGRAMMING LAB						Category: VSEC

Course Outcomes:

After the completion of course, the student should be able to

1. Apply concepts of object oriented programming in Python
2. Describe the different data structures and select appropriate data structure for the given application
3. Write programs to implement classical numerical methods solving engineering problems in Python
4. Implement different data structures and select appropriate data structure for the given application

Module	Content	Hrs.
1	**Introduction to Python** Features, Byte code, execution, Python Virtual Machine, frozen binaries memory management, C vs Python,	2
2	**Data types and operators in Python** Comments, Doc-strings, built-in-data types, basic operators, membership operators, operator precedence and associativity, conditional statements, control statements.	3
3	**Arrays, Strings and Functions** Arrays, importing, indexing, slicing, processing, mathematical operations On Arrays, strings, operations on strings, defining and calling Functions, formal and actual arguments.	2
4	**Classes and Objects** Class creation, constructor, methods, inheritance: single, multilevel and multiple polymorphism, method overloading and method overriding, Abstract classes and interfaces.	4
5	**Data Structures in Python** Linked list (single, double), stacks, Stack operations,queues, de-queues, Queue operation, Array, representation of Queue, Linked representation of Queue	3

For Lab

Sr.No.	Topics	
1	To understand and learn the basic syntax and Datatypes in Python	
2	To learn and demonstrate the concept of variables, operators and control structure in Python	
3	To understand and develop problem solving skills using functions and modules in Python programming	
4	To understand and apply the concept of loop structures (For, While, Nested Loops) in Python	
5	To understand, implement and apply array data structures in Python	
6	To understand and create functions, classes and objects in Python.	
7	To understand and apply operator overloading and method overriding in Python	
8	To understand,implement and apply link lists, stacks and queues in Python	
9	To understand and implement Abstract data types such as Lists, Stacks, Queues, Trees and Graphs in Python	

Course code	R5HS2401T	Semester	III	Credits	1	Scheme	2L:0T:0P
Course	UNIVERSAL HUMAN VALUES						Category: VEC

Course Objective:

1. To help the student see the need for developing a holistic perspective of life.
2. To help sensitize the student about the scope of life – individual, family (interpersonal relationship), society and nature.
3. To strengthen self reflection
4. To develop more confidence and commitment to understand, learn and act accordingly

Course Outcomes:

After the completion of course, the student should be able to

1. Analyze the significance of value inputs provided in formal education along with skills and develop a broader perspective about life and education.
2. Formulate their aspirations and concerns at different levels of living, and the way to fulfill them them in a sustainable manner.
3. Evaluate their current state of understanding and living, and model a healthy lifestyle
4. Examine the issues of homesickness, interactions with seniors on the campus, peer pressure with better understanding and feel grateful towards parents, teachers and others
5. Develop more confidence and commitment for value-based living in family, society and nature.

Course Content

Module	Description	Hrs.
1	Aspirations and concerns – Understanding basic human aspirations, fixing one's goals, and the need for a holistic perspective in form of Universal Human values Self management – self confidence, handling peer pressure, time management, anger, stress, personality development and self improvement which leads to harmony in the human being.	
2	Understanding Health – Health issues, healthy diet, healthy lifestyle which shall lead to Harmony of the self and body in forms of mental and physical health.	
3	Relationships – Learning to handle home sickness, gratitude towards parents, teachers and others, understanding impact of ragging and interaction, competition and cooperation to achieve harmony in relationships.	
4	Participation in society, participation in nature leading to harmony in the society and nature/existence, Role of education in developing holistic perspective	

Textbooks:

1. E.P.G.Gohl, L.D.Vilensky, Textile Science, an Explanation of Fibre Properties, Second Edition, 1987, CBS Publishers & Distributors Pvt. Ltd.
2. Manufactured Fibre Technology, V.B. Gupta and V.K. Kothari, Springer Science + Business Media, 2003, ISBN 978-94-010-6473-6

References:

1. Tatsuya Hongu, Glyn O. Phillips, MachikoTakigam, New Millennium Fibers, Woodhead Publishing Ltd., CRC Press LLC, 2005, ISBN 0-8493-2598-6.
2. H.V.S. Murthy, Introduction to Textile Fibres (Revised edition- 2015), Wood Head Publication, ISBN 9789385059094 .

SEMESTER -IV

Course code	R5EL2006T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	SIGNALS AND SYSTEMS						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Understand basic concepts of linear systems and how they interact with continuous-time and discrete time signals.
2. Analyze continuous-time and discrete time signals and systems in the time domain.
3. Analyze CT and DT signals and systems using Laplace descriptions
4. Analyze CT and DT signals and systems using Z-domain descriptions
5. Represent and interpret signals in Fourier domain

Module	Content	Hrs
1	**Introduction to signals & Systems (CT and DT domain)** Definition of Signal, Signal classification, Signal manipulations, Periodicity in CT (Continuous Time) & DT (Discrete Time) domain, Concept of a system, System representations & classification, Concept of Impulse Response, Convolution in CT and DT domain	10
2	**Laplace Transforms** Definition & properties of Two-sided & one-sided Laplace Transform, Region of Convergence (ROC), System transfer function, Relationship with Fourier Transform & mapping, Zero state & zero input responses System Transfer function & Impulse response, Differential Equations	6
3	**Z Transform** Definition & properties of Two-sided & one-sided Z Transform, Region of Convergence (ROC), Relationship with Fourier and Laplace Transform , & mapping, Inverse Z Transform	8
4	**DT system Realization** Difference equation, FIR & IIR systems, System transfer function, System realization: Direct forms, Cascade & parallel forms,	6
5	**Fourier Series & Fourier Transform (CTFS, CTFT, DTFS & DTFT)** Introduction, properties and uses, amplitude & phase spectra, Energy Spectral Density, Power Spectral Density	6
6	**Time Domain Analysis of DT Systems** System Transfer function & Impulse response, Difference equation, Solution of a difference equation, zero input & zero state response calculations	6

Text Book:

1. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, 2nd edition, 2004.
2. A Nagoor Kani, Signals and Systems, Tata McGraw Hill, 2nd Edition,2010.
3. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, India, 2nd edition, 2010.

Reference:

1. Michael J Roberts, Fundamentals of Signals and systems, Tata McGraw Hill, Indian Economy edition, 2009.
2. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, 2nd edition, 2002

Course code	R5EL2007T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	MICROPROCESSOR AND MICROCONTROLLER						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Describe architecture of a typical microprocessor and microcontroller.
2. Design a microprocessor system consisting of a microprocessor / microcontroller, memory, I/ O and other relevant devices.
3. Design and implement assembly language programs for 8085 / 8051 microprocessor / microcontroller.
4. Design and implement I/O data transfer techniques

Module	Content	Hrs.
1	**Introduction** **1.** Introduction to Microprocessors, Microcontrollers and Assembly Language.	3
2	**8085 Microprocessor Architecture and Memory Interfacing** 1. The 8085 architecture, Instruction cycles, machine cycles and T states. 2. Concept of wait states. Memory interfacing with timing considerations. 3. Clock, Reset and buffering circuits.	6
3	**8085 Assembly Language Programming** 1. The 8085 programming model, 2. Instruction classification, Instruction and Data format, 3. Process of writing, assembly and execution of simple assembly language programs.	6
4	**Programming Techniques** 1. Data transfer operations, Arithmetic & Logic operations, Branch operations, 2. Writing assembly language programs, Debugging a program. 3. Looping, Counting and indexing, counters and timers, 4. Code conversion, BCD arithmetic and 16 bit data operations. 5. Software Development Systems and Assemblers. 6. Concept of Stack and subroutines, parameter passing techniques, 7. Re-entrant and recursive subroutines.	10
5	**Parallel I/O Data Transfer Techniques** 1. Basic interfacing concepts, Interfacing input and output devices with examples, 2. Memory mapped I/O and I/O mapped I/O. I/O data transfer classification, Programmed I/O. 3. Interrupt driven program controlled I/O,Interrupt Requirements 4. Single level interrupt, Multi-level interrupt, Vectored interrupt. 5. 8085 interrupt structure and operation. 6. 8259A programmable interrupt controller features and operation – single and cascaded. 7. Hardware I/O (Direct Memory Access).	10

6	**Intel MCS 51 family** 1. Introduction to Single chip microcontrollers of Intel MCS 51 family. 2. Architectural and operational features. Instruction set. 3. CPU timing and machine cycles. 4. Interrupt structure and priorities. 5. Internal Timer /counters, serial interface. 6. Interfacing of external memory. 7. Power saving modes. 8. 8051 variants. 9. 89C51 devices	7

Text Book:

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Sixth edition, Penram International Publishing (India), 2013.

2. Kenneth Short, Microprocessors and Programmed Logic, second edition, Prentice Hall of India, 1987.

Reference:

1. Kenneth Ayala, The 8051 Microcontroller & Embedded Systems Using Assembly and C, Cengage Learning, first edition, 2010
2. Muhammad A Mazidi, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, second edition, 2008.

Course code	R5EL2007L	**Semester**	IV	**Credits**	1	Scheme	0L:0T:2P
Course	MICROPROCESSOR AND MICROCONTROLLER LAB						**Category**: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Understand and use microprocessor circuits and kits.
2. Design and implement assembly language programs for 8085 / 8051 microprocessor / microcontroller.
3. Design and program parallel data transfer techniques

Sr.No.	**Topics**	
1	Two programs on Data transfer operations based on 8085 microprocessor	
2	Five programs on Arithmetic & Logic operations with increasing complexity based on 8085 microprocessor	
3	Three programs on sorting based on 8085 microprocessor	
4	Three programs on I/O operations and interrupts based on 8085 microprocessor	
5	Three programs on Arithmetic & Logic operations with increasing complexity based on 8051 microcontroller.	
6	Two programs on I/O operations and interrupts based on 8051 microcontroller.	

Course code	R5EL2008T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	ANALOG INTEGRATED CIRCUITS						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Analyze differential amplifier circuits and describe basic OP-AMP configuration and characteristics
2. Design linear and nonlinear circuits using OP-AMPS.
3. Design active filters and waveform generators using OP-AMPS.
4. Describe the operation of various voltage regulators

Module	Content	Hrs
1	**Basics of OPAMP** Analysis of differential amplifiers, Basic OPAMP configuration, Ideal OPAMP circuit characteristics and analysis. Feedback in OPAMP circuits, IC741 study	5
2	**Linear applications of OPAMP** Amplifiers, Current to Voltage converters, Voltage to Current converters, Difference amplifier, Instrumentation amplifiers, Summing and scaling amplifiers, Integrator, Differentiator	6
3	**Non Linear Circuit Applications** Voltage Comparators, Comparator applications, Schmitt triggers, Precision rectifiers (Half wave & Full wave), Peak detectors, Sample & Hold circuits, Clippers and clampers using OPAMP, Log - Antilog amplifiers, PLL (IC565), Analog MUX and DEMUX	7
4	**Active Filters** Classification, Transfer Function, First order Butterworth filters, Standard second order response, KRC filters (Low pass, High pass, Band pass filters, band stop filters, notch filters), Multiple feedback filters, State variable and Biquad filters	6
5	**Waveform Generation using OPAMP and Special ICs (IC-555, IC XR2206)** Sine wave generation using OPAMP, Multivibrators using OPAMPs, Timer IC 555 in detail with internal diagram, applications of IC 555 in monostable & astable mode. Triangular & Sawtooth waveform generator, Monolithic Waveform Generator IC XR – 2206	7
6	**Analog to Digital and Digital to Analog Convertors** Analog switches, Digital to analog conversion techniques (R-2R, Binary Weighted). Analog to Digital Conversion techniques (Dual Slope ADC, Flash type ADC, Ramp ADC, Successive Approximation ADC, Delta modulation etc)	6
7	**Voltage Regulators** Performance Specification, Linear Regulator (IC 78xx & IC 79xx, LM317), Voltage reference and its applications, Adjustable voltage regulators, switching regulators, monolithic switching regulator IC LM337, Special regulator and ICs.	5

Text Books

1. William D. Stanley, Operational Amplifiers with Linear Integrated Circuits, Pearson Education, fourth edition, 2004.
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Prentice Hall/Pearson Education, fourth edition, 2002.
3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, TATA McGraw-Hill fourth edition, 2014

Reference:

1. Millman, Microelectronics, TATA McGraw-Hill fourth edition

Course code	R5EL2008L	**Semester**	IV	**Credits**	1	Scheme	0L:0T:2P
Course	ANALOG INTEGRATED CIRCUITS LAB						**Category**: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Analyze and design various linear, non-linear applications of OPAMP using IC741, IC311.
2. Design first-order active filters using OPAMPS.
3. Design and construct waveform generator using OPAMP, timer IC 555, XR -2206.
4. Design a regulator using IC 78/79xx, LM337.
5. Design PLL using IC565

Sr.No.	**Topics**	
1	**Linear applications of OPAMP:** Design inverting and non-inverting amplifier using IC 751, Calculation of OPAMP bandwidth in inverting and non-inverting configuration mode, design of summing and difference amplifiers with gain	
2	**Differentiator and Integrator Circuits** Design of integrator and differentiator, for specific cutoff frequencies and find out the range in which circuit will act as differentiator and integrator.	
3	**Non-Linear Operational amplifier circuits** Voltage comparators, Schmitt triggers, window detectors using IC 311, Precision rectifiers, Peak detectors, sample and hold circuit.	
4	**Active Filters**: First order active filters, second order low pass and high pass butterworth KRC filters, standard second order band pass and bandstop filters.	
5	**Waveform Generators** Sine wave generation using IC 741 (Oscillators), Multivibrators using OPAMP and timer IC555, triangular waveform generation using OPAMP, Monolithic waveform generator IC XR-2206.	
6	**Nonlinear Amplifiers and PLL** Log, antilog amplifiers, Phase Lock Loop using IC565	
7	**Voltage Regulators** Regulator design using IC 78/79xx, IC723 low voltage and high voltage designs, switching regulators.	
8	**ADC and DAC** Dual slope ADC, staircase RAMP type ADC, flash type ADC, successive approximation ADC, R-2R DAC, weighted resistor DAC	

Course code	R5EL2009T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	DIGITAL COMMUNICATION						Category: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Understand and explain digital communication system
2. Explain and analyse baseband modulation and demodulation techniques
3. Explain and analyse passband modulation and demodulation techniques
4. Analyse channel coding techniques
5. 5. Explain spread spectrum techniques

Module	Content	Hrs
1	**Introduction:** Elements Of Digital Communication Systems: Model of digital communication systems ,digital representation of analog signal ,Sampling theorem ,Introduction to base band sampling, Quantization Noise ,Non Uniform Quantization and compandin	6
2	**Pulse Modulation and Waveform Coding Techniques:** Pulse Code Modulation (PCM), Bandwidth of PCM ,Differential PCM, Delta Modulation (DM), Adaptive Delta Modulation (ADM), ADPCM, Comparison of PCM and DM Line Coding and its Properties: NRZ and RZ Types, Signalling Format for Unipolar, Polar, Bipolar and Manchester Coding, Digital Multiplexing**.**	10
3	**Information theory and Error control coding:** information, entropy and redundancy ,Shannon fano coding, source coding, Huffman coding ,Variable length coding, Error control codes: Linear block codes: matrix description of linear block code. Error detection and error correction capabilities of linear block code. Cyclic codes: Encoding and decoding, Convolution codes: encoding and decoding.	10
4	**Digital Modulation and Demodulation Techniques:** Types of Digital Modulation and demodulation, Waveforms for Amplitude, Frequency and Phase Shift Keying ,Method of Generation and Detection of Coherent and non-coherent Binary ASK, FSK and PSK, Differential Phase Shift Keying (DPSK), Quadrature Modulation Techniques: Quadrature Amplitude Modulation (QAM) and Quadrature Phase Shift Keying (QPSK), Minimum Shift Keying (MSK) – Generation and detection.	10
5	**Spread Spectrum Techniques** Use of Spread Spectrum, Direct Sequence Spread Spectrum DSSS ,Multiplexing ,Code division Multiple Access ,Ranging using DSSS, Frequency Hopping ,Frequency Hopping Spread Spectrum, PN – Sequences: Generation, PN Sequences Characteristics	6

Text Books

1. Digital Communications fundamentals and applications 2 nd edition, 2009 by Bernard Sklar, Pabitra Kumar Ray. Pearson
2. Digital Communication System, 2014 by Simon Haykin. Wiley

Reference:

1. Digital Communications 4th edition 2001 by John G. Proakis. Mc Graw Hill
2. Principles of Digital communication, 2008 by Robert G Gallager. Cambridge

3. Digital Communication 3rd edition 2004 by John R Barry Edward A. Lee David G. Messerschmitt. Springer.

Course code	R5EL2009L	**Semester**	-	**Credits**	1	Scheme	0L:0T:2P
Course	DIGITAL COMMUNICATION LAB						**Category**: PCC

Course Outcomes:

After the completion of course, the student should be able to

1. Simulate & validate the various functional modules of a communication system.
2. Demonstrate their knowledge in bandpass modulation schemes.
3. Apply various channel coding schemes.
4. Demonstrate their ability to improve the noise performance of the communication system.

Sr.No.	**Topics**	
1	Signal Sampling and reconstruction	
2	Pulse Code Modulation and Demodulation	
3	Delta Modulation and Demodulation	
4	Line coding schemes	
5	Simulation of ASK generation and detection scheme	
6	Simulation of FSK generation and detection scheme	
7	Simulation of BPSK generation and detection scheme	
8	Simulation of Linear Block and Cyclic error control coding scheme	
9	Generation of PN sequence.	

Course code	R5CH2402T	Semester	IV	Credits	1	Scheme	2L:0T:0P
Course	ENVIRONMENTAL SCIENCES						Category: VEC

Course Outcomes:

After the completion of course, the student should be able to

1. Imply the basic knowledge of environmental protection, sustainable development and improvement.
2. Categorize and scrutinize impact of human development on natural resources and its conservation.
3. Interpret the impact of environmental problems on socio economic growth.
4. Apply different Science and Technology (S&T) based sustainability solutions and technological improvement, and methods for the remediation of degraded environment.
5. Familiarize with the legislation, management and protocols existing for environmental protection.

Course Content

Module	Description	Hrs.
1	**Significance of Environment Science:** Definition, basic principles and scope of environment science. Need for awareness Industrialization & Urbanization; Basic Ecological Concepts Ecosystems, nature of environmental threats, Current environmental problems, Importance of clean air	8
2	**Natural Resources Management and Sustainability** Concept of Ecosystem, Conservation of ecosystem: Natural Resources, Renewable and Non-renewable Resources, Natural resources and challenges with the conservation. Forest resources, Water resources, Energy resources. Role of an individual in conservation of natural resources. Impact of energy use on Environment. Energy conservation and sustainability	8
3	**Environment & Society** Urbanization and environment, social movements, Community participation, JFM, participation by NGOs Impact of energy use on Environment, energy production on environment change, nuclear explosion, impact of dam construction, Energy conservation and sustainability	6
4	**Green Technologies** Role of advancements in science and technology in developing environment friendly technologies 3 R's for Green Technology, Green technology towards sustainable future, Reduction of ecological footprint, Concept of Sustainability and Green Chemistry as a tool for sustainable development.	6
5	**Environmental Legislation, Management & Policies** Aims And Objectives of EnvironmentalImpact Assessment (EIA), Environmental Management Plan (EMP) , Indian forest act, The water act(prevention and control of water pollution), The Air act (prevention & control of air pollution) ***International efforts for environmental protection and contribution of India for same, National Action Plan on Climate Change*** ***Role of Ministry of Environment, forest and climate***	

	Mitigation measures for climate change, international protocols, Montreal protocol, Kyoto protocol, Carbon credits and carbon trading	

Reference Books:

1. De., Environmental Chemistry, 6th Edition, New Age International.
2. Erach Bharucha, Text Book of Environmental Studies for Undergraduate Courses, Universities Press, Second Edition (UGC Recommended)
3. P.K.Goel, Water Pollution, Causes, Effects and Control, New Age International
4. Dr. JagdishKrishnaswamy and Dr. R. J. Ranjit Daniels, Environmental Studies, Wiley India Private Limited, New Delhi, First Edition, 2009.

Recommended Reading:

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad,
2. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., Environmental Encyclopedia, Jaico Publ. House, Mumbai, 2000
3. Jadhav, H &Bhosale, V.M., Environmental Protection and Laws. Himalaya Pub. House, Delhi, 1995
4. Wanger K.D., Environmental Management. W.B. Saunders Co. Philadelphia, USA, 1998
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)

Exit Courses

Course code	R5EL2903L	**Semester**	-	**Credits**	3	Scheme	2L:0T:2P
Course	ELECTRONIC ENGINEERING PRACTICE						**Category**: EC

Course Outcomes:

After the completion of course, the student should be able to

1. Implement digital circuits in a high level descriptive language
2. Program Arduino and Raspberry Pi boards and implement mini projects
3. Design and implement and program 8/16 bit microcontroller and microprocessor systems

Module	**Content**	**Hrs.**
1	**Introduction to HDL** Design and implement in Verilog- digital circuits like Arithmetic / Logic Unit and simple sequential circuits	14 [Theory]
2	**Introduction to Open source hardware** Introduction to Arduino uno, programming Arduino boards, Block diagram of Raspberry Pi boards, programming of Raspberry Pi boards, Hardware interface for Arduino and Raspberry Pi- shields / daughter boards	14 [Theory]
	For Lab	
	Mini Project Design, fabricate, implement and test an 8 bit microcontroller or microprocessor based system.	

Text Book:

1. John F. Wakerley, Digital Design Principles and Practices, fourth edition, Pearson Education India, 2008
2. Kenneth Ayala, The 8051 Microcontroller & Embedded Systems Using Assembly and C, Cengage Learning, first edition, 2010
3. Massimo Banzi, Getting Started with Arduino: The Open Source, Shroff Publishers & Distributors Pvt Ltd, first edition, July 2014

Course code	R5EL2904L	Semester		Credits	3	Scheme	2L:0T:2P
Course	ELECTRONIC INSTRUMENTATION						Category: EC

Course Outcomes:

After the completion of course, the student should be able to

1. Identify various types of electronic instruments suitable for specific measurement.
2. Describe the working principle, selection criteria and applications of various electronic meters.
3. Understand construction, working principle and types of signal generators and oscilloscopes.

Module	Content	Hrs.
1	**Introduction to HDL** Design and implement in Verilog- digital circuits like Arithmetic / Logic Unit and simple sequential circuits	14 [Theory]
2	**Introduction to Open source hardware** Introduction to Arduino uno, programming Arduino boards, Block diagram of Raspberry Pi boards, programming of Raspberry Pi boards, Hardware interface for Arduino and Raspberry Pi- shields / daughter boards	14 [Theory]

For LAB

Sr. No.	Topic	
1	Measurement of AC & DC Voltages, AC & DC currents	
2	Extension of Ammeter range.	
3	Extension of Voltmeter range.	
4	To study construction ,working and troubleshooting of Function Generator	
5	To study construction, working and troubleshooting of Digital Oscilloscope.	

Text Book:

1. Electronic Instrumentation by Kalsi H S, Tata McGraw Hill, New Delhi, 4th Ed 2010.
2. Electrical and Electronics Measurements and Instrumentation, by Sawhney A K,Dhanpat Rai and Sons, New Delhi,2010.

Additional Reading:

1. Measurement systems: application & design, E. A. Doebelin, Mc Graw Hill, Publisher: McGraw-Hill Higher Education; 5 edition.

MDM course content - EC

Multi-disciplinary Minor –I (Sem. III)

MINOR FROM ELECTRONICS (**Specialization theme -IOT**)

COURSE OUTCOMES:

After the completion of the course, Students will be able to

1. Describe various diode-based circuits
2. BJT transistor circuits for their DC and AC characteristics.
3. Describe FET and MOSFET circuits and their DC and AC characteristics.
4. Describe the Op-Amp circuits and their DC and AC characteristics along with their application.

MDM-I: Basics of Electronic Circuits

COURSE CONTENTS		**Hrs**
1	**Diode Circuits:** Review of Semiconductor Materials and Properties, The PN Junction, Introduction to Semiconductor Diode Theory. Design of Rectifier Circuits, Half Wave Rectification, Full Wave Rectification, Clipper and Clamper Circuits, Photodiode, Light–Emitting Diode, Zener Diode	**7**
2.	**BJT (No small signal analysis)** Basic Bipolar Junction Transistor, Operation, Current-Voltage Characteristics, Modes of Operation, Applications – Switch, Amplifier: CE, CB and CC.	**7**
3	**FET and MOSFET (No small signal analysis)** Junction Field–Effect Transistor, MOS Field–Effect Transistor, MOSFET, Applications: Switch and Amplifier: CS, CG and CD	**7**
4	**Differential Amplifier and Op-Amp (No small signal analysis)** Differential Amplifier, Op-Amp: Inverting and Non-Inverting Amplifier, Adder, Subtractor, Differentiator, Integrator	**7**

Text Books:

1. Robert L. Boylestad, Electronic Devices and Circuit Theory, 11e. Taiwan, Pearson Education India.
2. Donald A. Naeman, Electronic Circuit Analysis and Design, Second Edition, McGraw Hill International Edition 2001.

References:

1. Donald Schilling and Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International Edition, 1989
2. Adel Sedra and Kenneth Smith, Microelectronic Circuits, Fifth edition, Oxford University Press, 2004.

Multi-disciplinary Minor –I (Sem. III)

MINOR FROM ELECTRONICS (specialization theme - **Signal and Image Processing**)

COURSE OUTCOMES:

After the completion of the course, Students will be able to:

1. Describe basic concepts of linear systems and how they interact with discrete time signals.
2. Analyze DT signals and systems using Z-domain descriptions.
3. Realize DT systems using various approaches
4. Analyze DT systems in the frequency domain

MDM-I: Signals and Systems

COURSE CONTENTS		**Hrs**
1	**Introduction to signals & Systems (CT and DT domain)** Definition of Signal, Signal classification, Signal manipulations, Concept of a system, System representations & classification, Concept of Impulse Response, Convolution in CT and DT domain	**6**
2.	**Z Transform** Definition & properties of Two-sided & one-sided Z Transform, Region of Convergence (ROC), Relationship with Fourier and Laplace Transform, & mapping, Inverse Z Transform	**8**
3	**DT Systems Realization** Difference equation, FIR & IIR systems, System transfer function, System realization: Direct forms, Cascade & parallel forms, Linear and circular Convolution, BIBO stability.	**6**
4	**Frequency Domain Analysis of DT Systems** Pole-zero diagram, Frequency domain analysis using Analytical & graphical techniques, System classification based on pass-band as low pass, high pass, Bandpass & band reject, System classification based on phase response as Minimum phase, maximum phase, mixed phase, or linear phase systems,	**8**

Text Books:

1. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, 2nd edition, 2004.
2. A Nagoor Kani, Signals and Systems, Tata McGraw Hill, 2nd Edition,2010.
3. B.P. Lathi, Principles of Linear Systems and Signals, Oxford University Press, India, 2nd edition, 2010.

References:

1. Michael J Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill, Indian Economy edition, 2009.

Multi-disciplinary Minor –II (Sem. IV)

MINOR FROM ELECTRONICS (**Specialization theme -IOT**)

COURSE OUTCOMES:

After the completion of the course, Students will be able to

1. Describe the fundamental concepts of digital electronics.
2. Numerically analyze various logic circuits and perform Boolean reduction
3. Design various combinational circuits as per different specifications.
4. Design various sequential circuits as per different specifications.

MDM-II: Digital Electronics

COURSE CONTENTS		**Hrs**
1	**Introduction to Digital Electronics:** Number systems, Binary arithmetic, Logic gates: OR, NOT, AND, NOR, NAND, XOR, XNOR gate; Truth tables	**6**
2.	**Logic Circuits** Boolean Algebra, theorems, SOP and POS minimization, Karnaugh Maps minimization	**6**
3	**Combinational Logic Design** Introduction to combinational circuit: Realization of basic combinational functions like comparison, code-conversion, decoding, multiplexing, de-multiplexing, addition, and subtraction.	**8**
4	**Sequential Logic systems** Basic sequential circuits- latches and flip-flops: Latches, SR flip-flop, JK flip-flop, M-S flip-flop, D flip-flop,T flip-flop	**8**

Text Books:

1. John F. Wakerley, Digital Design Principles and Practices, fourth edition, Pearson Education India, 2008.
2. Stephen Brown & ZvonkoVranesic, Fundamentals of Digital logic with VHDL design, third edition, McGraw Hill edition, 2014.

References:

1. G K Kharate, Digital Electronics, Oxford University Press 2015.

Multi-disciplinary Minor –II (Sem. IV)

MINOR FROM ELECTRONICS (**Specialization theme - Signal and Image Processing**)

COURSE OUTCOMES:

After the completion of the course, Students will be able to:

1. Design linear phase systems to meet the desired specifications.
2. Compute DFT using FFT algorithms.
3. Design FIR filters to meet the given specifications.
4. Design IIR filters to meet the given specifications.

MDM-II: Digital Signal Processing

COURSE CONTENTS		**Hrs**
1	**Linear Phase FIR Systems** Need for linear phase, concept of phase delay & group delay, Condition for Linear Phase, Magnitude & phase response for Four types of Linear Phase systems, Location of zeros.	**6**
2.	**Discrete Fourier Transform and Fast Fourier Transform** DFT and its Properties, Relation between DFT and Z-Transform, FFT: Decimation in Time (DIT) and Decimation in Frequency (DIF), 8-point DFT using Radix-2 DIT FFT and Radix-2 DIF FFT, Computation of Inverse DFT using FFT.	**8**
3	**FIR Filter Design** Design of FIR filters by windowing technique: (Gibb's phenomenon, Use of different windows: Rectangular, Triangular, Hamming, Hanning, Kaiser), Design of FIR filters using Frequency sampling techniques,	**7**
4	**IIR filters** The design process Methodology, Different types of analog approximations: Butterworth, Chebyshev, inverse Chebyshev, elliptical, Bessel, etc., Spectral transformations, Conversion techniques like bilinear transformation, impulse invariance,	**7**

Text Books:

1. J. G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall of India.
2. A. Nagoor Kani, Digital Signal Processing, McGraw-Hill Education Second edition 2013

Reference:

1. Oppenheim and Schafer with Buck, Discrete-Time Signal Processing, Prentice Hall of India
2. Ashok Ambardar, Analog and Digital Signal Processing, Thomson Learning