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 and Telecommunication Engineering

Implemented from the batch admitted in Academic Year 2023-2024

[NEP 2020 Based Syllabus]

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(109)

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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 and Telecommunication Engineering Graduates will have ability to

1. Deliver fundamental as well advanced knowledge with research initiatives in the field of Electronics and Communication Engineering with emphasis on state of the art technology.
2. Design solutions for electronic systems for real-world applications which are technically feasible and economically viable leading to societal benefits.
3. Demonstrate leadership qualities and professional attitudes to deal with challenges.

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

Credit Framework for Multidisciplinary UG Programme in Electronics & Telecommunication 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	R5MA2009T	Mathematics for Electronics Engineers	3	0	0	3	3	20	30	50	Mathematics
2	PCC	R5ET2001T	Electronic Devices and Circuits	3	0	0	3	3	20	30	50	EXTC
3	PCC	R5ET2002T	Electrical Network Theory	3	0	0	3	3	20	30	50	EXTC
4	PCC	R5ET2003T	Digital Logic Design	3	0	0	3	3	20	30	50	EXTC
5	PCC	R5ET2004T	Analog Communication Systems	3	0	0	3	3	20	30	50	EXTC
6	MDM	R5XX22XXT	Multi-disciplinary Minor-I	2	0	0	2	2	20	30	50	Respective Department
7	VSEC	R5ET2005L	Python Programming Lab	0	0	2	2	1	ISCE:60		40	EXTC
8	VSEC	R5ET2001L	Electronic Devices and Circuits Lab	0	0	2	2	1	ISCE:60		40	EXTC
9	PCC	R5ET2003L	Digital Logic Design Lab	0	0	2	2	1	ISCE:60		40	EXTC
10	PCC	R5ET2004L	Analog Communication Systems Lab	0	0	2	2	1	ISCE: 60		40	EXTC
11	VEC	R5HS2401O	Universal Human Values	2	0	0	2	2	ISCE: 60		40	Humanities
12												
			Total	19	0	8	27	**23**				

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

Credit Framework for Multidisciplinary UG Programme in Electronics & Telecommunication Engineering (Level 5.0) -Semester - IV

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %			Ownership
									TA	MST	ESE	
1	PCC	R5ET2006T	Signals & Systems	3	0	0	3	3	20	30	50	EXTC
2	PCC	R5ET2007T	Microprocessor & Microcontroller	3	0	0	3	3	20	30	50	EXTC
3	PCC	R5ET2008T	Digital Communication Systems	3	0	0	3	3	20	30	50	EXTC
4	PCC	R5ET2009T	Linear Integrated Circuits	3	0	0	3	3	20	30	50	EXTC
5	MDM	R5XX22XXT	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	R5ET2007L	Microprocessor & Microcontroller Lab	0	0	2	2	1	ISCE:60		40	EXTC
8	PCC	R5ET2008L	Digital Communication Systems Lab	0	0	2	2	1	ISCE:60		40	EXTC
9	PCC	R5ET2009L	Linear Integrated Circuits Lab	0	0	2	2	1	ISCE:60		40	EXTC
10	**AEC**		Modern Indian language	2	0	0	2	2	ISCE:60		40	Humanities
11	CEP/FP	R5ET2601P	Comm. Engg. Project / Field Project	0	0	4	4	2	ISCE:60		40	EXTC
			Total	18	0	10	28	23				

MDM Courses offered by Electronics & Telecommunication Engineering

Sr. No.	Course code	Name of MDM	Name of the MDM Course	Semester
1	R5ET2201T	Cyber Security	Fundamentals of Cybersecurity	III
2	R5ET2202T	Electronics & Communication	Basics of Electronic Circuits	III
3	R5ET2203T	Cyber Security	Modern Cryptography	IV
4	R5ET2204T	Electronics & Communication	Digital Electronics	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. Students have to complete these courses 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 same will be issued by the Institute.

List of Exit Courses after completion of Semester III and IV: E&TC Engineering

Sr.	Course Type	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
									TA	MST	ESE
1	EC	R5ET2901I	Internship (6-8 weeks)					6	ISCE:60		40
2	EC	R5ET2902P	Project / Mini-Project	0	0	12	12	6	ISCE:60		40
3	EC	R5ET2903L	Electronic Engineering Practice	2	0	0	2	2	ISCE:60		40
4	EC	R5ET2904L	Electronic Instrumentation	2	0	0	2	2	ISCE:60		40
5	EC	R5ET2905T	Basics of Telecom Network Management	2	0	0	2	2	20	30	50
6	EC	R5ET2906L	Basics of Telecom Network Management Lab	0	0	2	2	1	ISCE:60		40
			Total								

S. Y. B. Tech. Electronics and Telecommunication Engineering

Course code	R5MA2009T	**Semester**	III	**Credits**	3	Scheme	3L:0T:0P
Course	MATHEMATICS FOR ELECTRONICS ENGINEERS						

Course Outcomes:

After the completion of the 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	R5ET2001T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	ELECTRONIC DEVICES AND CIRCUITS						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 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	5
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 configuration: single- stage MOSFET amplifiers, Basic JFET Amplifiers.	6
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.	5
5	**Multistage Amplifiers** 1. The Darlington Amplifier 2. Cascade amplifier 3. Cascode amplifier 4. RC coupled amplifier	4
6	**Power Amplifiers** 1. Power Amplifiers, Power Transistors - Power BJTs, Power MOSFETS, Heat Sinks 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.	5
7	**Feedback and Oscillators**	6

	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.	

Text Book:

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

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	R5ET2001L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	ELECTRONIC DEVICES AND CIRCUITS LAB						Category: VSEC

Course Outcomes:

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

1. Analyse and design wave shaping circuits.
2. Understand 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 DEVICES AND CIRCUITS LAB

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

Course code	R5ET2002T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	ELECTRICAL NETWORK THEORY						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. Synthesize electrical networks using different approaches..

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	**Electrical Network synthesis** 1. The concept of complex frequency –driving point and transfer functions 2. Restriction of poles and zeros in the driving point and transfer function. 3. Time domain behavior from the pole—zero plot. 4. Foster I,II 5. Cauer I-II forms	8

Text Book:

1. M. E. Van Valkenburg, Network Analysis, Prentice Hall of India, third edition. 2006.
2. 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	R5ET2003T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	DIGITAL LOGIC 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. Analyze and design A/D and D/A converter.

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 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; 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	**A/D and D/A Converters** Analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs. Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, Specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit	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. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
2. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
3. G K Kharate , Digital Electronics, Oxford University Press 2015.

Course code	R5ET2003L	Semester	III	Credits	1	Scheme	0L:0T:2P
Course	DIGITAL LOGIC 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.	
12	Analyze and Design A/D and D/A converter	

Course code	R5ET2004T	Semester	III	Credits	3	Scheme	3L:0T:0P
Course	ANALOG COMMUNICATION SYSTEM						Category: PCC

Course Outcomes:

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

1. Understand basic analog communication processes.
2. Understand 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 Superheterodyne 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 Book:

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

Reference:

1. **“**Modern Digital And Analog Communication Systems”, B.P. Lathi, Oxford, 4th Edition, 2011.
2. “Principles of Communication Systems”, Herbert Taub and Donald Schilling, Tata McGraw-Hill, 3rd edition
3. **“**Electronic Communication Systems”, Wayne Tomasi, Pearson Education, 5th Edition,2008

Course code	R5ET2004L	Semester	IV	Credits	1	Scheme	0L:0T:2P
Course	ANALOG COMMUNICATION SYSTEM LAB						Category: PCC

Course Outcomes:

After the completion of 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	R5ET2005L	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	
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	

Text Book:

1. Core Python Programming, 2nd Edition, Nageswara Rao, Dreamtech Press. New Delhi, 2018.

2. E Balagurusamy, Introduction to computing and problem solving using python, McGraw Hill Education.

Reference:

1. Martin Brown, Python, The complete Reference, Indian Edition, Tata McGraw Hill, ISBN: 9789387572942, 9387572943.

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	
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	R5ET2006T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	SIGNALS AND SYSTEMS						Category: PCC

Course Outcomes:

After the completion of the 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 the 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. Oppenheim, Alan S. Willsky and S. Hamid Nawab, Signals and Systems, Prentice-Hall of India, 2nd edition, 2002

Course code	R5ET2007T	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 program	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.	7

	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	

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	R5ET2007L	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	R5ET2008T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	DIGITAL COMMUNICATION SYSTEMS						Category: PCC

Course Outcomes:

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

1. Describe basic components of Digital Communication Systems.
2. Understand different error detecting and error correction codes .
3. Understand and analyse baseband modulation and demodulation techniques.
4. Understand and analyse passband modulation and demodulation techniques.
5. Define spread spectrum and its types.

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, Waveform coding techniques: PCM Generation and Reconstruction ,Quantization Noise ,Non Uniform Quantization and companding,, Differential PCM system (DPCM) Adaptive DPCM, Delta modulation, its draw backs, adaptive delta modulation, noise in PCM and DM systems.	10
2	**Baseband modulation and demodulation** Synchronization, Bit synchronization, scramblers, frame synchronization, Additive white Gaussian noise (AWGN) , Intersymbol interference ,Baseband pulse Transmission: introduction, matched filter ,Probability of error of matched filter, optimum filter, Coherent detection of signal to noise ratio ,Correlation receiver.	9
3	**PPassband Modulation and demodulation Techniques:** Digital modulation techniques: introduction ,coherent and non coherent detection, power spectra of coherent BPSK,BFSK ,and QPSK, generation detection of M-array PSK,M-array QAM, generation and detection of Minimum shift keying ,Non coherent BFSK,DPSK,DEPSK	8
4	**Channel Coding** The channel, Received signal power and noise power, Link Budget analysis, Noise figure, Noise temperature and system temperature, Sample link analysis Satellite repeaters, Waveform coding, Types of error control, Error detecting and correcting capability, Standard array, Interleaving and concatenated codes	9
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 Book:

1. Bernard Sklar, Pabitra Kumar Ray; “Digital Communications fundamentals and applications”, Pearson,2nd edition,2009.
2. Simon Haykin.,” Digital Communication System”, Wiley,4th edition, 2014.

Reference:

1. John G. Proakis, “Digital Communications”, Mc Graw Hill, 4th edition 2001.
2. Robert G Gallager, “Principles of Digital communication”, Cambridge,2008.
3. John R Barry, Edward A. Lee ,David G. Messevschmitt, “Digital Communication”, Springer, 3rd edition 2004

Course code	R5ET2008L	Semester	IV	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 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 pulse shaping and matched filter	
6	Simulation of FSK ,ASK 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	R5ET2009T	Semester	IV	Credits	3	Scheme	3L:0T:0P
Course	LINEAR 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 OPAMP configuration and characteristics
2. Design linear and nonlinear circuits using OPAMPS.
3. Design active filters and waveform generators using OPAMPS. Describe the operation of various voltage regulators

Module	Content	Hrs
1	**Fundamentals for OPAMP** Analysis of differential amplifiers using current mirror circuits with active loads. Basic OPAMP configuration, Ideal OPAMP circuit characteristics, and analysis. Feedback in OPAMP circuits, IC741 study	6
2	**Linear applications of OPAMP** Amplifiers, Current to Voltage converters, Voltage to Current converters, Difference amplifier, Instrumentation amplifiers, Summing and scaling amplifiers, Integrator, Differentiator	7
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	7
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	8
6	**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.	7

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	R5ET2009L	Semester	IV	Credits	1	Scheme	0L:0T:2P
Course	LINEAR 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.	

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	R5ET2903L	**Semester**	III	**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 [Th]
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 [Th]
	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	R5ET2904L	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 [Th]
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 [Th]

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 .

Course code	R5ET2905T	Semester		Credits	2	Scheme	2L:0T:0P

Course	BASICS OF TELECOM NETWORK MANAGEMENT	Category:EC

Course Outcomes:

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

1. Describe the concept of Network Management Planning.
2. Verify TNM Standards and Fundamentals of Network Management Functions.
3. Expertise in Telecommunication management network (TMN) architecture.
4. Understand the concept of Internet Network Management framework

Module	Content	Hrs.
1	**Network Management Planning** NetworkManagement definition , Network Management objectives,Network Management project development flow,resources in Network Management project	7
2	**Network Management Functions** Network management standards, network management model, organization model, information model abstract syntax notation 1 (ASN.1), functional model. Network management application functional requirements: Configuration management, fault management, performance management, security management, accounting management,	7
3	**Telecommunication management network (TMN) architecture** Terminology, functional architecture, information architecture, physical architecture, TNN cube, TMN architecture.	7
4	**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	7
5	**Internet Network Management framework** SNMP architecture, SMI information model,standards MIBs,SNMP operations, SNMP Security.	7

Text Book:

1. Network Management: Principles and Practice, 2000 by Mani Subramanian. Addison Wesley
2. Fundamentals of Telecommunication Network Management 1999 by Lakshmi Raman. IEEE Communication Society, Prentice Hall of India Edition
3. Telecommunication Network Management: Technologies and Implementations 1997 by Airdarous Salah, Plevyak Thomas. Prentice Hall of India
4. Advances in Network Management:2009 by Jianguo Ding. CRC Taylor and Francis

Additional Reading:

1. Telecommunication Network Management 1999 by Haojin Wang. TMH.
2. Advances in Network Management: 2009 by Jianguo Ding. CRC Taylor and Francis

Course code	R5ET2906L	Semester		Credits	1	Scheme	0L:0T:2P
Course	BASICS OF TELECOM NETWORK MANAGEMENT LAB						Category: EC

Course Outcomes:

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

1. Understand the concept of Network Management Planning.
2. Improve performance of network systems.
3. Expertise in security management for telecom networks.
4. Understand the concept of Internet Network Management framework

Sr. No.	Topic	
1	**Study of Network Management Planning** Development flow of network planning ,resources in Network Management project.	
2	**Study of a foundation for Network Management** Remote operation of equipment, Collection of information which helps faults to be dealt with proactively before a complete failure. Easier interworking of equipment from different manufacturers,	
3	**Study of performance of changes in motion in Communication Networks.** a)Traffic flow theories b) Definition of performance measures.	
4	**Study the security challenges in Telecom Network Management** a) Threats to Telecom Networks b) Essential security measurement techniques for Telecom Network.	
5	**Study of performance in Simple Network Management Protocol (SNMP)** a)Get request b) Set request c) Get next request d) Get bulk request e) Response f) Trap g) Inform Request	

MDM course content - EXTC

Multi-disciplinary Minor –I (Sem. III)

MINOR FROM E & TC (**Specialization theme - Electronics & Communication**)

COURSE OUTCOMES:
After the completion of the course, Students will be able to
1. Describe various diode-based circuits
2. Describe BJT transistor circuits for their DC and AC characteristics.
3. Describe FET and MOSFET circuits for their DC and AC characteristics.
4. Describe Op-Amp circuits for their DC and AC characteristics

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	**8**
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 Book:

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

Reference:

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

MDM course content -
Multi-disciplinary Minor –I (Sem. III)
MINOR From Electronics & Telecommunication (**Specialization theme -Cybersecurity**)

Course code	R5ET2201T	**Semester**	III	**Credits**	2	Scheme	2L:0T:0P
Course	Fundamentals of Cybersecurity						Category: MDM

Course Outcomes:

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

1. Understand cyber-attacks and learn about data privacy issues and preventive measures.
2. Achieve a fair and sound understanding of the concepts of the Cyber Crime Law.
3. Understand the basic concept of number theory for cybersecurity.
4. Demonstrate Encryption and Decryption methods using various Traditional Symmetric-Key Ciphers techniques.

COURSE CONTENTS		**Hrs**
1	**Introduction to Cybersecurity:** Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability, Security services and mechanisms, web attacks: Browser attacks, web attacks, Email attacks. OSI security architecture, cryptography, Viruses, Trojans Horses and Worms	**7**
2.	**Cyber Crimes and Information Technology Act, 2000:** **Cyber Crimes:** Meaning of Cyber Crimes, Different Kinds of Cyber-crimes **Information Technology Act, 2000:** Aims and Objects, Overview of the Act, Jurisdiction, Electronic Governance, Legal Recognition of Electronic Records and Electronic Evidence, Digital Signature Certificates.	**6**
3	**Introduction to Number Theory:** Divisibility and Division Algorithm, Euclidean Algorithm, Modular Arithmetic, prime numbers, Euler's phi function, Fermat's and Euler's Theorems, Chinese Remainder theorem.	**7**
4	**Traditional Symmetric-Key Ciphers:** Kerckhoff's Principle, Cryptanalysis, Categories of Traditional Ciphers **Substitution Ciphers**: Monoalphabetic Ciphers, Polyalphabetic Ciphers **Transposition Ciphers**: Keyless Transposition Ciphers, Keyed Transposition Ciphers, Combining Two Approaches, Stream and block ciphers, One-time pad, Playfair techniques, Hill cipher	**8**

Text Books:

- Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Third Edition, Mc Graw Hill Education,2010.
- William Stallings "Cryptography and Network Security Principles and Practice", Eighth Edition, Person Education, 2020.

References:

- Vakul Sharma and Seema Sharma, "Information Technology Law and Practice", 6th Edition, LexisNexis publishers,2019.
- Sarhan M. Musa, "Network Security and Cryptography",2nd Edition, Mercury Learning and Information, 2018.

Multi-disciplinary Minor –II (Sem. IV)

MINOR FROM E & TC (**Specialization theme - Electronics & Communication**)

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 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	**8**

Text Books

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

Reference:

- G K Kharate, Digital Electronics, Oxford University Press 2015

MDM course content

Multi-disciplinary Minor –II (Sem. IV)

MINOR From Electronics & Telecommunication (**Specialization theme -Cybersecurity**)

Course code	R5ET2203T	**Semester**	IV	**Credits**	2	Scheme	2L:0T:0P
Course	Modern Cryptography						Category: MDM

Course Outcomes:

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

1. Demonstrate Encryption and Decryption methods using various Symmetric-key Cipher like DES and AES.
2. Understand and implement various public key cryptosystems like RSA.
3. Implement standards for integrity and authentication.
4. Understand the concept of digital signatures and key management.

	COURSE CONTENTS	**Hrs**
1	**Introduction to Modern Symmetric-key Cipher:** Block cipher Design Principles, Block cipher modes, Data Encryption Standards, DES example, strength of DES, AES structure, AES transformation function, AES key expansion, AES example	**8**
2.	**Asymmetric key Ciphers:** Public key cryptography: Principles of a public key cryptosystem, RSA algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve cryptography.	**6**
3	**Integrity, Authentication Algorithm:** Message Integrity, Hash functions: SHA, Message Authentication functions, Security of MAC, MAC based on Hash function: HMAC, MAC based on Block Ciphers: DAA and CMAC	**6**
4	**Digital Signature and Key Management:** Digital certificate and Digital signature: Need for digital certificate, X.509 digital certificate and structure, Digital signature Standards, attacks on Digital signature, Principles of Digital Signature, Digital signature algorithm, Key Management: Symmetric key distribution and public key distribution, Kerberos.	**8**

Text Books:

- Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, Third Edition, Mc Graw Hill Education,2010.
- William Stallings “Cryptography and Network Security Principles and Practice”, Eighth Edition, Person Education, 2020.

References:

- Bruce Schneier, “Applied Cryptography, Protocols, algorithms and Source code in C”, 20th-anniversary Edition, Wiley, 2017.
- Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone,” Handbook of Applied Cryptography”, Fifth Edition, CRC Press, 2001