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 2018-19

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In

109 Electronics and Telecommunication Engineering

Institute Vision

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

Institute Mision

- **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.**

PROGRAM 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 the leadership qualities and professional attitudes to deal with challenges.

PROGRAM OUTCOMES (POs)

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 modelling 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.

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.

B. Tech. (Electronics and Telecommunication Engineering)
Scheme

S Y B. Tech (Electronics and Telecommunication Engineering), SEMESTER III								
Scheme of Instruction				Scheme of Evaluation				
S. No.	**Course Code**	**Course Title**	**L-T-P (Hours/week)**	**Credits**	**TA**	**MST**	**ESE**	**ESE hours**
1.	R4MA2003S	Mathematics for Electrical Engineers - I	3-0-0=3	3	20	20	60	3
2.	R4ET2001S	Signals and Systems	3-0-0=3	3	20	20	60	3
3.	R4ET2002S	Network Analysis and Synthesis	3-0-0=3	3	20	20	60	3
4.	R4ET2003T	Electronics Circuit Analysis and Design	3-0-0=3	3	20	20	60	3
	R4ET2003P	Electronics Circuit Analysis and Design Lab	0-0-2=2	1	60	-	40	2
5.	R4ET2004T	Analog Communication	3-0-0=3	3	20	20	60	3
	R4ET2004P	Analog Communication Circuits Lab	0-0-2=2	1	60	-	40	2
6.	R4ET2005T	Digital Logic Design	2-0-0=2	2	20	20	60	3
	R4ET2005P	Digital Logic Design Lab	0-0-2=2	1	60	-	40	2
7.	R4ET2006A	Information Technology Acts	1-0-2=3	MNC	60	-	40	2
		Total	26	20				

S Y B. Tech (Electronics and Telecommunication Engineering), SEMESTER IV								
Scheme of Instruction				Scheme of Evaluation				
S. No.	**Course Code**	**Course Title**	**L-T-P (Hours/week)**	**Credits**	**TA**	**MST**	**ESE**	**ESE hours**
1.	R4MA2013S	Mathematics for Electrical Engineers – II	3-0-0=3	3	20	20	60	3
2.	R4ET2011S	Numerical Techniques	3-0-0=3	3	20	20	60	3
3.	R4ET2012T	Principles of Digital Communication	3-0-0=3	3	20	20	60	3
	R4ET2012P	Principles of Digital Communication Lab	0-0-2=2	1	60	-	40	2
4.	R4ET2013T	Integrated Circuits and Applications	2-0-0=2	2	20	20	60	3
	R4ET2013P	Integrated Circuits and Applications Lab	0-0-2=2	1	60	-	40	2
5.	R4ET2014T	Microprocessor and Microcontroller	3-0-0=3	3	20	20	60	3
	R4ET2014P	Microprocessor and Microcontroller Lab	0-0-2=2	1	60	-	40	2
6.	R4ET2015T	Python Programming	3-0-0=3	3	20	20	60	3
	R4ET2015P	Python Programming Lab	0-0-2=2	1	60	-	40	2
7.		Environmental Studies	1-0-1=2	MNC	60	-	40	2
		Total	27	**21**				

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4MA2003S
Course Title	MATHEMATICS FOR ELECTRICAL ENGINEERS – I

COURSE OUTCOMES

After completion of this course, students should be able to

- Compute and characterise behaviour of complex variables
- Compute the Laplace transform of various functions
- Analyse and solve differential equation using Laplace transforms
- Evaluate the Fourier components of various functions

COURSE CONTENTS

Module I	Complex Variables I
	1.1 Function of Complex variable. Analytic function, Necessary and sufficient conditions for f(Z) to be analytic. Cauchy-Riemann equations in polar coordinates. 1.2 Milne-Thomson method to determine analytic function f(Z) when its real or imaginary part or its combination is given. 1.3 Harmonic function, orthogonal trajectories. Transformations 1.4 Conformal mapping and standard transformations such as Rotation, Magnification and inversion. 1.5 Bilinear Transformation and Mapping under bilinear Transformation with geometrical interpretation. Cross ratio and fixed points.
Module II	**Complex Variables II**
	2.1 Line integral of a function of Complex variable, Properties of line integral Cauchy's theorem for analytic function. Cauchy's Goursat theorem (without proof), Cauchy's integral formula and deductions. 2.2 Series of Complex Term: Taylor's and Laurent's Series (without proof), Singularities and poles, Residues, Residue Theorem and its evaluation. 2.3 Application of Residue to evaluate real Function.
Module III	**Laplace Transforms I**
	3.1 Functions of bounded variation 3.2 Linear property of Laplace transforms. 3.3 Laplace transforms of standard functions such as; *1, t^n, e^{at}, sinat, cosat, sinhat, erf(t)* 3.4 Change of scale property ,First shifting theorem, Second shifting theorem $L\{t^n f(t)\}, L\{f'(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\left\{\frac{d^n}{dt^n} f(t)\right\}$
Module IV	**Laplace Transform II**
	4.1 Inverse Laplace transform using linear property, theorems, partial fractions and convolution theorem.

	4.2 Unit step functions, Heaviside, Dirac delta functions, Periodic functions and their Laplace transforms. 4.3 Application to solve ordinary differential equations with one dependent variable.
Module V	**Fourier Series**
	Orthogonal, Orthonormal sets, Expressions of a Function in Series of Orthogonal Functions. 1.2. Dirchlet's conditions. 1.3. Fourier series of periodic function with period 2π, $2l$. 1.4. Dirchlet's theorem, even and odd functions. 1.5. Half range expansions, Parseval's relations. 1.6. Complex form of Fourier series. 1.7. Fourier integral and Fourier transform.
Text Books:	
1.	Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Ltd, 10^{th} edition, 2015
2.	Complex Variables & Applications: James Brown and Ruel Churchill, McGraw Hill, 8^{th} Edition, 2017.
Reference Books:	
1.	T Veerrajan ,Engineering Mathematics, McGraw Hill India, 2002
2.	B S Grewal, Higher Engineering Mathematics, Khanna Publications, 39th Edition, 2005
3.	Jain & Iyengar, Advanced Engineering Mathematics, Narosa Publication, 2^{nd} Edition

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – III
Course Code	R4ET2001S
Course Title	SIGNALS AND SYSTEMS

COURSE OUTCOMES

After completion of this course, students should be able to

- Understand basic concepts of linear systems and how they interact with continuous-time and discrete time signals.
- Analyse CT and DT signals and systems using Laplace and Z-domain descriptions
- Represent and interpret signals in Fourier domain
- Analyse continuous-time and discrete time signals and systems in time domain.

COURSE CONTENTS

Module I	**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
Module II	**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
Module III	**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
Module IV	**Fourier Series & Fourier Transform (CTFS, CTFT, DTFS & DTFT)**
	Introduction, properties and uses, amplitude & phase spectra, Energy Spectral Density, Power Spectral Density
Module V	**Introduction to CT Systems**
	System Transfer function & Impulse response, Differential Equations
Module VI	**Introduction to DT Systems**
	Difference equation, FIR & IIR systems, System transfer function, System realization: Direct forms, Cascade & parallel forms, Linear and circular Convolution, BIBO stability.
Module VII	**Time Domain Analysis of DT Systems**
	System Transfer function & Impulse response, Difference equation, Solution of a difference equation, zero input & zero state response calculations
Text Books:	
1.	Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley and Sons, 2nd edition, 2004
2.	B.P. Lathi, Principles of Linear Systems and Signals, Oxford University

	Press, India, 2nd edition, 2010.
Reference Books:	
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

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4ET2002S
Course Title	NETWORK ANALYSIS AND SYNTHESIS

COURSE OUTCOMES

After completion of this course, students should be able to

1. Students will be able to analyze circuit system and calculate the circuit parameters using direct application of networks theorems.
2. Students will be able to explain the characteristics of the capacitor, inductor and transformer circuit elements and their behavior variations with alternating currents.
3. Students will be able to perform Network synthesis which will help them to design circuits with desired properties.
4. Students will be able to interpret analytical circuit results to properly assign power, current and voltage values to circuit graphical representations.

COURSE CONTENTS

Module I	**Circuit Concept and Network Equations**
	Introduction, Charge and Energy, the Capacitance Parameter, Inductance Parameter, Resistance parameter, Kirchhoff's laws, Source transformation, loop variable analysis, Node variable analysis. Super position theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Tellegen's theorem and Maximum Power Transform Theorem
Module II	**Signal Representation and Graph Theory**
	Impulse, step, pulse, ramp and exponential functions S-Domain analysis of circuits - review of Laplace transform - transformation of a circuit into S domain, node analysis and mesh analysis of the transformed circuit - nodal admittance matrix, mutually coupled circuits – RC circuit as integrator and differentiator - transient analysis of RC, and LC networks with Impulse, step, pulse, ramp and exponential inputs – step response of a RLC network, Application of Laplace transform. Introductory concepts of graph theory, cut-set, tie-set and matrix representations
Module III	**Network Functions**
	The concept of complex frequency –driving point and transfer functions-Impulse response-Poles and Zeros of network functions, their locations and effects on the time and frequency domain responses. Restriction of poles and zeros in the driving point and transfer function. Time domain behavior from the pole—zero plot.
Module IV	**Two -port Network and Synthesis**
	Parameters of two-port network – impedance, admittance, transmission and hybrid – Conversion formulae. Analysis of interconnected two port networks-parallel, series and cascade connections of 2 port networks - Characteristic impedance and propagation constant. Attenuators -propagation constant, types of attenuators-T and Bridged T - compensated attenuators. Foster I,II and Caur I-II forms
Text Books:	
1.	Introduction to Modern Network Synthesis, Van Valkenberg M.E., Wiley Eastern
2.	William H Hayt, Jack E Kemmerly and Steven M Durbin, Engineering

	Circuit Analysis, McGraw Hill International, sixth edition, 2002.
Reference Books:	
1.	Artice M Davis, Linear Circuit Analysis, Thomson Asia Pvt. Ltd., Singapore, first edition, 2001
2.	M. E. Van Valkenburg, Network Analysis, Prentice Hall of India, third edition. 2006
3.	Raymond A DeCarlo and Pen-Min Lin, Linear Circuit Analysis, Oxford University Press, second edition, 2001.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4ET2003T
Course Title	ELECTRONIC CIRCUITS ANALYSIS AND DESIGN

COURSE OBJECTIVES

1. To introduce semiconductor devices and their properties.
2. To understand the behavior of semiconductor devices under the application of DC and AC signals.
3. To study various Electronic circuits comprising of Diodes & Transistors such as Amplifiers.
4. To introduce MOS Technology and related circuits.

COURSE OUTCOMES

1. Students shall be able to understand the electrical behavior of semiconductor devices along with their static & dynamic characteristics.
2. Students shall be able to design small electronic circuits to meet desired specifications.
3. Student shall be able to analyze and design amplifier circuits as per requirements.
4. Student shall be aware regarding the MOS technology and circuits

COURSE CONTENTS

Module I	**Semiconductor Materials and Diodes**
	The PN Junction, Diode Circuits: DC Analysis and Models, AC Equivalent Circuits, Zener Diode, Temperature Effects,. Design of Rectifier Circuits, Half Wave Rectification, Full Wave Rectification, Filter, Ripple Voltage and Diode Current, Voltage Doubler Circuit, Zener Diode Circuits, Clipper and Clamper Circuits, Multiple–Diode Circuits
Module II	**Bipolar Junction Transistor**
	Basics, Transistor Structures, NPN and PNP Transistor : Forward–active Mode Operation, Current–Voltage Characteristics, Non ideal Transistor Leakage Currents and Breakdown, DC Analysis of Transistor Circuits, Common–Emitter Circuits, Load Line and Modes Of Operation, Common Bipolar Circuits: DC Analysis, Basic Transistor Applications – Switch, Amplifier, Bipolar Transistor Biasing – Single Base Resistor Biasing, Voltage Divider Biasing and Bias Stability, Integrated Circuit Biasing, Multistage Circuits. Op-Amp Application
Module III	**Bipolar Junction Transistor Amplifiers**
	Analog Signals and Linear Amplifiers, The Bipolar Linear Amplifier, Graphical Analysis and AC Equivalent Circuit, Small Signal Hybrid Equivalent Circuit, Hybrid –Equivalent Circuit Including the Early Effect, Expanded Hybrid Equivalent Circuit, Other Small Signal Parameters And Equivalent Circuits, Basic Transistor Amplifier Configurations, Common Emitter Amplifiers, AC Load Line Analysis, Common Collector Emitter Follower Amplifier, Common Base Amplifier, Three Basic Amplifier configurations, Multistage Amplifiers, Power Considerations, Thermal Considerations in Transistor Amplifiers, Design of amplifier and classes
Module IV	**Field Effect Transistor**
	Junction Field–Effect Transistor, The Three Basic Configurations: CS-CC Cascade, MOS Field–Effect Transistor, MOSFET DC Circuit Analysis, Basic MOSFET Applications: Switch, Digital Logic Gate and Amplifier. Temperature effects in MOSFETs, Input Protection in MOSFET, The Power FET (VMOS). The MOSFET Amplifier, Basic Transistor Amplifier Configurations, the Common Source Amplifier, The Source Follower

	Amplifier, The Common Gate Configuration.
Module V	**Feedback and Oscillators**
	Basic concepts of feedback, Types of feedback and its effect on bandwidth, input impedance, output impedance and gain. Oscillators , Types of oscillators: RC Phase shift, LC Oscillators, Piezoelectric Oscillators
Text Books:	
1.	Donald A. Neamen, Electronic Circuit Analysis and Design, Second edition, McGraw Hill International edition, 2006
2.	Martin Roden , Gordon Carpenter, William Wieserman, Electronic Design, Fourth edition, Shroff Publishers, 2002
Reference Book:	
1.	David Bell, Electronic Devices and Circuits, Oxford University Press, 5th Edition, 2008
2.	Donald Schilling & Charles Belove, Electronic Circuits Discrete and Integrated, Third edition, McGraw Hill International edition, 1989

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – III
Course Code	R4ET2003P
Course Title	ELECTRONIC CIRCUITS ANALYSIS AND DESIGN LAB

COURSE OBJECTIVES

1. To develop student ability to apply basic engineering sciences to understand the operation & analysis of electronic circuits using diodes, bipolar junction transistors and field effect transistors.

2. To provide analog electronic circuit design techniques using diodes, bipolar junction transistors and field effect transistors, and to develop analytical skills.

COURSE OUTCOMES

1. Students will be able to design electronic circuits to meet desired specifications.

2. Students will be able to analyze and design electronic circuits such as wave shaping circuits, multistage amplifiers, and power amplifiers.

3. Students will be able to explain basic analog electronic circuit design techniques using diodes, bipolar junction transistors and field effect transistors.

LIST OF EXPERIMENTS

Sr.	Experiments
1	Forward and reverse characteristics of PN junction diode.
2	Forward and reverse characteristics of Zener diode.
3	Zener diode as voltage regulator.
4	Static and dynamic characteristics of BJT
5	BJT bias circuits – Design, assemble and test.
6	JFET bias circuits – Design, assemble and test.
7	Design, assemble and test of BJT common-emitter circuit – D.C and A.C performance: Voltage gain, input impedance and output impedance with bypassed and un-bypassed emitter resistor.
8	Design, assemble and test of BJT emitter-follower – D.C and A.C performance: A.C. voltage gain, input impedance and output impedance.
9	Design, assemble and Test of JFET/MOSFET common-source and common-drain amplifiers – D.C and A.C performance: Voltage gain, input impedance and output impedance.
10	Frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4ET2004T
Course Title	ANALOG COMMUNICATION

COURSE OBJECTIVES

1. To introduce the students to the basic concepts of communication system.
2. To introduce various Modulation Techniques and their significance.
3. To study radio transmitters and receivers which in turn are used as the building blocks of the larger and more complex communication systems.
4. To understand ways to improve spectral efficiency.

COURSE OUTCOMES

1. The students will be able to explain basic analog communication process
2. The students will be able to explain and solve problems on modulation
3. The students will be able to analyse and interpret pulse analog technices
4. The students will be able to explain and differentiate different radio wave propagation methods

COURSE CONTENTS

Module I	**Introduction**
	Elements of a communication system, modulation and demodulation, Noise in Communication systems, Signal-to-Noise ratio, Noise factor and Noise Figure, Equivalent Noise Temperature
Module II	**Amplitude Modulation**
	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.
Module III	**Angle Modulation**
	Frequency modulation, Phase modulation, Effect of noise, FM modulators, Transmitters, FM detectors, Receiver circuits.
Module IV	**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
Module V	**Radio Wave Propagation**
	Electromagnetic waves, Properties of radio waves, Propagation of waves, Propagation terms and definitions
Text Books:	
1.	Electronic Communication Systems, Wayne Tomasi ,Pearson Education, 4th Edition
2.	Roy Blake, Electronic Communication Systems, Thomson Asia Pte. Ltd., Singapore, 2nd edition.
Reference Books	
1.	Modern Digital And Analog Communication Systems: Fourth Edition by B.P. Lathi
2.	Herbert Taub and Donald Schilling, Principles of Communication Systems, Tata McGraw-Hill, 3rd edition.

Programme Name	**B. Tech. (EXTC Engineering), SEMESTER - III**
Course Code	**R4ET2004P**
Course Title	**ANALOG COMMUNICATION LAB**

COURSE OBJECTIVES

1. The main objective of this course is to understand and implement the basic analog circuits.
2. To implement modulation and demodulation circuits and analyze the signals.

COURSE OUTCOMES

1. Student will be able to implement of generation of various types of signals
2. Students will be able to generate and demodulate various modulations scheme.
3. Students will be able to learn practical methods of how real communication takes place in communication systems.

LIST OF EXPERIMENTS

Sr.	Experiments
1	RF Amplifier Characteristics
2	Simple method of generation and detection of AM.
3	Simple method of generation and detection of FM.
4	Study of AM super heterodyne receiver. Study of generation and detection of PM
5	Study of generation and detection of SSP, ,
6	Simple method of generation and detection of PAM, PPM and PWM.
7	Radio Receiver Characteristics

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4ET2005T
Course Title	DIGITAL LOGIC DESIGN

COURSE OUTCOMES

After completion of this course, students should be able to

- Represent data in various number systems and perform inter conversions.
- Analyse the behaviour of various logic circuits and logic families.
- Design various combinational circuits as per different specifications.
- Numerically analyse various logic circuits and perform Boolean reduction
- Explain principles of sequential circuits and their applications

COURSE CONTENTS

Module I	**Introduction**
	Analog vs Digital systems, digital devices, integrated circuits, programmable logic devices, digital design levels, software aspects of digital design
Module II	**Number System**
	Positional number systems, Binary and Hexadecimal number systems, general positional number systems conversions, arithmetic operations, representation of negative numbers, arithmetic operations on signed numbers, binary and gray codes, character codes, codes for detecting and correcting errors.
Module III	**Logic Circuits**
	Logic signals and gates, Boolean Algebra, theorems, combinational circuit analysis, combinational circuit synthesis – minimization, Karnaugh Maps, sum of products and product of sums expressions and their minimization, programmed minimization methods – Quine-Mc-Cluskey minimization algorithm, timing hazards – static and dynamic hazards, introduction to VHDL hardware description language.
Module IV	**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.
Module V	**Combinational Logic Design**
	Introduction to Combinational and Sequential Circuits: Introduction to combinational circuit: Realization of basic combinational functions like comparison, code conversion, decoding, multiplexing, de-multiplexing, addition, subtraction. Delays and hazards in combinational circuits.

Module VI	**Sequential Logic Principles**
	Bi-stable elements, Latches and flip–flops, S-R latch, D latch, Edge triggered D flip–flop, Master/slave flip–flops, T flip–flop.
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.
Reference Books:	
1.	Moris & Miller (Eds), Designing with TTL Integrated Circuits: Prepared by Staff of Texas Instruments, McGraw Hill International edition, 1981
2.	G K Kharate , Digital Electronics, Oxford University Press 2015

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - III
Course Code	R4ET2005P
Course Title	DIGITAL LOGIC DESIGN LAB

COURSE OUTCOMES

After completion of this course, students should be able to

- Design and implement combinational circuits using gates.
- Design combinational circuits using ICs
- Implement simple combinational circuits in VHDL

LIST OF EXPERIMENTS

Sr	Experiments
1	Realization of Logic Gates using discrete components and ICs.
2	Design of combinational logic circuits (Half Adder, Full Adder, Half Subtractor, Full Subtractor) using fundamental and Universal Logic gates
3	Design of Multiplexer, De-multiplexer
4	Design of Encoder and Decoder circuits
5	Design of Code Converters
6	VHDL for Combinational logic.
7	Study of various parameters of logical families and comparative study of TTL and CMOS.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – III
Course Code	R4ET2006A
Course Title	Information Technology Act

COURSE OUTCOMES

After completion of the course, students should be able to

- Describe cyber laws in general
- Describe the various facets of cyber crimes
- Solve problems arising out of e-commerce transactions
- Interpret Intellectual Property issues in the cyber space and the growth and development of the IT Act
- Differentiate the regulation of cyber space at national and international level

COURSE CONTENTS

Module 1	**Concept of Information Technology and Cyber Space**
	Interface of Technology and Law, Jurisdiction in Cyber Space and Jurisdiction in traditional sense, Internet Jurisdiction, Indian Context of Jurisdiction, Enforcement agencies, International position of Internet Jurisdiction, -Cases in Cyber Jurisdiction
Module 2	**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, Securing Electronic records and secure digital signatures, Duties of Subscribers, Role of Certifying Authorities, Regulators under the Act, The Cyber Regulations Appellate Tribunal, Internet Service Providers and their Liability, Powers of Police under the Act, Impact of the Act on other Laws
Module 3	**E-Commerce**
	UNCITRAL Model, Legal aspects of E-Commerce, Digital Signatures, Technical and Legal issues, E-Commerce, Trends and Prospects, E-taxation, E-banking, online publishing and online credit card payment, Employment Contracts, Contractor Agreements, Sales, Re-Seller and Distributor Agreements, Non-Disclosure Agreements, Shrink Wrap Contract, Source Code, Escrow Agreements etc.
Module 4	**Cyber Law and IPRs**
	Understanding Copy Right in Information Technology, Software, Copyrights vs Patents debate, Authorship and Assignment Issues, Copyright in Internet, Multimedia and Copyright issues, Software Piracy, Patents, Understanding Patents, European Position on Computer related Patents, Legal position of U.S. on Computer related Patents, Indian Position on Computer related Patents, Trademarks, Trademarks in Internet, Domain name registration, Domain Name Disputes & WIPO, Databases in Information Technology, Protection of databases, Position in USA, EU and India
Module 5	**Cyber Crimes**

	Meaning of Cyber Crimes, Different Kinds of Cyber-crimes, Cyber-crimes under IPC, Cr.P.C and Indian Evidence Law, Cyber-crimes under the Information Technology Act-2000, Cyber-crimes under International Law, Hacking, Cyber Stalking, Denial of service Attack, Virus Dissemination, Software Piracy, Internet Relay Chat (IRC) Crime, Credit Card Fraud, Net Extortion, Phishing etc, Cyber Terrorism, Violation of Privacy on Internet, Data Protection and Privacy
TEXT BOOKS:	
1.	Kamlesh N. and Murali D.Tiwari (Ed), IT and Indian Legal System, Macmillan India Ltd, New Delhi,2002
Additional Reading:	
1.	K. L. James, The Internet: A User's Guide, Prentice Hall of India, New Delhi, 2003
2.	Chris Reed, Internet Law-Text and Materials, Universal Law Publishing Co., 2nd Edition, 2005,
3.	Vakul Sharma, Hand book of Cyber Laws, Macmillan India Ltd, New Delhi
4.	S.V.Joga Rao, Computer Contract & IT Laws (in 2 Volumes), Prolific Law Publications, New Delhi, 2005

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - IV
Course Code	R4MA2013S
Course Title	MATHEMATICS FOR ELECTRICAL ENGINEERS – II

COURSE OUTCOMES

After completion of this course, students should be able to

- Perform operations on matrices including transformation and reduce to canonical form.
- Solve problems on vectors using different theorems.
- Understand Bessel function and solve problems on Legendre polynomials.
- Apply properties of Z transform and its inverse to solve engineering problems.
- Explain and solve basic problems of probability and random variables

COURSE CONTENTS

Module I	**Matrices**
	1.1 Eigen values Eigen vectors of square matrix. 1.2 Cayley Hamilton's theorem and function of square matrix. 1.3 Similarity Matrices, Modal Matrix 1.4 Function of Square a Matrix, Minimal Polynomial and Minimal Equation of a Matrix, Derogatory and Non-Derogatory Matrices. 1.5 Quadratic forms : Linear Transformation , Linear Transformation of Quadratic forms , Congruence of a square Matrix 1.6 Reduction to Canonical form under Congruent and Orthogonal Transformation of Quadratic form, rank, index, signature and class value of Quadratic form.
Module II	**Vector Calculus and Analysis**
	2.1 Scalar and vector point functions, Directional derivative, Curl and Divergence, Conservative, Irrotational and Solenoid field. 2.2 Line integral, Green's theorem for plane regions and Properties of Line integral. 2.3 Stoke's theorem, Gauss's divergence theorem (without proof) related identities and deductions.
Module III	**Bessel Functions**
	3.1 Bessel's Equation**,** Solutions of Bessel's function**,** Bessel's Function of Jn(x). 3.2 Recurrence formula Jn(x), Equation Reducible to Bessel's equation 3.3 Orthogonality of Bessel's functions, A Generating function for Jn(x), 3.4 Trigonometric Expansion involving Bessel's functions, 3.5 Bessel's Integral, Legendre's Equation, Legendre's Polynomial, General solution of Legendre's Equation, Rodrigue's Formula, A Generating function of Legendre polynomial, Orthogonality of Legendre polynomial.
Module IV	**Z Transform**
	4.1 Z-Transform, Properties of z-transform, Theorem, change of Scale, Shifting property. 4.2 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 4.3 Convolution, Convolution property of Casual Sequence, Inverse of Z-transform by Division, By Binomial Expansion and partial fraction,
Module V	**Probability Theory**
	5.1 Review of introduction to probability, concept of random variable, probability density function, cumulative distribution function 5.2 Moments, characteristic functions, Two random variables: Bi-variate distribution, functions of random variables 5.3 Joint moments, Joint Characteristic functions, Conditional distribution
Text Books:	
1.	Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Ltd, 10^{th} edition, 2015
2.	B. V. Ramana, Higher Engineering Mathematics, McGraw Hill India, 1^{st} edition, 2006
Reference Books:	
1.	T. Veerarrajan, Engineering Mathematics, Tata McGraw-Hill, 2^{nd} Edition
2.	Srimanta Pal & Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 1^{st} edition, 2015

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	R4ET2011S
Course Title	NUMERICAL TECHNIQUES

COURSE OUTCOMES

After completion of this course, students should be able to

- Perform an error analysis for a given numerical method.
- Solve linear algebraic equations
- Solve numerical on curve fitting problems
- Perform numerical integration and differentiation

Course Contents

Module I	**Errors in Numerical Computation**
	Error types, analysis and estimation. Error propagation.
Module II	Systems of Linear Algebraic Equations
	Bracketing Methods – The Bisection method, The False position method. Open Methods – The Newton-Raphson method, The Secant method. Gauss-Elimination method – Technique, pitfalls, improvement. Gauss-Jordan method. LU decomposition and matrix inversion. Gauss-Seidel method. (all the methods with relevant engineering applications)
Module III	**Curve Fitting**
	Interpolation – Newton's divided difference, Lagrange Interpolating polynomials. Approximation - Least square approximation technique, linear regression, and polynomial regression. (relevant engineering applications)
Module IV	**Numerical Differentiation and Integration**
	Methods based on interpolation and finite differences. (relevant engineering applications) The Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.
Text Books:	
1.	Seven C Chopra, Raymond C Canale, Numerical Methods for engineers, fourth edition, Tata McGraw Hill, 2002
2.	Robert J Schillig, Sandra L Harris, Applied numerical Methods for Engineers First Edition Thomson AsiaPvt. Ltd., 2002

Programme Name	**B. Tech. (Electronics & Telecommunication Engineering), SEMESTER - IV**
Course Code	R4ET2012T
Course Title	**PRINCIPLES OF DIGITAL COMMUNICATION**

COURSE OUTCOMES

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

1. Describe random variables and characterize them by distribution and density functions
2. Compute the amount of information, entropy and information rate, and use various coding schemes.
3. Use various error control coding techniques
4. Compare various modulation techniques on the basis of power spectra and bandwidth efficiency.

COURSE CONTENTS

Module I	Introduction
	Review of probability theory, communication examples, Random variables, probability distribution function, probability density function, joint cumulative distribution and probability density, marginal pdfs from joint pdfs, Average value and variance of a random, variable, error function, conditional expectations, moment generating functions, functions of random variables, properties of moments
Module II	**Information Theory**
	Discrete messages, the concept of amount of Information, Entropy, Information rate, coding to increase average Information per bit – Huffman coding, Shannon's Theorem, Channel capacity, Capacity of a Gaussian channel, Bandwidth – S/N trade-off, Differential entropy and mutual information for continuous random ensembles, Information and implementation of capacity law, Information capacity of colored noisy channel, Rate distortion Theory
Module III	**Base band shaping for data transmission**
	Baseband systems, Messages, characters and symbols, Formatting analog information, Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers, Data formats and their spectra, Source of corruption, Discrete PAM signals (Line Coding), Power spectra of discrete PAM signals, Inter symbol Interference, Nyquist's criteria for distortion less base band, Binary transmission, Base band M-ary PAM systems
Module IV	**Digital Modulation Techniques**
	Digital Modulation formats, coherent binary modulation Techniques, Coherent quadrature modulation Techniques, Non coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-Ary modulation, Power spectra, Bandwidth efficiency, Applications of Digital modulation Techniques.
TEXT BOOKS	
1	Symon Haykin - Digital Communication John Wiley and Sons 5TH EDITION
2	Taub and Schilling - Principles of Communication Systems - Tata Mc Graw Hill 4th Edition.
Reference	
1	Bernad Sklar, Digital Communications, Pearson Education.3rd edition

Programme Name	**B. Tech. (EXTC Engineering), SEMESTER – IV**
Course Code	**R4ET2012P**
Course Title	**Principles of Digital Communication LAB**

COURSE OUTCOMES

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

1. Implement shift keying techniques for digital communication
1. Implement PCM systems with uniform and non-uniform quantization
2. Generate digitally modulated signals and perform their detection in the presence of noise.

Sr.	Experiments
1	Verification of sampling theorem
2	Generation and Detection of B-ASK & its spectral analysis
3	Generation and detection using communication circuits B-FSK & its spectral analysis. B-PSK & its spectral analysis. Q-PSK & its spectral analysis
4	Study of PCM with uniform and non-uniform quantization
5	Spectral analysis of line codes
6	Detection of digital baseband signal in the presence of noise

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	R4ET2013T
Course Title	INTEGARATED CIRCUITS AND APPLICATIONS

COURSE OBJECTIVES

- To introduce the basic building blocks, theory and applications of linear integrated circuits.
- To develop ability among students for problem formulation, system design and solving skills.
- This subject introduces the theoretical & circuit aspects of Op-amp, which is the backbone for the basics of linear integrated circuits.

COURSE OUTCOMES

- Students will be able to elucidate and design the linear and non-linear applications of op-amp.
- Students will be able to explain and compare the working of multi-vibrators using IC 555 and general purpose Op-amp.
- Students will be able to illustrate the function ICs as Voltage regulators, PLL and its application in communication.
- Students will be able to design and analyze analog to digital conversion circuits using ICs

COURSE CONTENTS

Module I	**Operational Amplifier Fundamentals**
	Basic Op Amp Configurations, Ideal Op Amp Circuits Analysis, Negative Feedback, Feedback in Op Amp Circuits. Properties of ideal and practical Op Amp, Virtual ground concept, Comparator
Module II	**Circuits with Resistive Feedback**
	Current-to-Voltage Converters, Voltage-to-Currents Converters, Current Amplifiers, Difference Amplifier, Instrumentation Amplifier (Three Op-amp and IC AMP-01), Instrumentation Applications, Flying capacitor techniques (LTC 1043), Active Guard drive, Current Input Instrumentation Amplifier.
Module III	**Active Filters and nonlinear circuits**
	The Transfer function, First-Order Active Filters, Audio Filter Applications, Standard Second- Order Responses, KRC Filters, Multiple-Feedback Filters, State-Variable and Biquad Filters, Sensitivity, Filter approximations, generalized impedance converters, direct design, Switched capacitor filters. Voltage Comparators, Comparator Applications, Schmitt Triggers, Precision Rectifier(half wave and full wave), Analog Switches, Peak Detectors, Sample and-Hold Amplifiers.
Module IV	**Waveform Generators**
	Sine Wave Generators using Op-Amps, Multi vibrators using Op-Amps, Monolithic Timer - NE555 with applications, Triangular Wave Generator using Op-Amps, Saw tooth Wave Generator using Op-Amps, Monolithic Waveform Generator – XR-2206, V-F and F-V Converters
Module V	**Voltage References and Regulators**
	Performance Specifications, Voltage References, Voltage-Reference Applications, Linear Regulators, IC 723 low voltage, high voltage and high current designs, three terminal Linear Regulators and Applications, Switching Regulators, Monolithic Switching Regulators, IC LM 3525,

	μA78S40 Universal Switching Regulator.
Module VI	**D/A and A/D Converters**
	D to A Conversion Techniques, R - 2R ladder, Multiplying DAC with Applications, A to D Conversion Techniques, Dual slope ADC, Ramp ADC, Successive approximation ADC, half flash and flash ADC, Delta modulation.
Text Books:	
1.	Sergio Franco, Design with Operational Amplifiers and analog integrated circuits, Third edition, McGraw Hill International edition, 2002.
2.	James M. Fiore, Op Amps and Linear Integrated circuits, First reprint, Thomson Asia Pte. Ltd., 2001.
1.	William D. Stanley, Operational Amplifiers with Linear Integrated circuits, Pearson Education Asia, fourth edition
2.	Frank R. Dungan, Op Amps & Linear Integrated Circuits for Technicians, Delmar Publishers.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	R4ET2013P
Course Title	INTEGARATED CIRCUITS AND APPLICATIONS LAB

COURSE OUTCOMES

After completion of this course, students should be able to
Students will be able to

- Measure various electrical parameters of IC-741
- Design circuits using Op-amps for various applications
- Design circuits using IC-555 for various applications
- Design oscillators using op-amps

COURSE CONTENTS

Sr	Experiments
1	To measure different parameters of op-amp (IC 741).
2	To design and implement voltage follower, adder, summer, multiplier using op-amp.
3	To design and implement multi-vibrators (astable, monostable, bistable) using op-amp.
4	To design and implement different types of Oscillators using op-amp.
5	To implement and test instrumentation amplifier using op-amp.
6	Design and test a Schmitt trigger circuit for the given values of UTP and LTP.
7	To implement and test frequency synthesis using phase locked loop.
8	To design and implement different types of waveform generators using op-amp.
9	Design and test the following circuits using IC 555 a. Astable multivibrator for given frequency and duty cycle. b. Monostable multivibrator for given pulse width-W.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	R4ET2014T
Course Title	MICROPROCESSOR AND MICROCONTROLLER

COURSE OUTCOMES

After completion of this course, students should be able to

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

COURSE CONTENTS

Module I	**Introduction**
	Introduction to Microprocessors, Microcontrollers and Assembly Language.
Module II	**8085 Microprocessor Architecture and Memory Interfacing**
	The 8085 architecture, Instruction cycles, machine cycles and T states. Concept of wait states. Memory interfacing with timing considerations. Clock, Reset and buffering circuits.
Module III	**8085 Assembly Language Programming**
	The 8085 programming model, Instruction classification, Instruction and Data format, process of writing, assembly and execution of simple assembly language programs.
Module IV	**Programming Techniques**
	Data transfer operations, Arithmetic & Logic operations, Branch operations, Writing assembly language programs, Debugging a program. Looping, Counting and indexing, counters and timers, Code conversion, BCD arithmetic and 16 bit data operations. Software Development Systems and Assemblers. Concept of Stack and subroutines, parameter passing techniques, Re-entrant and recursive subroutines.
Module V	**Parallel I/O Data Transfer Techniques**
	Basic interfacing concepts, Interfacing input and output devices with examples, Memory mapped I/O and I/O mapped I/O. I/O data transfer classification, Programmed I/O, Interrupt driven program controlled I/O, Interrupt Requirements, Single level interrupt, Multi-level interrupt, Vectored interrupt. 8085 interrupt structure and operation. 8259A programmable interrupt controller features and operation – single and cascaded. Hardware I/O (Direct Memory Access).
Module VI	**Intel MCS 51 family**

	Introduction to Single chip microcontrollers of Intel MCS 51 family. Architectural and operational features. Instruction set. CPU timing and machine cycles. Interrupt structure and priorities. Internal Timer / counters, serial interface. Interfacing of external memory. Power saving modes.8051 variants. 89C51 devices
Text Books:	
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 Books:	
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

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	R4ET2014P
Course Title	MICROPROCESSOR AND MICROCONTROLLER LAB

COURSE OUTCOMES

After completion of this course, students should be able to

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

LIST OF EXPERIMENTS

COURSE CONTENTS

Module I	Two programs on Data transfer operations based on 8085 microprocessor
Module II	Five programs on Arithmetic & Logic operations with increasing complexity based on 8085 microprocessor
Module III	Three programs on sorting based on 8085 microprocessor.
Module IV	Three programs on I/O operations and interrupts based on 8085 microprocessor.
Module V	Three programs on Arithmetic & Logic operations with increasing complexity based on 8051 microcontroller.
Module VI	Two programs on I/O operations and interrupts based on 8051 microcontroller.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - IV
Course Code	R4ET2015T
Course Title	Python Programming

COURSE OUTCOMES

After completion of this course, students should be able to

- Explain basics concepts of Python programming
- Explain object oriented programming in Python
- Explain the different data structures and select appropriate data structure for the given application

COURSE CONTENTS

Module I	**Introduction to Python**
	Features, Byte code, execution, Python Virtual Machine, frozen binaries memory management, C vs Python,
Module II	**Data types and operators in Python**
	Comments, Docstrings, built-in-data types, sequences, sets, literals, user-defined data types , basic operators, membership operators, operator precedence and associativity, Output, input statements, command line statements, control statements
Module III	**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, function decorators, generators
Module IV	**Classes and Objects**
	Class creation, constructor, inheritance: single and multiple , super class constructors and methods, polymorphism, duck typing, operator overloading, overriding, abstract classes and interfaces
Module V	**Data structures in Python**
	Linked list (single, double) , stacks, queues, dequeues, The Stack as an ADT, Stack operations, Array representation of Stack, Link representation of Stack, The Queue as an ADT, Queue operation, Array representation of Queue, Linked representation of Queue
Text Books:	
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 Book:	
1.	Martin Brown, Python, The complete Reference, Indian Edition, Tata McGraw Hill, ISBN: 9789387572942, 9387572943.

Programme Name	B. Tech. (EXTC Engineering), SEMESTER - IV
Course Code	R4ET2015P
Course Title	Python Programming LAB

After completion of this course, students should be able to

- Write programs to implement classical numerical methods solving engineering problems in Python
- Implement object oriented programming in Python
- Implement different data structures and select appropriate data structure for the given application

LIST OF TOPICS

Sr.	TOPICS
1	Design a simulation in Python which shows how the bisection, and Newton-Raphson methods works for finding roots of an equation f(x) =0
2	Design a simulation in Python to illustrate the Newton-Raphson method of finding roots of an equation f(x) =0
3	Design a simulation to illustrate the convergence of the Secant, Gauss-Seidal method of finding roots of an equation f(x) =0
4	To simulate and determine polynomial using method of Least Square Curve Fitting
5	Creating functions, classes and objects using python. Demonstrate exception handling and inheritance
6	To implement operator overloading, overriding
7	To implement link list, stack, queues
8	To perform operations on abstract data types

Programme Name	B. Tech. (EXTC Engineering), SEMESTER – IV
Course Code	
Course Title	ENVIRONMENTAL STUDIES

COURSE OUTCOMES

After completion of this course, students should be able to

- Imply the basic knowledge of environmental protection, sustainable development and improvement.
- Categorize and scrutinize impact of human development on natural resources. Provide the student with an understanding of radioactive waste.
- Interpret the impact of environmental problems on socio economic growth and human health.
- Imply various strategies, technological improvement, and methods for sustainable management of environmental systems and for the remediation of degraded environment.
- Apply different Science and Technology (S&T) based sustainability solutions and limitations as well as to identify impact of human population on the natural environment and human health.

COURSE CONTENTS

Module I	**Significance of Environment Science:**
	Definition, basic principles and scope of environment science. Earth Man and Environment inter-relationship. Need for awareness Industrialization & Urbanization; Modern Human Life, Basic Ecological Concepts Ecosystems, nature of environmental threats Current environmental problems, Importance of clean air.
Module II	**Ecosystems and Its conservation:**
	Introduction, definition: genetic, species and ecosystem diversity. **Concept of an ecosystem**: Structure and function of an ecosystem, Producers, consumers and decomposers. **Conservation of ecosystem**: Natural Resources, Renewable and Non-renewable Resources, Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources. Role of an individual in conservation of natural resources. Biodiversity and its significance, and conservation. Global, National and effects of biodiversity.
Module III	**Fundamentals of Environmental Chemistry**
	Definition, Causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) Radioactive Waste (I) E-waste. Importance of Environmental Chemistry to access and manage environmental pollution.
Module IV	**Pollution Monitoring and Control Methods**
	Methods of controlling air pollution: Pollution controlling methods, Principle, construction, working and application of Equipment for gaseous pollutants control: Method to control water pollution: Principle, construction, working. Concept of Sustainability and Green Chemistry as a tool for sustainable development.
Module V	**Environmental Assessment, Management and Legislation:**

	Aims And Objectives Of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS) And Environmental Management Plan (EMP) Environmental Ethics: Issues And Possible Solutions: Environment Audit :Principle, Procedure And Benefits Case study can be submit by the students. ***Projects and activities by students on Current Environmental Issues in India*** *Global Environmental Issues:* Biodiversity loss ,Climate change, Ozone layer depletion, Sea level rise Global Warming ***International efforts for environmental protection and contribution of India for same, National Action Plan on Climate Change***
Text Books:	
1.	De., Environmental Chemistry, 6th Edition, New Age International.
2.	P.K.Goel, Water Pollution, Causes, Effects and Control, New Age International
3.	Erach Bharucha, Text Book of Environmental Studies for Undergraduate Courses, Universities Press, Second Edition
4.	Dr. Jagdish Krishnaswamy and Dr. R. J. Ranjit Daniels, Environmental Studies, Wiley India Private Limited, New Delhi, First Edition, 2009.
Reference Books:	
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
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