Scheme & Syllabus of UG

Engineering Program

Bachelor of Technology

(B.Tech.)

Electronics & Communication Engineering

2020-21

IPS ACADEMY

INSTITUTE OF ENGINEERING & SCIENCE, INDORE

(A UGC Autonomous Institute affiliated to RGPV)

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curriculum

Department of Electronics & Communication Engineering

Bachelor of Technology (B.Tech.) III Semester

S.No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	BSC-EC301	BSC	Numerical Methods, Probability and Discrete Mathematics	70	20	10	-	-	100	3	1	-	4
2.	PCC-EC301	PCC	Electronic Devices	70	20	10	60	40	200	2	1	2	4
3.	PCC-EC302	PCC	Digital System Design	70	20	10	60	40	200	2	1	2	4
4.	PCC-EC303	PCC	Electronic Measurement & Instrumentation	70	20	10	60	40	200	3	-	2	4
5.	PCC-EC304	PCC	Network Analysis	70	20	10	-	-	100	2	1	-	3
6.	PCC-EC305	PCC	Electronics Workshop-I (Circuit Simulation and Design)	-	-	-	60	40	100	-	-	4	2
7.	MC 3	MC	Energy and Environmental Engineering	70	20	10	-	-	100	2	-	-	0
			Total	420	120	60	240	160	1000	14	4	10	21

1 Hr Lecture	1 Hr Tutorial	2 Hr Practical
1 Credit	1 Credit	1 Credit

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BSC-EC301	**Numerical Methods, Probability & Discrete Mathematics**	**3L:1T:0P (04hrs)**	**Credits:04**

Prerequisite(s): Basic Mathematics

Course Objective: The objective of this course is to serve the potential engineers with techniques of numerical mathematics, Probability theory, Functions of complex variables, Algebraic structures, Boolean algebra and their applications. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Module 1 **(09 hrs)**

Numerical Methods: Solution of algebraic and transcendental equations- Newton Raphson method and Regula Falsi method, Solution of simultaneous linear algebraic equations by Gauss's Jordan, Crout's triangularization methods, Jacobi's method, Gauss Seidal method.

Module 2 **(10 hrs)**

Functions of Complex Variables: Analytic functions, Harmonic conjugate, Cauchy-Riemann equation, Line integral, Cauchy-Goursat theorem, Cauchy integral formula, Singular points, Poles, Residues, Cauchy residue theorem, Application of residues theorem for evaluation of real integral (Unit Circle)..

Module 3 **(08 hrs)**

Algebraic Structures: Definition, Properties, Types, Semi groups, Monoid, Groups, Abelian group, Properties of groups, Subgroup, Cyclic groups, Cosets, Factor (Quotient) group, Permutation groups, Normal subgroup, Example and standard results, Rings and Fields: definition and standard results.

Module 4 **(08 hrs)**

Boolean Algebra: Introduction, development of Boolean algebra, Boolean logical operation and truth table, Basic laws of Boolean algebra, De-Morgan's laws, Sum of product and product of sums representation.

Module 5 **(10 hrs)**

Probability Theory: Introduction of probability, Conditional probability, Total probability, Baye's theorem, Random variables and random variables properties, Probability mass function, Probability density function, Discrete distribution: Binomial and Poisson's distribution, Continuous distribution: Normal distribution and Exponential distribution.

Course Outcomes:

Students earning credits will develop ability to:

1. To explain and illustrate numerical methods for the solutions of algebraic and transcendental equations Explain single and three phase AC Circuits.
2. To explain and apply the concepts of functions of complex variables for the analysis of engineering problems.
3. To explain and apply the basic concepts of algebraic structures in engineering problems
4. To interpret and apply the concepts of Boolean algebra.
5. To interpret and apply the concepts of probability theory.

Text/ Reference Books:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd edition, Reprint 2012.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th edition, 2018.
3. N. P. Bali, Manish Goyal, A Test Book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. T. Veerarajan, Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
5. P. G. Hoel, S. C. Port, C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.
6. S. Ross, A First Course in Probability, Pearson Education India, 6th edition, 2002.
7. A. Feller, An Introduction to Probability Theory and Its Applications, Wiley, Vol. 1, 3rd edition, 1968.
8. Chandrika Prasad and Reena Garg, Advanced Engineering Mathematics, Khanna Publishing, 2018.
9. S. Chakraborthy and B. K. Sarkar, Discrete Mathematics and Its Applications, Oxford, 2010.
10. D. C. Montgomery and G. C. Runjer, Applied Statistics and Probability for Engineers, Wiley Publication, 6th edition, 2014.

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Department of Electronics & Communication Engineering

PCC-EC301	Electronic Devices	2L: 1T: 2P (05hrs)	Credits:04

Recommended Prerequisite: Engineering Mathematics, Engineering Physics

Course Objective: To acquaint the students with construction theory and characteristics of electronic devices, Analyze BJT in different types of configurations such as CC, CE, CB with their applications and limitations, To design and analyze Power Amplifiers like Class A, Class B and Class AB, To know FET, MOSFET and UJT with their construction, characteristics, To understand Feedback Amplifier, Oscillators and introduction to IC

Module 1 **(08 hrs)**

Theory of PN juction, breakdown mechanism (Rectifying Diodes, Zener Diodes), Metal Semiconductor Junction. Special diodes: Tunnel diodes, Varactor diodes, Schottky diode, Photo diodes, Photodetector, LED, solar cell, Design of voltage regulator using Zener diode. Diode circuits: Ideal and Practical diode, Clipper, Clamper. Power Supply: Rectifiers-Half wave, Full wave, Bridge rectifier, filter circuits, Voltage regulation using shunt & series regulator circuits, Voltage regulation using IC,Design of power supply

Module 2 **(08 hrs)**

Fundamentals of BJT: Construction, basic operation, current components and equations,CB, CE and CC configuration, input and output characteristics, Early effect, Region of operations: active, cut-off and saturation region. BJT as an amplifier. Ebers-Moll model, Power dissipation in transistor (Pd, max rating), Photo transistor. Transistor biasing circuits and analysis: Introduction, various biasing methods: Fixed bias, Self bias, Voltage Divider bias, Collector to base bias, Load-line analysis: DC and AC analysis, Operating Point and Bias Stabilization and Thermal Runaway. Transistor as a switch, Design of Audio amplifier.

Module 3 **(08 hrs)**

Small Signal analysis: Small signal Amplifier, Amplifier Bandwidth, Hybrid model, analysis of transistor amplifier using h-parameter, Multistage Amplifier: Cascading amplifier, Boot-strapping Technique, Darlington amplifier and cascode amplifier, Coupling methods in multistage amplifier, Low and high frequency response, Hybrid π model, Current Mirror circuits. Large Signal analysis and Power Amplifiers: Class A, Class B, Class AB, Class C, Class D, Transformer coupled and Push-Pull amplifier.

Module 4 **(08 hrs)**

FET construction- JFET: Construction, n-channel and p-channel, transfer and drain characteristics, parameters, Equivalent model and voltage gain, analysis of FET in CG, CS and CD configuration. Enhancement and Depletion MOSFET drain and transfer Characteristics. Uni-junction Transistor (UJT) and Thyristors: UJT: Principle of operation, characteristics, UJT relaxation oscillator.

Module 5 **(08 hrs)**

Feedback Amplifier and Oscillators: Concept of feedback and their types, Amplifier with negative feedback and its advantages. Feedback Topologies.

Oscillators: Concept of Positive feedback, Classification of Oscillators, Barkhausen criterion, Types of oscillators: RC oscillator, RC Phase Shift, Wien Bridge Oscillators. LC Oscillator: Hartley, Colpitt's, Clapp and Crystal oscillator.

Introduction to integrated circuits: Advantages and characteristic parameters of IC's, basic building components, data sheets.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

List of Experiments:

1. To study and implement V-I characteristics of Silicon Diode. (Installation and Analysis)
2. To study and implement V-I characteristics of Germanium Diode.
3. To study and implement Zener diode Voltage regulator.
4. To study and implement Half wave rectification.
5. To study and implement Full wave rectification.
6. To study and implement Capacitive rectification for half wave rectifier.
7. To study and implement Capacitive rectification for full wave rectifier.
8. To design a power supply.
9. To study and implement BJT common emitter Characteristics.
10. To study and implement BJT common base Characteristics.
11. To study and implement Analysis of BJT CE amplifier.
12. To plot the Characteristics curve of various clipper circuits.
13. To plot the Characteristics curve of various clamper circuits.

Also simulate all experiments using Tina Pro/E-Sim software.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Illustrate and Review Fundamentals of diode and to analyze different types of diodes with their characteristics and their applications such as clipper, clamper and rectifier circuits.
2. Illustrate and Analyze BJT in different types of configurations such as CC, CE, CB with their applications and limitations.
3. Illustrate and Design and analyze Power Amplifiers like Class A, Class B and Class AB.
4. Illustrate and Analyze FET, MOSFET and UJT with their construction, characteristics etc.
5. Illustrate and Analyze Feedback Amplifier, Oscillators and introduction to ICs.

Text/Reference Books:

1. Millman & Halkias, "Electronic Devices and Circuits", 4th edition, TMH. 2015
2. Salivahanan, Kumar & Vallavaraj, "Electronic Devices And Circuits", 3rd edition, TMH, 2012
3. Boylestad & Neshelsky, "Electronic Devices & Circuits", 11th edition, PHI, 2015.
4. Schilling & Belove, "Electronic Circuits, Discrete & Integrated", TMH, 2009.
5. Chattopadhyay & Rakhshit, "Electronic Fundamentals & Applications", Two colour edition, New Age, 2018
6. Adel S. Sedra & Kenneth C. Smith, "Microelectronic Circuits", 6th edition, OUP, 2015.

7. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 11th edition, PHI, 2015
8. Theodore F. Bogart, Jeffrey S. Beasley, Guillermo Rico, "Electronic Devices & Circuits", 6th edition, Pearson/Prentice Hall, 2004.
9. Allen Mottershead, "Electronic Devices & Circuits", 1st edition, Prentice Hall, 2013.

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Department of Electronics & Communication Engineering

PCC-EC302	Digital System Design	2L: 1T: 2P (05hrs)	Credits:04

Recommended Prerequisite: Engineering Physics, Electronic Devices

Course Objective: To acquire the basic knowledge of digital logic levels and application of digital electronics circuits. To impart how to design Digital Circuits. To understand the basic software tools for the design and implementation of digital circuits and systems.

Module 1 **(10 hrs)**

Review of Number Systems, Codes-BCD, Excess- 3, Gray Reflected ASCII, EBCDIC, review of Logic gates and binary operations, Implementations of Logic Functions using gates, NAND–NOR implementations. Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality, Boolean function, Canonical and standard forms, Minimization of Boolean functions, Sum of Products (SOP), Product of Sums (POS), Karnaugh map Minimization, Quine-McCluskey method of minimization.

Module 2 **(08 hrs)**

Combinational logic circuits: Adder, subtractor Carry Look Ahead adder, BCD adder, Binary Multiplier, Multiplexer/De-multiplexer, decoder/encoder, code converters, designing of combinational Circuits, Races, Hazards.

Module 3 **(08 hrs)**

Flip- Flop & its types like RS, JK, D & T, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits, Asynchronous and Synchronous counters, Registers.

Module 4 **(08 hrs)**

Logic Families and its Specifications: TTL, ECL, CMOS, Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices, PLDs, Memories ROM. Introduction to digital ICs & data sheets.

Module 5 **(06 hrs)**

Digital hardware description methodology, HDL, different modeling in VHDL, VHDL construct and codes for combinational and sequential Circuits.

Assessment: Mid Term tests, Assignments, Tutorial, Quiz and End semester exams.

List of Experiments:

1. Design and implement half Adder and half Subtractor.
2. Design and implement Multiplexer, De-multiplexer.
3. Design and implement BCD to Gray Code converters.
4. Design and implement Encoder, Decoder.
5. Design and implement a Shift Registers.
6. Design and implement a modulo-4 Asynchronous counter.
7. Design and implement a modulo-8 Synchronous counter.

8. Design and simulate full Adder and full Subtractor.
9. Design and simulate a Boolean function using multiplexer.
10. Design and simulate BCD to Excess-3 Code convertor.
11. Design and simulate a modulo-10 Asynchronous counter.
12. Design and simulate a modulo-12 Synchronous Counter.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course Outcomes:
Students earned credits will develop ability to:
1. Illustrate basic postulates of Boolean algebra. To design Boolean functions by applying the methods for simplifying Boolean expressions.
2. Illustrate fundamental concepts and design of digital combinational circuits.
3. Illustrate the basic methods for the design of sequential circuits.
4. Illustrate the operation of Logic families and analyze and design of programmable logic devices
5. Design and simulate the Logic circuits using HDL and appropriate EDA tool.

Text /Reference Books:
1. R. P. Jain, "Modern digital Electronics", 4th edition, Tata McGraw Hill, 2009.
2. W. H. Gothmann, "Digital Electronics- An introduction to theory and practice", 2nd edition, PHI, 2006.
3. D. V. Hall, "Digital Circuit and System", Tata McGraw Hill, 1989.
4. S. Salivahanan & S. Arivazhagan, "Digital Circuits and Design", Vikas Publishing.
5. M. Morris Mano, "Digital Logic and Computer Design", 1st edition, Pearson India Education, 2012.
6. Douglas Perry, "VHDL Programming by example", 1st edition, McGraw Hill, 2002.
7. J. Bhaskar, "VHDL: Primer", 3rd edition, PTR Prentice Hall, 1999.

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PCC-EC303	Electronic Measurements & Instrumentation	3L: 0T: 2P (05hrs)	Credits:04

Recommended Prerequisite: Engineering Mathematics, Engineering Physic

Course Objective: This course is electronics based course dealing with measurements and instrumentation designed for students. The objectives of this course are to introduce students to the use of various electrical/electronic instruments, their construction, applications, and principles of operation, standards and units of measurements and provide students with opportunities to develop basic skills in the design of electronic equipments.

Module 1 **(08 hrs)**

Measurement and their techniques, Static and Dynamics Characteristics of Instruments and measurement systems, Static and Dynamics Error, DC and AC Ammeter, DC Voltmeter- Chopper type and solid state, AC voltmeter using Rectifier. Average, RMS, Peak responding voltmeters, Multi-meter, Power meter, Bolometer and Calorimeter.

Module 2 **(08 hrs)**

CRO: Different parts of CRO, Block diagram, Electrostatic focusing, Electrostatic deflection, Post deflection acceleration. Screen for CRTs, Graticules, Vertical and Horizontal deflection system, Time base circuit, Oscilloscope Probes, Applications of CRO, Special purpose CROs- Multi input, Dual trace, Dual beam, Sampling, Storage (Analog and Digital) Oscilloscope, Digital display system and indicators, Classification of Displays, Display devices: Light Emitting diodes (LED) and Liquid Crystal Display (LCD), 7 Segment Display.

Module 3 **(08 hrs)**

(Transducer): Classification of Transducers, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer- Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezo-electric transducer, Optical Transducer- Photo emissive, Photo conductive, Photo voltaic, Photo-diode, Photo Transistor.

Bridges: Maxwell's bridge (Inductance and Inductance-Capacitance), Hay's bridge, Schering bridge, Wein bridge. Impedance measurement by Q meter

Module 4 **(07 hrs)**

Advantages of Digital Instrument over Analog Instrument, Digital-to-analog conversion (DAC) and Analog-to digital Conversion (ADC), Resolution and sensitivity of digital multi-meter. Signal and Function Generators, Beat Frequency Oscillator, Signal Analyzer, Vector Analyzer.

Module 5 **(07 hrs)**

Classification of biomedical instruments, Components of Medical Instrumentation System: Bio amplifier, Blood Pressure measurement, Cardiac Pacemakers, Oximeter, Basic principles of ventilators, Introduction to ECG, EEG and EMG.

Assessment: Mid-term test, Assignment, Quiz and End semester exam.

List of Experiments:

1. To perform & analysis the basic operations of Digital Multimeter.
2. To perform & analysis the basic operations of Function Generator.
3. To perform & analysis Hay's Bridge for self-inductance L.
4. To perform & analysis Wien's Bridge for unknown frequency.
5. To perform & analysis De Sauty's Bridge for unknown capacitor.
6. To perform & analysis Characteristics of NTC Thermistor.
7. To perform & analysis voltage and frequency of unknown signals using CRO.
8. To perform & analysis measurement of displacement using LVDT.
9. To perform & analysis Analog to Digital converter.
10. To perform & analysis Digital to Analog converter.
11. To perform and analyze the operation of Hartley Oscillator.
12. To perform and analyze the Wien Bridge Oscillator and effect on output frequency with variation in RC combination.

Assessment: Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

Course outcomes:

Students earning credits will develop ability to:

1. Understand dynamics characteristics of instruments and measurement systems.
2. Analyze and measure amplitude, frequency, phase and other parameter of the various test signals using oscilloscope.
3. Illustrate the physical parameter by using transducer.
4. Apply and design various operations for analog to digital and digital to analog conversions.
5. Analyze and understanding of principles & design of monitoring instruments like ECG, EEG, EMG

Text/Reference Books:

1. H.S. Kalsi, "Electronics Instrumentation", 2nd Edition, TMH, 2004.
2. A.K. Sawhney, P. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", 2nd Edition, Dhanpat Rai & Co. 2012.
3. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Edition, Prentice Hall, 1994.
4. Kularatna, N, "Modern Electronic Test and Measuring Instruments", 2nd Edition, IEE, London, 1996.
5. A. D. Helfrick and W. D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", 2nd Edition, PHI Learning Press, 2008.
6. John G. Webster, "Medical Instrumentation: Application and design", 3rd Edition, John Wiley, 2012.
7. Khandpur R.S, "Hand-book of Biomedical Instrumentation", 2nd Edition, Tata McGraw Hill, 2003.

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PCC-EC 304	Network Analysis	2L: 1T: 0P (03 hrs.)	Credits:03

Recommended Prerequisite: Engineering Mathematics, Fundamental of Electrical circuits.

Course Objective: To make the students understand the fundamental concepts and theories about networks. Apply this knowledge to solve real-world, network-centric problems. Use advanced network analysis methods and tools to visualize and analyze networks.

Module 1 **(06 hrs)**

Introduction to circuit theory: basic circuit element R, L, C and their characteristics in terms of linearity & time dependent nature, voltage & current sources, controlled & uncontrolled sources KCL and KVL analysis, nodal & mesh analysis, analysis of magnetically coupled circuits. Dot convention, coupling coefficient, tuned circuits, series & parallel resonance.

Module 2 **(12 hrs)**

Network Theorems: Thevenin's & Norton's, Superposition's, Reciprocity, Compensation, Substitution, Maximum power transfer, and Millman's theorem, Tellegen's theorem, problems with dependent & independent sources. Design the network and verify the output of the network by applying the different-different theorems.

Module 3 **(10 hrs)**

Transient analysis: Transients in RL, RC & RLC Circuits, initial & final conditions, time constants. Steady state analysis Laplace transform: solution of Integro-differential equations, transform of waveform synthesized with step ramp, Gate and sinusoidal functions, Initial & final value theorem, Network Theorems in transform domain.

Module 4 **(06 hrs)**

Two port parameters: Z, Y, HRS, Hybrid parameters, their inverse & image parameters, relationship between parameters, Interconnection of two ports networks.

Module 5 **(06 hrs)**

Network Graph theory: Concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrices, dual networks.

Assessment: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Apply the fundamental concepts in solving and analyzing different Electrical networks.
2. Select appropriate and relevant technique for solving the Electrical network in different conditions.
3. Analyze the circuits in steady state and transient state and evaluate the response.
4. Apply mathematics in analyzing and synthesizing the networks in time and frequency domain.
5. Estimate the performance of a particular network from its analysis.

Text/Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", 3th edition, Pearson Education. 2014.
2. Franklin F. Kuo, "Network Analysis and Synthesis", 2th edition, John Wiley & Sons, 2006.
3. J. David Irwin, "Engineering Circuit Analysis", 10th edition, Wiley India. 2013.
4. Pankaj Swarnkar, "Network Analysis and Synthesis", 9th edition, Satya Prakashan, New delhi, 2015.
5. A. Sudhakar, Shyammohan S Palli, "Network Analysis & Synthesis", 3th edition MGH, 2009.
6. William Hayt and Jack E. Kemmerly, "Engineering circuit analysis", 6th edition, MGH, 2016.

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Department of Electronics & Communication Engineering

PCC-EC305	**Electronic Workshop-I (Circuit Simulation and Design)**	**0L: 0T: 4P (04 hrs)**	**Credits:02**

Recommended Prerequisite: Engineering Mathematics, Engineering Physics, and BEEE.

Course Objective: The focus of this course is to introduce the fundamental concepts and tools of electronic circuit designing software & amp; let students acquaint with the software being used in the electronic circuit designing industries

List of Experiments:

1. To design and simulate 5V power supply using 7805.
2. To design and simulate clipper circuit using PN junction diode.
3. To design and simulate clamper circuit using PN junction diode and capacitors.
4. To design and simulate peak detector circuit using OPAMP and NPN BJT.
5. To design and simulate voltage to current converter using Operational Amplifier.
6. To design and simulate current to voltage converter using Operational Amplifier.
7. To design and simulate differentiator using Operational Amplifier.
8. To design and simulate integrator using Operational Amplifier.
9. Design High pass filter using Operational Amplifier.
10. Design Low pass filter using Operational Amplifier.

    Simulation of experiments can be done using TinaPro /E-Sim /Tinkercad Softwares.

Assessment: Internal viva, Continuous evolution of experiments, Quiz and End semester exam.

Course Outcomes:

Students earning credits will develop ability to:

1. Analyze the mathematical and physical foundations of electronic circuits.
2. Critically evaluate alternate assumptions, approaches, procedures, tradeoffs, and results during electronic circuit designing.
3. Design variety of electronic circuits using simulation software.
4. Demonstrate their design and able to present views.
5. Get skilled and deliver technical presentation.

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Department of Electronics & Communication Engineering

MC 3	Energy & Environmental Engineering	2L: 0T: 0P (02 hrs)	Credits:00

Course objective-To provide an introduction to energy resources and an emphasis on alternative energy sources and their application. To study the interrelationship between the living organism and environment. To understand the transformation and degradation of organic pollutants in the environment

Module 1 **(06 hrs)**

Energy:Introduction, conventional and non-conventional energy resources - coal, oil, gas, solar energy, wind energy,geothermal energy, Hydropower, Bio-energy, Nuclear energy. Energy survey in India. Current and futureenergy requirements in India and across the world including associated environmental problems.

Module 2 **(08 hrs)**

Ecosystem and Biodiversity: Introduction of an ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, rivers, oceans),Biodiversity at global, national and local levels. Threats to biodiversity, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Endangered and endemic species of India. Conservation of biodiversity: In-Situ and Ex-Situ.

Module 3 **(08 hrs)**

Air pollution and Water Pollution: Definition, Cause, effects and control measures of Air pollution; Mobile and stationary sources of air pollutants, effective stack height concept, CO, CO_2, H_2S, SO_x, NO_x emissions, and its control. Definition, Classification, Cause, effects and control measures of water pollution, Measurement of levels of pollution such as DO, BOD, COD.

Module 4 **(06 hrs)**

E-Waste: Definition, Classification, Cause, effects and control measures of e-waste, global trade issues of e-waste, Recycling method of e-waste & its benefit.

Module 5 **(08 hrs)**

Environment Impact & Protection Act Environment: Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation; Public awareness. Environmental Impact Assessment. Measuring environmental impacts and policies for the regulation of environmental impacts.

Course outcome:

Students earning credits will develop ability to:

1. Ability to understand basic concepts conventional and non-conventional energy resources.
2. Ability to understand Ecosystem& Biodiversity.

3. To provide knowledge about Air pollution & Water Pollution.
4. To provide knowledge & reuse of E-Waste.
5. Ability to understand basic concepts of Environment Impact & Protection Act.

Text/Reference Book-

1. Environmental Engineering - H.S. Peavy & D.R. Rowe-Mc Graw Hill Book Company, New Delhi
2. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
5. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards', Vol I and II, Enviro Media (R)