

Silicon Institute of Technology
| An Autonomous Institute |

Curriculum Structure and Detailed Syllabus

**Bachelor of Technology
in
Electronics & Communication Engineering**



**Department of Electronics & Communication Engineering
Silicon Institute of Technology
Silicon Hills, Patia, Bhubaneswar - 751024**

Effective From Academic Year 2021-22

Version: 1.21 (Build: 23-10-2021)

Approval History

ACM#	Date	Resolutions
AC-6	09/10/2021	The curriculum structure and detailed syllabus of 1st Year as proposed by the Boards of Studies is approved by the Academic Council.

Program Outcomes (UG Engineering)

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Program Outcomes (POs) for UG Engineering programmes defined by NBA are:

- PO1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
- PO2. **Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

- PSO1. Understand, analyze and apply the elementary concepts in Electronics and Communication Engineering to design, formulate and implement efficient systems in the broad areas related to signal processing, image processing, communication, VLSI and embedded systems.
- PSO2. Develop the skills in modern technologies, tools & platforms to become a successful professional or entrepreneur, exhibit a passion for innovation & higher studies, and contribute as a responsible citizen with effective communication, strong moral values & professional ethics.
- PSO3. Embrace various technological advancements in electronics & communication to design and create useful and competitive systems for real-world needs using modern platforms and tools to meet future challenges.

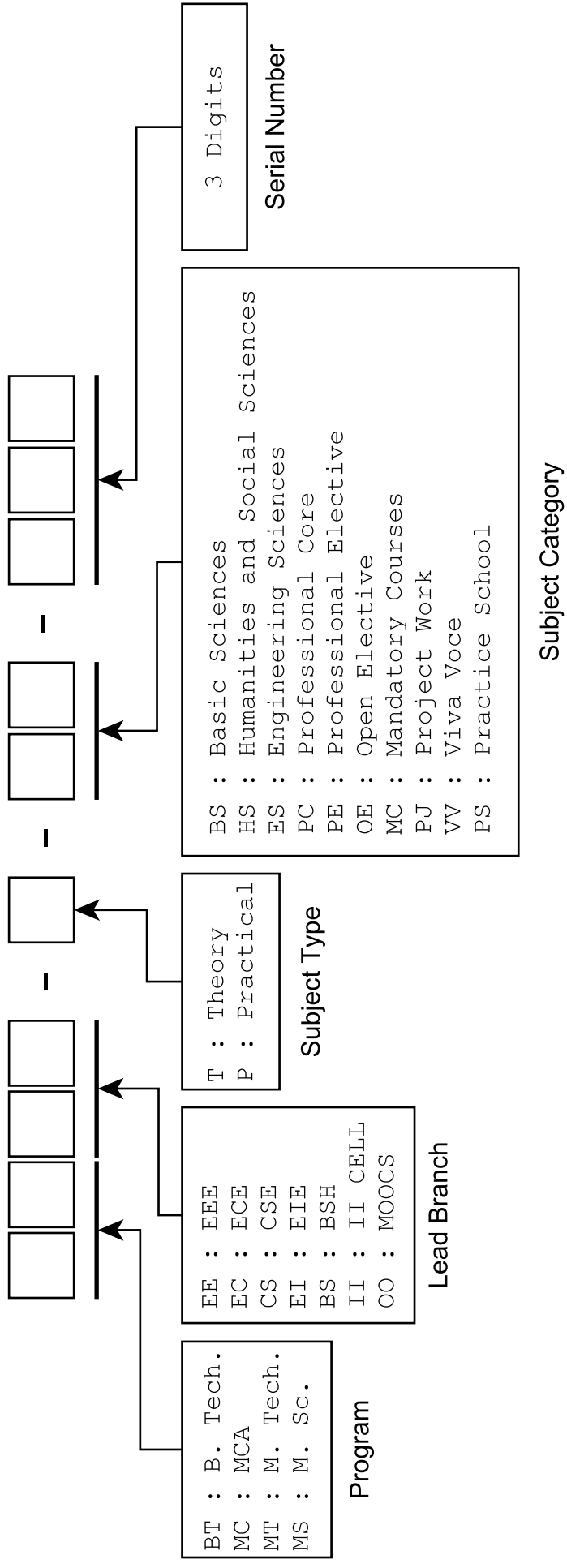
Program Educational Objectives (PEOs)

- PEO1. *Fundamental Knowledge & Core Competence:* To utilize the knowledge of mathematics, science and fundamentals of electronics & communication engineering required to become a successful professional and foster complex problem solving ability.
- PEO2. *Proficiency for the Real World:* To acquire the skills to analyze, design, develop, and optimize novel acceptable electronics and communication systems as per the growing needs of the real world.
- PEO3. *Leadership & Social Responsibility:* To exhibit leadership capability with professional, ethical, interpersonal skills, social & economic commitment with a sense of responsibility towards public policies, community services, humanity and environment.
- PEO4. *Life-long Learning:* To grow professionally through continued education & training of technical and management skills, pursue higher studies, and engage in life-long learning.

Course Types & Definitions

L	Lecture
T	Tutorial
P	Laboratory / Practical / Sessional
WCH	Weekly Contact Hours
BS	Basic Sciences
HS	Humanities & Social Sciences (including Management)
ES	Engineering Sciences
PC	Professional Core
PE	Professional Elective
OE	Open Elective
MC	Mandatory Course
OO	Massive Open Online Course (MOOC) - Self Study
PJ	Summer Internship / Project Work / Seminar
PS	Practice School / Industry Internship
VV	Viva Voce

Subject Code Format



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Part I

1st Year B. Tech.
(Common to All Branches)

Curriculum Structure

Semester I								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
BS	BTBS-T-BS-005	Engineering Mathematics-I	3	0	0	3	0	0
BS	BTBS-T-BS-002/ BTBS-T-BS-006	Engineering Chemistry/ Engineering Physics	3	0	0	3	0	0
ES	BTEC-T-ES-001/ BTEE-T-ES-001	Basic Electronics Engineering/ Basic Electrical Engineering	2	0	0	2	0	0
ES	BTCS-T-ES-001	Computer Programming	3	0	0	3	0	0
MC	BTBS-T-MC-001/ BTBS-T-MC-008	Constitution of India/ Environmental Science & Engineering	2	0	0	0	0	0
PRACTICAL								
BS	BTBS-P-BS-003/ BTBS-P-BS-007	Engineering Chemistry Lab/ Engineering Physics Lab	0	0	2	0	0	1
ES	BTBS-P-ES-009/ BTBS-P-ES-004	Manufacturing Practices/ Engineering Graphics	0	0	2	0	0	1
ES	BTEC-P-ES-002/ BTEE-P-ES-002	Basic Electronics Engineering Lab/ Basic Electrical Engineering Lab	0	0	2	0	0	1
ES	BTCS-P-ES-002	Computer Programming Lab	0	0	4	0	0	2
		SUB-TOTAL	13	0	10	11	0	5
		TOTAL	23			16		

Note: For some courses, the subjects have been mentioned as Subject-1 / Subject-2, i.e., with an OR option. Every student has to study both the subjects, however allocation of these subjects shall alternate between Semesters I and II. For example, if a student has been allocated *Engineering Chemistry* in Semester-I, then he/she will be allocated *Engineering Physics* in Semester-II, and vice-versa. The laboratory subjects will be as per the theory subjects allocated in the applicable semester. The same applies to all other courses provided with an OR option.

Semester II								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
BS	BTBS-T-BS-012	Engineering Mathematics-II	3	0	0	3	0	0
BS	BTBS-T-BS-006/ BTBS-T-BS-002	Engineering Physics/ Engineering Chemistry	3	0	0	3	0	0
ES	BTEE-T-ES-001/ BTEC-T-ES-001	Basic Electrical Engineering/ Basic Electronics Engineering	2	0	0	2	0	0
ES	BTCS-T-ES-003	Data Structures & Algorithms	3	0	0	3	0	0
MC	BTBS-T-MC-008/ BTBS-T-MC-001	Environmental Science & Engineering/ Constitution of India	2	0	0	0	0	0
HS	BTBS-T-HS-010	Communicative & Technical English	2	0	0	2	0	0
PRACTICAL								
BS	BTBS-P-BS-007/ BTBS-P-BS-003	Engineering Physics Lab/ Engineering Chemistry Lab	0	0	2	0	0	1
ES	BTBS-P-ES-004/ BTBS-P-ES-009	Engineering Graphics/ Manufacturing Practices	0	0	2	0	0	1
ES	BTEE-P-ES-002/ BTEC-P-ES-002	Basic Electrical Engineering Lab/ Basic Electronics Engineering Lab	0	0	2	0	0	1
ES	BTCS-P-ES-004	Data Structures & Algorithms Lab	0	0	4	0	0	2
HS	BTBS-P-HS-011	Communicative & Technical English Lab	0	0	2	0	0	1
		SUB-TOTAL	15	0	12	13	0	6
		TOTAL	27			19		

Note: For some courses, the subjects have been mentioned as Subject-1 / Subject-2, i.e., with an OR option. Every student has to study both the subjects, however allocation of these subjects shall alternate between Semesters I and II. For example, if a student has been allocated *Engineering Chemistry* in Semester-I, then he/she will be allocated *Engineering Physics* in Semester-II, and vice-versa. The laboratory subjects will be as per the theory subjects allocated in the applicable semester. The same applies to all other courses provided with an OR option.

Type	Code	Engineering Mathematics - I	L-T-P	Credits	Marks
BS	BTBS-T-BS-005		3-0-0	3	100

Objectives	The objective of this course is to familiarize the students with the knowledge and concepts of curve tracing, ordinary differential equations and applications, solution of system of linear equations using matrix methods, and Eigen vectors & Eigen values of matrices with applications.
Pre-Requisites	A good knowledge of trigonometry along with basics of differential and integral calculus of one variable and coordinate geometry of two and three dimensions.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Functions and their Graphs, Asymptotes & Curvature (concepts only), Geometric meaning of $y' = f(x, y)$ & direction fields, Separable ordinary differential equations (ODE) and Modeling.	8 Hours
Module-2	Exact ODE & Integrating Factor, Linear ODE, Bernoulli's Equation and Population models, Modeling electrical circuits, Homogeneous linear ODE of second order, Second order Linear ODE with constant coefficients, Modeling free oscillation.	8 Hours
Module-3	Euler-Cauchy ODE, Non-homogeneous linear ODE and applications to electrical circuits.	7 Hours
Module-4	Matrix algebra, system of linear equations, rank and inverse of matrices, vector space.	8 Hours
Module-5	Eigen values and Eigen vectors, Complex matrices, Diagonalization of matrices. Positive Definite Matrix, Singular Value Decomposition (SVD) and Pseudo Inverse.	11 Hours
Total		42 Hours

Text Books:

- T1. S. Narayan and P. K. Mittal, *Differential Calculus*, Revised Edition, S. Chand & Company, 2014.
- T2. E. Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley India, 2015.
- T3. G. Strang, *Linear Algebra and Its Applications*, 4th Edition, Cengage Learning, 2015.

Reference Books:

- R1. S. Pal and S. C. Bhunia, *Engineering Mathematics*, 1st Edition, Oxford University Press, 2015.
- R2. B. V. Ramana, *Higher Engineering Mathematics*, 1st Edition, McGraw Hill, 2017.

Online Resources:

1. <http://www.nptel.ac.in/courses/111105035>
2. <http://www.nptel.ac.in/courses/122104017>
3. <http://nptel.ac.in/courses/122102009>

4. <http://nptel.ac.in/courses/111107063>
5. <https://www.coursera.org/learn/linearalgebra2>
6. <https://www.coursera.org/learn/differentiation-calculus>
7. <https://www.coursera.org/learn/single-variable-calculus>
8. <https://alison.com/courses/Algebra-Functions-Expressions-and-Equations>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe graphs of functions (curves) and their characteristics like asymptotes and curvature.
CO2	Solve first order ordinary differential equations using various methods and apply them to find solutions of physical problems.
CO3	Explain the methodology to solve second order ordinary differential equations and apply them to solve applied problems of electrical circuits.
CO4	Explore the concepts and methods of system of linear equations to solve a system.
CO5	Use the eigen values and eigen vectors of matrices, its properties and applications of SVD.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	1								2	1	1
CO2	3	3	2	1	2								3	2	1
CO3	3	3	3	3	1								3	2	1
CO4	3	3	3	2	3								2	1	1
CO5	3	3	2	2	2								2	2	1

Type	Code	Engineering Chemistry	L-T-P	Credits	Marks
BS	BTBS-T-BS-002		3-0-0	3	100

Objectives	The purpose of this course is to emphasize the relevance of fundamentals and applications of chemical sciences in the field of engineering. The course attempts to address the principles of general chemistry and specific topics relevant to various engineering disciplines, so that the students can apply the knowledge in their respective areas of expertise.
Pre-Requisites	Basic knowledge on Normality, Molarity, mole concept, types of chemical reactions, and elementary idea on electrochemistry.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
	Introduction & Pre-requisites	2 Hours
Module-1	Water Treatments: Types of hardness-Units, Alkalinity of water and its significance, Softening methods and Numerical problems based on these methods; Membrane-based processes; Dissolved Oxygen, Problems with Boiler feed water and its treatments.	8 Hours
Module-2	Corrosion Science: Definition and scope of corrosion, Dry and wet corrosion; Direct chemical corrosion, Electrochemical corrosion and its mechanisms; Types of electrochemical corrosion, (differential aeration, galvanic, concentration cell); Typical Electrochemical corrosion like Pitting, Inter-granular, Soil, Waterline; Factors affecting corrosion, Protection of corrosion.	7 Hours
Module-3	Instrumental Techniques: Fundamentals of Spectroscopy; Principles and applications of molecular spectroscopy (such as UV-visible, IR and microwave).	8 Hours
Module-4	Energy Sciences: Types of fuels, Calorific value, Determination of Calorific value, Combustion and its calculations, Solid fuel: Coal analysis (Proximate and ultimate analysis), Elementary ideas on some gaseous fuels (Natural gas, Water gas, Producer gas, LPG) (Synthesis is excluded), Liquid fuels: IC engine fuel, concept of knocking, antiknocking, octane No and cetane No, Fractional Distillation of petroleum, Cracking of heavy oils; Battery technology – Fundamentals of primary & Secondary cells, Rechargeable batteries: Lead acid storage battery, Lithium ion battery, Fuel cells: principles, applications. Elementary idea on Photovoltaics.	10 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	Nanochemistry: Nanomaterials, Classification of nanomaterials, Synthesis of noble metal nanoparticles (e.g., Gold /silver) and oxide based nanoparticles (e.g., cuprous oxide/zinc oxide) using green synthetic route, Stabilization of nanoparticles using capping agents, Elementary ideas on characterization of nanoparticles (X-ray Diffraction (XRD) and electronic spectroscopy), applications of nanomaterials.	7 Hours
Total		42 Hours

Text Books:

- T1. Jain & Jain, *Engineering Chemistry*, 16th Edition, Dhanpat Rai Publishing Company, 2015.
 T2. Wiley-India Editorial Team, *Engineering Chemistry*, 2nd Edition, Wiley India, 2011.
 T3. C. N. Banwell, *Fundamentals of Molecular Spectroscopy*, 4th Edition, McGraw Hill Education, 2017.

Reference Books:

- R1. S. S. Dara, *Engineering Chemistry*, 12th Edition, S. Chand Publisher, 2014.
 R2. G. A. Ozin & A. C. Arsenault, *Nanochemistry - A Chemical Approach to Nanomaterials*, 2nd Edition, RSC Publishing, 2008.
 R3. J. M. Lehn, L. Cademartiri, *Concepts of Nanochemistry*, 1st Edition, Wiley-VCH, 2009.
 R4. Y. R. Sharma, *Elementary Organic Spectroscopy*, S Chand & Co Ltd., 2013.

Online Resources:

- https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Exemplars/Corrosion/Corrosion_Basics
- <https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/infrared/infrared.htm>
- <http://nptel.ac.in/courses/103105110/> - Fuel & Combustion
- <http://nptel.ac.in/courses/105104102/hardness.htm>
- http://nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
- <https://alison.com> - Spectroscopic Technique, Colorimetry

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Exploit the concept of hardness in softening hard water and determining the hardness of water.
CO2	Utilize the knowledge of electrochemistry and corrosion science in preventing engineering equipments from corrosion.
CO3	Apply the concept of molecular spectroscopy to analyze organic compounds using spectrophotometer.
CO4	Classify various fuels based on combustion parameters and understand the working principle of various batteries.
CO5	Acquire knowledge on synthesis & characterization of oxide based & noble metal nanoparticles through green synthetic route.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Cont'd...

PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	1	1					2	2	2
CO2	3	2	1	1	1	2	1						2	2	2
CO3	2	2	1	1	2	2	1	1					2	2	2
CO4	2	2	1	1	1	1	1						2	1	1
CO5	2	2	1	1	2	2	1	1					2	2	2

Type	Code	Engineering Physics	L-T-P	Credits	Marks
BS	BTBS-T-BS-006		3-0-0	3	100

Objectives	The objective of this course is to obtain basic idea about various laws and understand different phenomena using principles of physics. This knowledge will be useful for the engineering students to understand the basic operating principle of instruments and techniques. The knowledge obtained can also be used to prepare various models and projects.
Pre-Requisites	Adequate knowledge and clear concepts in higher secondary physics like waves, oscillations, optics, electricity, magnetism, modern physics, etc.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
	Introduction & Pre-requisites	2 Hours
Module-1	Wave Optics: Concept of wave and wave equation, Superposition of waves (two beam and multiple beam) and interference, Huygen's principle, Interference by division of amplitude and division of wavefront, Theory of Newton's rings and its applications, Diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer's diffraction from a single slit, Theory of plane diffraction grating, Determination of wavelength of light with a plane diffraction grating.	10 Hours
Module-2	Vector Calculus: Gradient of scalar field, Divergence and curl of vector field, Gauss divergence theorem and Stokes theorem (statement only). Maxwell's Equations: Gauss's law in electromagnetism, Faraday's law of electromagnetic induction, Ampere's circuital law, Displacement current, Maxwell's electromagnetic equations (integral and differential form). Electromagnetic Waves: Electromagnetic Wave (EM) equations - Free space, Dielectric and conducting medium, Transverse nature of EM wave, Electromagnetic wave in ionized medium, Electromagnetic energy density, Poynting's theorem and Poynting's vector.	11 Hours
Module-3	Introduction to Quantum Mechanics: Need of quantum mechanics, Particle nature of radiation - Black body radiation (no derivation), Photoelectric effect, Compton effect and pair production, Concept of de-Broglie's matter waves, Phase and group velocity, Heisenberg's Uncertainty principle with applications.	6 Hours
Module-4	Schrödinger's wave equation with applications: Concept of wave function ψ and interpretation of $ \psi ^2$, Schrödinger's time-dependent and time-independent equations, Probability current, Expectation values, Operators in quantum mechanics, Eigen functions and Eigen values, Applications of Schrödinger's equation- Particle in one dimensional rigid box, Potential barrier (emphasis on tunneling effect).	6 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	Laser: Radiation-matter interaction, Absorption of light, Spontaneous and stimulated emission of light, Population inversion, Types of Laser-Solid State Laser (Ruby), Gas Laser (He-Ne), Properties and applications of Laser. Optical Fiber: Structure and Principle, Types of optical fiber, Numerical aperture, Applications of optical fiber.	7 Hours
Total		42 Hours

Text Books:

- T1. D. R. Joshi, *Engineering Physics*, 1st Edition, Tata McGraw-Hill Publication, 2017.
 T2. Md. M. Khan and S. Panigrahi, *Principle of Physics*, Vol. I & II, Cambridge Univ. Press.

Reference Books:

- R1. A. Ghatak, *Optics*, Tata McGraw Hill.
 R2. B. S. Agarwal, *Optics*, Kedar Nath Rama Nath & Co.
 R3. S. Prakash, *Electromagnetic Theory and Electrodynamics*, Kedar Nath Ram Nath & Co.
 R4. D. J. Griffith, *Introduction to Electrodynamics*, Pearson Education.
 R5. R. Eisberg and R. Resnick, *Quantum Physics of Atoms, Molecules, Solids, Nuclei & Particles*, John Wiley Publications.
 R6. A. Beiser, *Concept of Modern Physics*, McGraw Hill.
 R7. R. K. Gour and S. L. Gupta, *Engineering Physics*, Dhanpat Rai Publications.

Online Resources:

- <https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/>
- <http://www.ilectureonline.com/lectures/subject/PHYSICS>
- <https://ocw.mit.edu/courses/physics>
- <https://nptel.ac.in/courses/115102026/>
- <https://nptel.ac.in/courses/113104012/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyze wave properties of light like interference and diffraction and apply them in communications
CO2	Develop Maxwell's equations from basic laws of electromagnetism and apply them to understand the properties of electromagnetic waves.
CO3	Analyze wave-particle duality to understand radiation-matter interaction
CO4	Develop and apply Schrödinger's equations to diverse fields like bound particle, potential barrier etc.
CO5	Investigate the basic principle, properties, operations and applications of laser & optical fibre in different fields like communication, industry, medicine, research etc.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Cont'd...

PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1								1	3	2	1
CO2	3	2	1	2	1							1	3	3	2
CO3	3	2		1								1	3	3	2
CO4	3	2		1								1	3	3	3
CO5	3	3	1	2	1							1	3	3	2

Type	Code	Basic Electronics Engineering	L-T-P	Credits	Marks
ES	BTEC-T-ES-001		2-0-0	2	100

Objectives	Know broadly the concepts and functionalities of the electronic devices, tools and instruments. Understand general specifications and deployability of the electronic devices, and assemblies. Develop confidence in handling and usage of electronic devices, tools and instruments in engineering applications.
Pre-Requisites	Knowledge on intrinsic and extrinsic Semiconductors, Physics and Chemistry of Higher Secondary Science level.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, and planned lectures to make the sessions interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Electronics: Signals, Frequency spectrum of signals, Analog and digital signals; Diodes and Applications: Semiconductor Diode - Ideal versus Practical, Resistance Levels, Diode Equivalent Circuits, Load Line Analysis; Diode as a Switch, Diode as a Rectifier, Half Wave and Full Wave Rectifiers, Breakdown Mechanisms, Zener Diode – Operation and Applications; Clipper and Clamper Circuits, Diode applications.	7 Hours
Module-2	Bipolar Junction Transistor (BJT): Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Fixed and Voltage divider Biasing Configurations.	6 Hours
Module-3	Field Effect Transistor (FET): Construction, Characteristics of Junction FET (JFET), Depletion and Enhancement type Metal Oxide Semiconductor FETs (MOSFET), Introduction to Complementary MOS (CMOS) circuits.	5 Hours
Module-4	Operational Amplifiers and Applications: Introduction to Op-Amp, Differential Amplifier Configurations, Basics of Op-Amp, Characteristics of Ideal Op-Amp, CMRR, PSRR, Slew Rate; Block Diagram and Pin Configuration of IC 741 Op-Amp, Applications of Op-Amp as: Summing Amplifier, Difference Amplifier, Differentiator, Integrator.	5 Hours
Module-5	Feedback Amplifiers: Principle, Advantages of Negative Feedback, Different Feedback Topologies. Oscillators: Classification, RC Phase Shift Oscillator.	5 Hours
Total		28 Hours

Text Books:

- T1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 11th Edition, Pearson Education, 2015.
- T2. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th Edition, Oxford University Press, 2009.

Reference Books:

- R1. A. Agarwal and J. Lang, *Foundations of Analog and Digital Electronic Circuits*, 1st Edition, Morgan Kaufmann, 2005.
- R2. V. K. Mehta and Rohit Mehta, *Principles of Electronics*, 10th Rev. Edition, S. Chand Publishing, 2006.

Online Resources:

1. <https://nptel.ac.in/courses/117/103/117103063/>: by Prof. G. Barua, IIT Guwahati
2. <https://nptel.ac.in/courses/108/101/108101091/>: By Prof. M. B. Patil, IIT Bombay
3. <https://nptel.ac.in/courses/122/106/122106025/>: By Prof. T. S. Natarajan, IIT Madras
4. <https://nptel.ac.in/courses/117/107/117107095/>: Web Content by IIT Roorkee
5. <https://nptel.ac.in/courses/122/104/122104013/>: Web Content by IIT Kanpur

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Become familiar with basic signals, diodes and their applications.
CO2	Investigate on the operation of different configurations of bipolar junction transistor. Analyze and design different biasing configurations with their applications.
CO3	Understand the construction, operation and characteristics of JFET and MOSFET. Analyze and design different biasing configurations with their applications.
CO4	Learn the construction and characteristics of Op-Amp and design circuits for various applications using Op-Amp.
CO5	Understand different types of feedback topologies and design various kinds of oscillators.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1										2	2	2
CO2	3	2	3	1									3	3	2
CO3	2	2	2	1									3	3	2
CO4	3		3										2	3	2
CO5	2	1	2										2	3	1

Type	Code	Basic Electrical Engineering	L-T-P	Credits	Marks
ES	BTEE-T-ES-001		2-0-0	2	100

Objectives	The objective of this course is to introduce the students to basic concepts of electricity and magnetism. The course will cover the basics of DC & AC networks, principle of operation of different electrical machines and measuring instruments. The course will train the students about the basic protection system and safety requirements and will give an overview of the electrical power systems.
Pre-Requisites	Basic knowledge of intermediate Physics, knowledge of basic Mathematics such as Calculus, Ordinary Differential Equations, Matrices etc.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Fundamentals of Electric Circuits: Charge & current, Voltage & current sources, Electrical circuit elements (R, L and C) and their characteristics, Kirchoff's current and voltage laws; Resistive Network Analysis: Node voltage & Mesh current analysis, Node voltage and mesh current analysis with controlled sources, Thevenin Theorem, Norton's Theorem, Principle of superposition, Maximum power transfer theorem; Formation of differential equation for RL & RC circuits; Concept of measurement and use of shunt and multipliers in ammeters and voltmeter.	8 Hours
Module-2	Representation of sinusoidal waveforms, Peak and rms values, Phasor representation, Real power, Reactive power, Apparent power, Power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel).	6 Hours
Module-3	Three phase balanced circuits, Voltage and current relations in star and delta connections. Brief introduction to generation, Transmission and Distribution of electrical power, Earthing & electrical safety.	3 Hours
Module-4	Electricity and magnetism, magnetic circuit and magnetic reluctance, Magnetic materials, BH characteristics, Ideal and practical transformer, e.m.f. equation of transformer, Equivalent circuit.	4 Hours
Module-5	Construction of D.C. machines, generator, Types of excitation system, working of D.C. motor, Classification of D.C. motor, Characteristics and speed control of dc motor; Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Torque-slip characteristic; Single-phase induction motor.	7 Hours
Total		28 Hours

Text Books:

- T1. E. Hughes, *Electrical & Electronic Technology*, 9th Edition, Pearson, 2004.
- T2. G. Rizzoni, *Principles and Applications of Electrical Engineering*, 5th Edition, McGraw Hill, 2006.

Reference Books:

- R1. A. E. Fitzgerald, D. E. Higginbotham, and A. Grabel, *Basic Electrical Engineering*, 5th Edition, Tata McGraw Hill.
- R2. B. L. Theraja and A. K. Theraja, *Textbook of Electrical Technology (Vol-I)*, 23rd Edition, S. Chand & Co.Ltd., 2002.
- R3. L. S. Bobrow, *Foundations of Electrical Engineering*, Asian Edition, Oxford Univ. Press, 2013.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105053/>: by Prof. G. D. Roy, Prof. N. K. De, and Prof. T. K. Bhattacharya, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/108/108108076/>: By Prof. L. Umanand, IISc Bangalore
3. <https://www.electrical4u.com/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand and analyze basic electrical network with D.C. source.
CO2	Measure current, voltage and power of series RLC circuit excited by single-phase ac circuit.
CO3	Analyze three phase electrical systems and develop an understanding of the real power system.
CO4	Explain different concepts of magnetic fields and apply it to single phase transformer.
CO5	Describe the working principles of rotating electrical machines.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2									3	1	1
CO2	3	3	2	3									2	1	1
CO3	3	2	1	1			2						2	1	2
CO4	3	2	2				1						3		1
CO5	3	3	2	1									2		1

Type	Code	Computer Programming	L-T-P	Credits	Marks
ES	BTCS-T-ES-001		3-0-0	3	100

Objectives	The objective of this course is to introduce fundamentals of computer programming using the C programming language to the students. Starting with simple programs, the course will cover advanced topics like structures, pointers, file processing and pre-processor directives etc. and enable the students to write programs using C language for solving various engineering problems.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to computers and programming, operating system, compilers, interpreters, algorithm, flowchart, pseudocode etc., structure of C program, character set, identifier, keywords, constants, variables, data types, operators, expressions, statements, operator precedence and associativity, type conversion, input/output statements.	8 Hours
Module-2	Decision making and branching: if, if-else, nested if-else, else-if ladder and switch constructs, iterative execution of code using loops: while, for, do-while, nested loops, controlling loop behavior using jump statements (break, continue, goto) and exit statements.	8 Hours
Module-3	Arrays (1-D & 2-D), declaration and initialization of arrays, accessing array elements, operations on arrays - insertion, deletion, searching, sorting (selection sort), merging etc., character arrays and strings, initialization, input & output of strings, operations on strings, array of strings, string handling functions.	9 Hours
Module-4	User-defined functions, declaration and definition, parameter passing by value, functions returning values, idea on call by reference, passing arrays to functions, recursion, storage classes - auto, register, static, extern, Structures and Unions - definition, initialization, accessing members, array of structures, arrays within structures, structures and functions, self-referential structures.	9 Hours
Module-5	Understanding pointers, declaration, initialization, accessing variables using pointers, pointer expressions, scale factor, chain of pointers, using pointers with arrays, strings, functions and structures, dynamic memory management, pre-processor directives, command line arguments, basics of file handling.	8 Hours
Total		42 Hours

Text Books:

- T1. E. Balagurusamy, *Programming in ANSI C*, 7th Edition, McGraw-Hill Education, 2017.
 T2. Y. Kanetker, *Let Us C*, 16th Edition, BPB Publications, 2018.

Reference Books:

- R1. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd Edition, Pearson Education, 2015.
 R2. H. Schildt, *C: The Complete Reference*, 4th Edition, McGraw-Hill, 2017.
 R3. A. Kelley and I. Pohl, *A Book on C*, 4th Edition, Pearson Education, 2008.
 R4. B. Gottfried, *Schaum's Outline of Programming with C*, 3rd Edition, McGraw-Hill, 2017.

Online Resources:

1. <http://www.stat.cmu.edu/~hseltman/c/CTips.html>
2. <http://www.c-faq.com/>
3. <https://www.learn-c.org/>
4. <https://www.javatpoint.com/c-programming-language-tutorial>
5. <http://www2.its.strath.ac.uk/courses/c/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Formulate logic of a problem and write C programs using variables, expressions and input/output statements.
CO2	Develop structured C programs involving decision making using different control constructs.
CO3	Solve problems involving similar set of data items and convert them into C programs using arrays.
CO4	Design modular C programs and handle heterogeneous data items using structures & unions.
CO5	Write C applications using pointers, pre-processor directives, command line arguments and files.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1								1	3	2	2
CO2	3	3	2	2								1	3	2	2
CO3	3	3	2	2								1	3	2	2
CO4	3	2	2	2								1	3	2	2
CO5	3	3	2	3								1	3	2	2

Type	Code	Constitution of India	L-T-P	Credits	Marks
MC	BTBS-T-MC-001		2-0-0	0	100

Objectives	The objective of this subject is to provide understanding of the basic concepts of Indian Constitution and various organs created by the constitution including their functions. The course acquaints students with the constitutional design of state structures and institutions, and their actual working over time.
Pre-Requisites	Basic knowledge of Indian history, overall idea on India's political system.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required and each session is planned to be interactive.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Indian Constitution, Historical perspective of the constitution of India. Preamble of Indian constitution, Salient features of Indian constitution, Fundamental rights, Fundamental Duties and its legal status, Directive principles of state policy-its importance and Implementation.	8 Hours
Module-2	Federal structure and distribution of legislative and financial powers between the Union and the States, The Union legislature - The Parliament - The Lok Sabha and the Rajya Sabha, Composition, powers and functions, Union executive, President of India (with powers and functions), Vice-President, The Council of Ministers and the Prime Minister - Powers and functions.	6 Hours
Module-3	State Government, The State Legislature - composition, powers and functions, State executive, Governor (with powers and functions).	5 Hours
Module-4	Amendment of the Constitutional Powers and Procedure, Emergency Provisions : National Emergency, President Rule, Financial Emergency. Scheme of the Fundamental Right to Equality Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21. Local Self Government - Constitutional Scheme in India.	5 Hours
Module-5	The Indian Judicial System - the Supreme Court and the High Court's composition, jurisdiction and functions, Judicial review, Judicial activism, independence of Judiciary in India.	4 Hours
Total		28 Hours

Text Books:

- T1. D. D. Basu, *Introduction of Constitution of India*, 22nd Edition, LexisNexis, 2015.
- T2. K. Subas, *An Introduction to India's Constitution and Constitutional Law*, 5th Edition, National Book Trust India, 2011.

P.T.O

Reference Books:

- R1. M. Laxmikanth, *Indian Polity*, 5th Edition, McGraw Hill, 2011.
 R2. P. M. Bakshi, *The Constitution of India*, 14th Edition, Universal Law Publishing Co, 2006.

Online Resources:

1. https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
2. <https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text>
3. https://www.tutorialspoint.com/indian_polity/indian_polity_tutorial.pdf
4. <https://www.careerpower.in/wp-content/uploads/2016/03/SSC-POLITY-CIVICS-CAPSULE-2016.pdf>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Provide basic information about Indian constitution and to analyze the legalities and related issues of drafting, adoption and enforcement of the Indian Constitution as a fundamental law of the nation and the provisions and privileges of Indian Citizenship.
CO2	Understand and judiciously use the fundamental rights and privileges envisaged in the constitution propagating social harmony and equality and respecting the rights and liberties of other people.
CO3	Analyze the major dimensions of Indian Political System and to contribute in protecting and preserving the sovereignty and integrity of India.
CO4	Know the successful functioning of democracy in India and to respect the Constitutional Institutions like Judiciary, Executive and Legislature.
CO5	Understand their obligations, responsibilities, privileges & rights, duties and the role that they have to play in deciding the Administrative Machinery of the country.

Program Outcomes Relevant to the Course:

PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				1		2	1	1	1				1	2	2
CO2						2	1	1	1				1	1	1
CO3						3	1	1	1				1	2	1
CO4						2	1	1	1				2	2	1
CO5						2	1	2	1				1	2	1

Type	Code	Environmental Science & Engineering	L-T-P	Credits	Marks
MC	BTBS-T-MC-008		2-0-0	0	100

Objectives	This course serves as a general introduction to environmental science. From ecology and ecosystems, it acquaints the students to air & water quality and the impact of pollution on the environment due to industries and urbanization. Some remediation methods of minimizing the impact of pollutants through technology and legal systems are also addressed.
Pre-Requisites	Basic knowledge of physics, chemistry and biology is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required and some sessions are planned for expert talk, seminar presentation by students.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Ecology & Biogeochemical Cycles: Introduction to environmental science, ecological perspective and value of environment, biodiversity of species, biotic components, energy, food chain, biogeochemical cycles like water, oxygen, nitrogen and carbon cycle.	6 Hours
Module-2	Water & Wastewater Treatment: Water quality standards and parameters, pre-treatment and conventional treatment processes of water, DO, BOD, COD, wastewater treatment.	6 Hours
Module-3	Atmospheric chemistry, soil chemistry, ground water recharge, noise source & abatement: atmospheric chemistry, air pollution, climate change, soil chemistry, water table and aquifer, ground water recharge, noise standards, noise measurement, noise control and activities including expert talk.	5 Hours
Module-4	Waste Management: Municipal Solid Waste (MSW), Hazardous waste and e-waste handling & management, Introduction to Life Cycle Assessment (LCA), Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS).	6 Hours
Module-5	Environmental gradients & Laws: Environmental gradients, tolerance levels of environment factors, Indian environmental laws, Human population & the environment, Activities including seminar presentations by students.	5 Hours
Total		28 Hours

Text Books:

- T1. G. M. Masters and W. P. Ela, *An Introduction to Environmental Engineering and Science*, 3rd Edition, PHI Learning, 2015.
- T2. G. Kiely, *Environmental Engineering*, Spl. Indian Edition, McGraw Hill, 2007.

Reference Books:

- R1. M. L. Davis and S. J. Masten, *Principles of Environmental Engineering and Science*, 2nd Edition, McGraw-Hill, 2017.
- R2. H. D. Kumar and U. N. Dash, *Environmental Studies*, 2nd Edition, IndiaTech Publishers, 2017.

Online Resources:

1. <http://nptel.ac.in/courses/120108002/>: Aquatic Biodiversity and Environmental Pollution.
2. <http://nptel.ac.in/courses/120108004/>: Environment Management.
3. <http://nptel.ac.in/courses/120108005/>: Municipal Solid Waste Management.
4. <https://www.epa.gov/environmental-topics/>: All Current Environmental Issues.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply concepts of ecology, eco systems, food chain and biogeochemical cycles for better understanding of functions of the environment.
CO2	Enhance knowledge of water and wastewater treatment for prevention of water pollution.
CO3	Understand the chemistry of pollutants in the atmosphere, soil and groundwater and understand principles of noise abatement.
CO4	Enhance knowledge of waste minimization technique to minimize and manage solid, hazardous wastes generated in different areas.
CO5	Understand environmental gradients, tolerance levels and environmental laws for prevention of environmental pollution.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					2	3	1	2		1			1	1
CO2	1					2	2	2	2		1			1	1
CO3	1					1	2	1	1		1		1	2	1
CO4	1					2	3	1	2		1		1	2	1
CO5	1					3	3	3	2		1			1	1

Type	Code	Engineering Mathematics - II	L-T-P	Credits	Marks
BS	BTBS-T-BS-012		3-0-0	3	100

Objectives	The objective of this course is to familiarize the perspective engineers with the knowledge and concepts of probability and statistics which are essential to study non-deterministic systems.
Pre-Requisites	Basics of sets, counting techniques, differential and integral calculus of one variable and coordinate geometry of two and three dimensions.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Measures of central tendencies, Elementary probability, Conditional probability, Bayes' Rule (related problems only), Random variable, Binomial & Hypergeometric distribution, Mean and variance, Chebyshev's Theorem.	9 Hours
Module-2	The Poisson approximation to Binomial Distribution, Poisson Process, Geometric Distribution & Multinomial Distribution, Continuous random variables, Normal Distribution, Normal Approximation to the Binomial Distribution, Uniform Distribution, Exponential Distribution, Joint Discrete Distribution.	9 Hours
Module-3	Populations and Samples, Sampling Distribution of Mean (σ known), Sampling Distribution of Mean (σ unknown) & Sampling Distribution of Variance; Point Estimation of mean, Interval Estimation of mean, Tests of hypotheses and errors involved, Hypotheses concerning one mean, Inference concerning two mean, Estimation of variance, Hypotheses concerning one variance, Hypotheses concerning two variances.	8 Hours
Module-4	Estimation of Proportions, Hypotheses Concerning proportion (one & several), Analysis of $r \times c$ table (Contingency table), Goodness of fit, Application of goodness of fit, Kolmogorov-Smirnov test.	7 Hours
Module-5	The method of least squares, Inferences based on the least square estimation, Curvilinear Regression, Multiple Regression, Checking the adequacy of the model, Correlation, Multiple linear regression (matrix notation); Analysis of Variance, General principle, Completely Randomized Design, Randomized Block Design.	9 Hours
Total		42 Hours

Text Books:

- T1. R. A. Johnson, *Miller & Freund's - Probability and Statistics for Engineers*, 8th Edition, PHI Learning, 2011.

P.T.O

Reference Books:

- R1. W. Mendenhall, R. J. Beaver, and B. M. Beaver, *Probability and Statistics*, 14th Edition, Cengage Learning, 2014.
- R2. R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, *Probability & Statistics for Engineers & Scientists*, 9th Edition, PHI Learning, 2012.

Online Resources:

1. <https://nptel.ac.in/courses/111/105/111105041/>: by Prof. S. Kumar, IIT Kharagpur
2. <https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/lecture-notes/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply the concepts of probability and random variables to evaluate probabilities of events.
CO2	Apply different discrete and continuous probability models to solve real life problems.
CO3	Apply the concepts of sampling to estimate population parameters and test hypothesis.
CO4	Test the goodness of a model and apply it to real life problems.
CO5	Apply regression model and ANOVA to study the characteristics data sets.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2								2	1	1
CO2	3	3	3	3	3								2	1	1
CO3	3	2	3	2	2								2	1	1
CO4	3	3	3	3	3								3	2	1
CO5	3	3	3	3	3								3	2	1

Type	Code	Data Structures & Algorithms	L-T-P	Credits	Marks
ES	BTCS-T-ES-003		3-0-0	3	100

Objectives	To understand the abstract data types and to solve problems using data structures such as stacks, queues, linked lists, hash tables, binary trees, heaps, binary search trees, graphs and writing programs for these solutions.
Pre-Requisites	Knowledge of programming in C, specifically on structures, pointers, functions, recursion etc., are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to data structures, classification of data structures, algorithmic notation, complexity of algorithms, asymptotic notations, abstract data types. Arrays - introduction, representation of arrays (row and column major representation), basic operations on array (traverse, insert, delete, search), sparse matrix, representation of sparse matrix using triplet form, operations on sparse matrix (addition, transpose)	8 Hours
Module-2	ADT Stack - stack model, representation of stack using array, basic operations with analysis, applications- recursion, and conversion of infix to post fix expression, evaluation of postfix expression. ADT Queue - queue model, representation using array, basic operations with analysis, circular queue, introduction to priority queue and double ended queue.	8 Hours
Module-3	Linked list - introduction, types of linked list (single, double, circular), representation in memory, operations on linked list (traverse, search, insert, delete, sort, merge) in each type with analysis. Representation of polynomial and its operations (addition, multiplication), implementation of stack and queue using linked list.	9 Hours
Module-4	Tree - terminology, representation, binary tree - tree traversal algorithms with and without recursion. Binary search tree, Operations on Binary Search Tree with analysis, threaded binary tree, general tree, Height balanced tree (AVL tree), m-way search trees, B-trees. Graph - terminology, representation (adjacency matrix, incidence matrix, path matrix, linked representation), graph traversal (BFS, DFS), Dijkstra's single source shortest path algorithm, Warshall's all pair shortest path algorithm, topological sort.	9 Hours
Module-5	Sorting algorithms - bubble sort, selection sort, insertion sort, quick sort, merge sort, radix sort, heap sort. Hashing- hash functions and hashing techniques. collision resolution techniques- linear probing, quadratic probing, chaining.	8 Hours
Total		42 Hours

Text Books:

- T1. E. Horowitz, S. Sahni, S. Anderson-Freed, *Fundamentals of Data Structures in C*, 2nd Edition, Universities Press, 2008.
- T2. M. A. Weiss, *Data Structures and Algorithm Analysis in C*, 2nd Edition, Pearson Education, 2002.

Reference Books:

- R1. A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, *Data Structures Using C*, 3rd Edition, Pearson Education, 2007.
- R2. J. P. Tremblay and P. G. Sorenson, *An Introduction to Data Structures with Applications*, 2nd Edition, McGraw Education, 2017.
- R3. S. Lipschutz, *Data Structures*, 1st Revised Edition, McGraw Education, 2014.

Online Resources:

1. <https://nptel.ac.in/courses/106/106/106106127/>: By Prof. H. A. Murthy, Prof. S. Balachandran, and Dr. N. S. Narayanaswamy, IIT Madras
2. <https://nptel.ac.in/courses/106/102/106102064/>: By Prof. N. Garg, IIT Delhi
3. <https://nptel.ac.in/courses/106/106/106106130/>: By Dr. N. S. Narayanaswamy, IIT Madras
4. <https://www.geeksforgeeks.org/data-structures/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyze performance of algorithms and implement various operations on array and sparse matrix.
CO2	Apply the basic operations of stacks and queues to solve real world problems.
CO3	Implement different types of linked list operations and their applications.
CO4	Represent data using trees & graphs to use them in various real life applications.
CO5	Analyze various sorting algorithms and explore different hashing techniques.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2		1						1	2	2	1
CO2	3	3	3	2		1						1	2	1	1
CO3	3	3	3	2		1						1	2	1	1
CO4	3	2	3	3		2						1	2	2	1
CO5	3	3	3	3		1						1	2	3	1

Type	Code	Communicative & Technical English	L-T-P	Credits	Marks
HS	BTBS-T-HS-010		2-0-0	2	100

Objectives	The objectives of this course are to develop the students' communication skills with proficiency in Technical English, make them speak with a standard accent, develop analytical skills to read and comprehend texts, and help students compose basic business messages.
Pre-Requisites	Basic knowledge of English grammar and the ability to read and write using the English language.
Teaching Scheme	Regular classroom lectures with the use of PPTs as and when required; sessions are planned to be interactive with focus on improving spoken and written communication skills in English.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Elements of Communication: Process, factors and importance of communication; Principles of communication; Barriers to communication; General vs Business communication.	3 Hours
Module-2	Sounds of English: Importance of neutral accent; vowels, diphthongs, consonants and consonant clusters; syllable and stress.	5 Hours
Module-3	Critical Reading: Importance of reading; Intensive and extensive reading; reading strategies, Reading texts (short story, contemporary essay, editorial).	5 Hours
Module-4	Effective Business Communication (Oral): Purpose and importance of business communication; technology in communication; Structure of business organisation; Patterns of business communication; Models of communication in business settings.	7 Hours
Module-5	Effective Business Communication (Written): Constituents of effective business writing; Process writing; Paragraph writing; Common written forms in business writing; Importance, features, format and uses.	8 Hours
Total		28 Hours

Text Books:

- T1. M. A. Rizvi, *Effective Technical Communication*, 2nd Edition, McGraw-Hill Education, 2017.
- T2. T. Balasubramaniam, *English Phonetics for Indian Students*, 3rd Edition, Trinity Press, 2017.
- T3. M. Raman and S. Sharma, *Technical Communication: Principles & Practice*, 2nd Edition, Oxford University Press, 2011.
- T4. D. K. Das, A. Kumari, and K. K. Padhi, *Anthology of Modern English Prose*, 1st Edition, Laxmi Publications, 2011.

Reference Books:

- R1. S. Kumar and P. Lata, *Communication Skills*, Oxford University Press, 2011.
- R2. K. R. Lakshminarayanan and T. Murugavel, *Communication Skills for Engineers*, Scitech Publications, 2009.

- R3. J. Seeley, *The Oxford Guide to Effective Writing and Speaking*, 3rd Edition, Oxford University Press, 2013.
- R4. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohanty, *An Introduction to Professional English and Soft Skills*, Cambridge University Press, 2009.
- R5. S. Samantray, *Business Communication and Communicative English*, S. Chand & Co, 2017.

Online Resources:

1. <https://nptel.ac.in/courses/109/106/109106094/>: By Prof. A. Iqbal, IIT Madras
2. <https://nptel.ac.in/courses/109/104/109104031/>: By Dr. T. Ravichandran, IIT Kanpur
3. <https://www.coursera.org/specializations/business-english>
4. <https://ocw.mit.edu/courses/comparative-media-studies-writing/21w-732-5-introduction-to-technical-communication-explorations-in-scientific-and-technical-writing-fall-2006/download-course-materials/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the elements of and technical communication and possible barriers to it.
CO2	Explain the basic aspects of English pronunciation and speak using a neutral accent.
CO3	Enhance their reading skills and be able to critically analyse texts of various kinds.
CO4	Effectively use the channels of business communication and hierarchies to communicate in a business set-up.
CO5	Compose basic business correspondences effectively.

Program Outcomes Relevant to the Course:

PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								1	1	2	2	3	1	3	1
CO2									1	1	1	3	1	2	1
CO3								1	1	1	2	3	1	3	1
CO4									3	2	3	3		3	1
CO5								3		3		3		3	2

Type	Code	Engineering Chemistry Lab	L-T-P	Credits	Marks
BS	BTBS-P-BS-003		0-0-2	1	100

Objectives	Objectives of the subject is to educate the students with modern instrumental techniques & role of chemical analysis in various fields of engineering and science to examine and understand the effect of chemicals, compositions, impurities etc., on the properties of materials & the detrimental effects of polluting materials, and other unwanted impurities.
Pre-Requisites	Student should have the knowledge of balancing equations, principle of titrations, titrant, titrand, preparation of standard solutions, concentration of a solution, indicators used in a titration, principle of reduction-oxidation reactions, handling of instruments like pH meter & accurate measurement of sample by using electronic balance.
Teaching Scheme	Regular laboratory experiments conducted under supervision of the teacher. Demonstration will be given for each experiment.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
<i>At least 10 Experiments</i>	
1	Determination of Total hardness of water sample by EDTA method.
2	Determination of alkalinity of water.
3	Determination of available chlorine of bleaching powder/residual chlorine in tap water.
4	Determination of dissolved oxygen in supplied water.
5	Determination of saponification value of oil.
6	Determination of Acid value of oil.
7	Determination of Flash-point/fire point of a lubricant by Pensky-Martens apparatus.
8	Determination of kinematic viscosity and Viscosity Index of a lubricant by Redwood viscometer.
9	Determination of concentration of a colour substance by Spectrophotometer.
10	Green synthesis of noble metal/oxide based nanoparticles.
11	Estimation of calcium in limestone powder.
12	Determination of chloride content of water.
13	Determination of the partition coefficient of a substance between two immiscible liquids.
14	Adsorption of acetic acid by charcoal.
15	Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin solutions and/or coagulation of the white part of egg.

Cont'd...

Experiment-#	Assignment/Experiment
16	Proximate analysis of coal sample.
17	Determination of iodine value of oil/fat.

Text Books:

- T1. Jain & Jain, *Engineering Chemistry*, 16th Edition, Dhanpat Rai Publishing Company, 2015.
 T2. S. S. Dara, *Engineering Chemistry*, 12th Edition, S. Chand Publisher, 2014.

Reference Books:

- R1. S. Chawla, *Essentials of Experimental Engineering Chemistry*, Dhanpat Rai & Co.
 R2. S. K. Bhasin and S. Rani, *Laboratory Manual on Engineering Chemistry*, 3rd Edition, Dhanpat Rai & Co, 2012.

Online Resources:

- <https://www.metrohm.com/en/industries/petro-lubricants/>: Lubricant analysis according to international standards
- <http://www.eco-web.com/edi/01759.html>: Efficient Wastewater Treatment: The field for analytical and monitoring

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyse various water quality parameters such as alkalinity, hardness, dissolved oxygen & chloride content before it is put into use in various general, research, or industrial purposes.
CO2	Test the quality of an oil/fat by measuring its iodine or acid value by means of amount of unsaturation for various industrial use.
CO3	Verify quality of a lubricant by means of its viscosity or flash point which gives their nature & flammability for various industrial applications.
CO4	Analyse various fractions present in coal by proximate analysis for better use of carbon based compounds in industrial applications.
CO5	Study the importance of green synthesis by way of synthesising metal/ metal oxide based nano-particles for various material applications.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Cont'd...

PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1	2		1		2	1			1	1	2
CO2	2	2		1	2		2		2	2			1	2	1
CO3	3	2		1	2		1		2	2			1	1	2
CO4	3	3		1	1		2		2	2			1	2	2
CO5	3	2		1	1		1		1	1			2	1	1

Type	Code	Engineering Physics Lab	L-T-P	Credits	Marks
BS	BTBS-P-BS-007		0-0-2	1	100

Objectives	The objective of this course is to develop the basic practical skill to design and measure different parameters of a physical quantity with proper error analysis which can help them in different field of engineering sciences. This practical knowledge will be useful for the engineering students to understand the basic operating principle of instruments. The knowledge obtained can also be used to prepare various models and projects.
Pre-Requisites	Adequate practical knowledge in Higher Secondary Physics including measuring instruments like screw gauge, slide caliper, spherometer etc. Knowledge of error analysis, graphical analysis etc. is also required.
Teaching Scheme	Regular laboratory experiments conducted under supervision of the teacher. Demonstration will be given for each experiment.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Determination of bandgap of semiconductor.
2	Determination of rigidity modulus by static method.
3	Determination of surface tension by capillary rise method.
4	Determination of acceleration due to gravity by bar / Kater's pendulum.
5	Determination of Plank's constant, verification of inverse square law by photocell.
6	Determination of wavelength of light by Newton's ring apparatus.
7	Determination of grating element of a diffraction grating.
8	Plotting of characteristic curve of a PN junction diode.
9	Plotting of characteristic curves of BJT.
10	Verification of laws of vibration of stretched string using sonometer.
11	Determination of wavelength of laser source by diffraction grating method.
12	Study of Hall effect.
13	Study of RC circuit.
14	Determination of Young's modulus by bending of beams.
15	Michelson Interferometer.
16	Determine of reduction factor of the given tangent galvanometer and horizontal component of Earth's magnetic field using tangent galvanometer.

Text Books:

- T1. C. L. Arora, *B.Sc. Practical Physics*, 20th Edition, S.Chand & Co.Ltd, 2009.
 T2. S. Srivastava, *Practical Physics*, 3rd Edition, New Age International, 2017.

Reference Books:

- R1. H. Singh, *B.Sc. Practical Physics*, S. Chand & Co.Ltd, 2002.
 R2. B.Mallick, S. Panigrahi, *Engineering Practical Physics*, Cengage Learning, 2015.

Online Resources:

1. <https://nptel.ac.in/courses/122103010/>
2. <https://www.practicalphysics.org/>
3. <http://www.bsauniv.ac.in/>: Search for PHYSICS-LAB-MANUAL2017-(new-regulation).pdf
4. <https://arxiv.org/ftp/arxiv/papers/1510/1510.00032.pdf>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyze the wave aspect of light like interference and diffraction by conducting Newton's rings and Fraunhofer diffraction experiment.
CO2	Investigate some properties of matter like surface tension of water (capillary rise method) and coefficient of elasticity of steel, copper.
CO3	Verify and analyze the IV characteristics of junction diode and BJT, charging and discharging of capacitor in RC circuit.
CO4	Study and apply Hall effect to calculate the Hall coefficient, carrier concentrations; measure band gap of semiconductor and dielectric constant of dielectric material.
CO5	Understand and verify laws of transverse vibrations in a stretched string using sonometer.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2								1	3	2	2
CO2	2	2		1	1							1	1		1
CO3	2	1		2									3	3	2
CO4	2	2		3	1								3	2	2
CO5	3	1		1								1	1		1

Type	Code	Manufacturing Practices	L-T-P	Credits	Marks
ES	BTBS-P-ES-009		0-0-2	1	100

Objectives	The objective of this practical course is to provide the basic concepts about tools used in manufacturing practices. Detailed concepts are proposed in all the major trades of engineering interest.
Pre-Requisites	None
Teaching Scheme	Regular manufacturing jobs using tools under supervision of the teacher. Demonstration will be given for each experiment.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction & familiarity with tools: measuring, marking, holding, and cutting tools, Fitting (limit, fit, tolerance), Fastening (different types of screws, rivets, nuts & bolts).
2	Welding: Arc welding & Gas welding - theory & setup, Machining: Study of different parts & function of Lathe, Milling & Shaping.
3	To make a hexagonal bolt & nut with facing, step turning, internal & external threading & grooving (V-groove, rectangular groove on a square block) using Lathe, milling & shaping machine.
4	To make a flange coupling using Gas welding, arc welding & fitting.
5	To make heat-sink by using a metal plate (sheet metal work).
6	Introduction to electrical tools and safety measures. Demonstrate the precautionary steps adopted in case of electrical shocks.
7	Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
8	To design and develop a simple winding for inductor and 230/12V transformers used in electronics circuits.
9	Introduction to house wiring: <ol style="list-style-type: none"> 1. Wiring of simple circuit for controlling light/fan point. 2. Wiring of Two-way switches. 3. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
10	Familiarization of PCB assembling tools [such as Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screwdrivers, Tweezers, Crimping tool, Micro-soldering station, Hot air soldering and de-soldering station etc.] and testing tools [such as Multimeter, DSO, clamp meter, function generator etc.]
11	Familiarization of EDA tools (such as Eagle or Xcircuit) with general purpose components for designing a Printed Circuit Board (PCB) and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride solution).
12	Testing of a sample PCB (Types: Single sided, Double sided) for selected applications with general purpose instruments.

Text Books:

- T1. S. K. H. Choudhury, *Elements of Workshop Technology, Vol-1 and Vol-2*, Media Promotors & Publishers, 2008.
- T2. B. H. Deshmukh, *Electrical Materials and Wiring Practices*, Nirali Prakashan, 2018.
- T3. R. S. Khandpur, *Printed Circuit Boards: Design, Fabrication, Assembly and Testing*, 1st Edition, McGraw Hill, 2006.

Reference Books:

- R1. S. Monk, *Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards*, McGraw-Hills, 1st edition, 2014.
- R2. H. Joshi, *Residential, Commercial and Industrial Electrical Systems: Protection, Testing and Commissioning, Vol-3*, McGraw-Hill Education, 2008.
- R3. J. Varterisian, *Fabricating Printed Circuit Boards*, 1st Edition, Newnes, 2002.

Online Resources:

1. <http://www.technicaltrainingsolutions.co.uk/courses/bench-fitting-course.html>
2. <http://nptel.ac.in/courses/112101005/14>: (Sheet Metal Forming Processes)
3. <http://nptel.ac.in/downloads/112105127>: (Machining Processes)
4. <http://nptel.ac.in/courses/112107144/27>: (Welding Processes)
5. https://bharatskills.gov.in/pdf/E_Books/Electrician_SEM1_TP.pdf
6. https://bharatskills.gov.in/pdf/E_Books/Electrician_SEM2_TP.pdf
7. <https://bharatskills.gov.in/Home/StudyMaterial?var=WSdYV6aWadK8jUuNKxoBWg==>
8. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
9. https://www.lanl.gov/safety/electrical/docs/arc_flash_safety.pdf
10. https://www.ee.iitb.ac.in/~pcpandey/courses/ee616/pcblayout.c_aug07.pdf
11. <https://nptel.ac.in/courses/108/108/108108157/>
12. <https://nptel.ac.in/courses/122/106/122106025/>
13. <https://nptel.ac.in/courses/108/101/108101091/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Brief idea about the workshop, different tools and their operation, limits, fits, tolerance while assembling different parts of a flange coupling by using fitting shop.
CO2	Design and fabricate the components of a flange coupling by using machine tools and welding operation.
CO3	Identify different safety equipment and apply those in various electrical systems.
CO4	Plan and Design wiring configuration of residential and office and calculate the energy consumption for various loads.
CO5	Familiarity with PCB designing and fabrication methodology for different applications.
CO6	Analysis and application of specific PCB using modern instruments.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Cont'd...

PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1	1		2			3		3	2	1	1	1
CO2	2	1	2	1		2			3		3	2	1	1	1
CO3	1	1	2	1	2	1		1	1	1	3	1	1	1	1
CO4	2	3	3	1	1	1		1	2	2	3	1	1	1	1
CO5	3	3	3	1	2	1			3	1	3	2	2	3	2
CO6	3	3	1	1	2	1			2	1	3	2	2	2	1

Type	Code	Engineering Graphics	L-T-P	Credits	Marks
ES	BTBS-P-ES-004		0-0-2	1	100

Objectives	The objective of this laboratory course is to learn engineering drawing standards, conventions & practices, develop drawing skills in 2D & 3D, and use computer-aided drawing software to create meaningful engineering drawings.
Pre-Requisites	Basic understanding of 2D and 3D geometry is required.
Teaching Scheme	Regular laboratory classes using drawing tools under supervision of the teacher. Demonstration will be given for each drawing assignment using both conventional and CAD software tools as per requirement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Principles of Engineering Graphics and their significance (lettering & scale) and usage of Drawing instruments.
2	Orthographic projections, Principles of orthographic projections, Projections of points and lines.
3	Projections of different planes.
4	Projection of solids, 3D to 2D views, Machine component diagrams, Sectional views of simple and compound solid models.
5	Principles of Isometric projection, Isometric Scale & Views, Isometric views of planes and solids.
6	Development of surface and intersection of surfaces.
7	Engineering curves and conics.
8	Introduction to AutoCAD, GUI of AutoCAD, Tool bars and commands, use of mouse and short cut keys.
9	2D AutoCAD drawing using basic tools, Draw & Modify menu commands.
10	Orthographic projection drawings of various models using AutoCAD.
11	Isometric drawing & 3D modeling in AutoCAD, different solid editing options.
12	3D modeling of simple & compound models, and machine components using AutoCAD.

Text Books:

- T1. N. D. Bhat, M. Panchal, *Engineering Drawing*, Charotar Publishing House, 2008.
- T2. M. B. Shah, B. C. Rana, *Engineering Drawing and Computer Graphics*, Pearson Education, 2008.
- T3. S. Tickoo, *AutoCAD 2020 Work Book*, BPB Publications, 2020.

Reference Books:

- R1. R. K. Dhawan, *A Text Book of Engineering Drawing*, S. Chand Publications, 2007.
- R2. K. Venugopal, *Engineering Drawing and Graphics*, 3rd Edition, New Age International, 1998.

Online Resources:

1. <http://nptel.ac.in/courses/112103019>
2. <https://nptel.ac.in/courses/112/102/112102101/>
3. <https://freevideolectures.com/course/3420/engineering-drawing>
4. <https://www.autodesk.in/campaigns/autocad-tutorials>
5. <https://help.autodesk.com/view/ACD/2020/ENU/>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand and apply the concepts of lettering and dimensioning for drafting of machine drawings and building drawings and different conics and curves.
CO2	Recognize and be familiar with the orthographic projections of points, lines, planes and solids.
CO3	Visualize the real product from isometric projections, solid and sectional views.
CO4	Become familiar with AutoCAD, its different tools and commands.
CO5	Draw various 2D drawings using draw and modify tools of AutoCAD.
CO6	Design various machine components and building structure by using AutoCAD.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1					2	1	1	1		1
CO2	3	2	1	1	1					2	1	1	1		1
CO3	3	2	1	1	1					2	1	1	1		1
CO4	3	1	1	1	1					2	1	1	1		1
CO5	3	2	2	2	3					2	2	1	1		1
CO6	3	2	1	1	2					2	2	1	2		2

Type	Code	Basic Electronics Engineering Lab	L-T-P	Credits	Marks
ES	BTEC-P-ES-002		0-0-2	1	100

Objectives	Know broadly the concepts and functionalities of the electronic devices, tools and instruments. Understand general specifications and deployability of the electronic devices, and assemblies. Develop confidence in handling and usage of electronic devices, tools and instruments in engineering applications.
Pre-Requisites	Knowledge on intrinsic and extrinsic Semiconductors, Physics and Chemistry of Higher Secondary Science level.
Teaching Scheme	Regular laboratory experiments to be conducted under the supervision of teachers and demonstrators with the help of ICT, as and when required along with pre-lab session and demonstration for each experiment.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi-meter).
2	Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
3	V-I characteristics of semiconductor diode and determining its DC and AC resistances.
4	Implementation of clipper circuits, both positive clipper and negative clipper. Observe its output waveforms and compare them with theoretical analyzed results.
5	Study of half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectified output.
6	Study of static characteristics of BJT in CE configuration.
7	DC biasing (Fixed bias) of the transistor in CE configuration and determination of its operating point.
8	Studies on Op-Amp applications (Inverting, non-inverting, integrating differentiating configurations) recording of the input-output waveforms.
9	Studies on logic gates (truth table verification of various gates, implementation of EXNOR and Half Adder using basic gates).
10	Design of 2:1 MUX and simple SR Latch.

Text Books:

- T1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 11th Edition, Pearson Education.
- T2. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th Edition, Oxford University Press.

Reference Books:

- R1. V. K. Mehta and R. Mehta, *Principles of Electronics*, 3rd Edition, S. Chand Publishing, 1980.

Online Resources:

1. http://vlab.co.in/ba_labs_all.php?id=1
2. <http://iitg.vlab.co.in/?sub=59&brch=165>

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Familiarize with various electronic components, measuring instruments, semiconductor diodes and their applications.
CO2	Acquire knowledge of characteristics of transistors and design, testing & implementation of transistors in various applications
CO3	Gain understanding of operational amplifiers (Op-Amp) and design & testing of electronic circuits for various applications using Op-Amp.
CO4	Develop understanding of digital logic gates and design & test digital circuits for various applications using logic gates.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1										2	2	2
CO2	3	3	2	1									3	3	2
CO3	2	2	2	1									3	2	2
CO4	2	2	3										3	3	2

Type	Code	Basic Electrical Engineering Lab	L-T-P	Credits	Marks
ES	BTEE-P-ES-002		0-0-2	1	100

Objectives	Introduce the students to different electrical components and basic safety rules and regulations, give hands on practice about different measuring and protection equipment and their operations to understand and verify the basic concept of electrical & magnetic circuits and electric machines. The laboratory experiments shall go hand-in-hand with the topics taught in the theory class.
Pre-Requisites	Basic knowledge of different electrical components and different analysis techniques of electrical and magnetic circuits. Topics taught in Basic Electrical Engineering theory class are essential to conduct the experiments.
Teaching Scheme	Regular laboratory experiments conducted under supervision of the teacher. Demonstration will be given for each experiment.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Connection and measurement of power consumption of a fluorescent lamp.
2	Identification of different terminals of a DC compound machine.
3	Power and power factor measurement of 3-phase load by two wattmeter method.
4	Connection and testing of a single-phase energy meter.
5	Determination of open circuit characteristics (OCC) of DC shunt generator.
6	Calculation of power and power factor in series R-L-C circuit by AVW method.
7	Polarity test of a single-phase transformer.
8	Study of single-phase induction motors / fan motor.
9	Verify Thevenin's Theorem and Superposition Theorem.
10	Draw the B-H curve of a magnetic Specimen.
11	Starting of three-phase induction motor.
12	Regulation and efficiency of single phase transformer by direct loading.

Text Books:

- T1. A. Husain, *Fundamentals of Electrical Engineering*, 4th Edition, Dhanpat Rai & Co., 2016.
 T2. B. L. Thereja & A. K. Thereja, *A Textbook of Electrical Technology*, 23rd Edition, S. Chand & Co.

Reference Books:

- R1. J. B. Gupta, *A Textbook of Electrical Science*, S. K. Kataria & Sons, 2013.
 R2. B. R. Gupta and V. Singhal, *Electrical Science*, S. Chand & Co, 2005.

Online Resources:

- www.nptel.iitm.ac.in/electricalengineering
- www.electronics-tutorials.ws/dc-circuits

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Get an exposure to common electrical components and their ratings.
CO2	Develop electrical circuits using wires, measuring instruments, and protective devices of appropriate ratings.
CO3	Understand the usage of common electrical measuring instruments.
CO4	Understand the basic characteristics of transformers and electrical machines.
CO5	Verify different network theorems and magnetic properties.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			2		1		1	1	1	1	1	1	1	2
CO2	2			2		1		2	1	1	2	1	1	1	1
CO3	1			3		2		2	1	1	1	1	2	1	2
CO4	1			2		2		1	1	2	2	1	2	1	2
CO5	1			1		1		1	1	1	1	1	2	1	2

Type	Code	Computer Programming Lab	L-T-P	Credits	Marks
ES	BTCS-P-ES-002		0-0-4	2	100

Objectives	To enable the students to analyse problems, formulate and implement solutions using the C programming language. The students will develop logical understanding for converting solutions of problems into C programs to be executed on a computer.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to computers and Linux operating system.
2, 3	Get acquainted with the programming environment - Linux commands and VI-editor.
4	Editing, compiling, executing, and debugging of simple C programs.
5	Programs using operators and formatted input/output statements.
6	Decision making using if, if-else, else-if ladder, nested if.
7	Decision making using switch-case construct.
8, 9	Loop control structure (while, do-while, for) with jump statements.
10	Nested loops (printing various formats)
11, 12	1-D arrays including operation like searching, sorting, merging etc.
13	Handling 2-D arrays such as matrix operations.
14, 15	Programs on strings using various string handling functions (library functions)
16, 17	Designing user-defined functions.
18, 19	Programs on recursion.
20	Designing user defined functions for string manipulation.
21	Passing arrays (both 1D and 2D) to functions.
22, 23	Structure, array of structure, nested structure.
24	Dynamic memory management.
25	Self-referential structure (create and display operation of single linked list)
26, 27	File handling - reading from and writing to files.
28	Command-line argument, pre-processor directives.

Text Books:

- T1. E. Balagurusamy, *Programming in ANSI C*, 7th Edition, McGraw-Hill Education, 2017.
- T2. Y. Kanetker, *Let Us C*, 16th Edition, BPB Publications, 2018.

Reference Books:

- R1. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd Edition, Pearson Education, 2015.
- R2. H. Schildt, *C: The Complete Reference*, 4th Edition, McGraw-Hill, 2017.
- R3. A. Kelley and I. Pohl, *A Book on C*, 4th Edition, Pearson Education, 2008.
- R4. B. Gottfried, *Schaum's Outline of Programming with C*, 3rd Edition, McGraw-Hill, 2017.

Online Resources:

1. <https://www.w3resource.com/c-programming-exercises/>
2. <https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx>
3. https://www.onlinegdb.com/online_c_compiler
4. https://www.tutorialspoint.com/compile_c_online.php

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct C programs for mathematical operations using control statements.
CO2	Develop C programs for Array and String manipulation.
CO3	Construct modular programs for better maintenance and reusability.
CO4	Manipulate heterogeneous data using structure and union.
CO5	Create and manipulate files using C programs.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1								1	3	2	3
CO2	3	3	3	2								1	3	2	3
CO3	3	3	3	2								1	3	2	3
CO4	3	2	2	2								1	3	2	3
CO5	3	3	2	3								1	2	1	1

Type	Code	Data Structures & Algorithms Lab	L-T-P	Credits	Marks
ES	BTCS-P-ES-004		0-0-4	2	100

Objectives	Develop skills to design and analyze simple linear and non linear data structures, strengthening the ability of students to identify and apply the suitable data structure for the given real world problem.
Pre-Requisites	Knowledge of programming in C, specifically on structures, pointers, functions, recursion etc., are required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Operations on arrays – insert, delete, merge.
2	Selection Sort, Bubble sort.
3	Linear Search and Binary search.
4	Representation of sparse matrix.
5, 6	Addition and transpose of sparse matrix.
7	Implementation of stack using array.
8	Conversion of infix to postfix expression.
9	Evaluation of postfix expression.
10	Operations of queue using array.
11	Operations of circular queue.
12, 13	Single linked list operations.
14, 15	Double linked list operations.
16	Circular linked list operations.
17	Stack using linked list.
18	Queue using linked list.
19	Polynomial addition using linked-list.
20, 21	Binary Search Tree operations.
22, 23	Graph traversal (BFS, DFS).
24	Warshall's shortest path algorithm.
25, 26	Implementation Insertion Sort and Quick Sort.
27, 28	Implementation of Merge Sort and Heap Sort.

Text Books:

- T1. E. Horowitz, S. Sahni, S. Anderson-Freed, *Fundamentals of Data Structures in C*, 2nd Edition, Universities Press, 2008.
- T2. M. A. Weiss, *Data Structures and Algorithm Analysis in C*, 2nd Edition, Pearson Education, 2002.

Reference Books:

- R1. A. K. Rath and A. K. Jagadev, *Data Structures Using C*, 2nd Edition, Scitech Publication, 2011.
 R2. Y. Kanetkar, *Data Structures Through C*, 2nd Edition, BPB Publication, 2003.

Online Resources:

1. <https://nptel.ac.in/courses/106/106/106106127/>: By Prof. H. A. Murthy, Prof. S. Balachandran, and Dr. N. S. Narayanaswamy, IIT Madras
2. <https://nptel.ac.in/courses/106/102/106102064/>: By Prof. N. Garg, IIT Delhi
3. <https://nptel.ac.in/courses/106/106/106106130/>: By Dr. N. S. Narayanaswamy, IIT Madras

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Implement various operations on array and sparse matrix.
CO2	Design functions to implement basic operations on stack & queue and apply them to solve real world problems.
CO3	Implement single, double & circular linked list and apply them in various real life applications.
CO4	Construct binary search tree and perform traversal, insertion, deletion, and search operations on it.
CO5	Perform BFS and DFS traversal operations in a graph and implement various sorting and searching algorithms.

Program Outcomes Relevant to the Course:

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2								1	2	2	1
CO2	3	3	3	2								1	2	1	1
CO3	3	3	3	2								1	2	1	1
CO4	3	3	2	3								1	2	2	1
CO5	3	3	3	3								1	2	3	1

Type	Code	Communicative & Technical English Lab	L-T-P	Credits	Marks
HS	BTBS-P-HS-011		0-0-2	1	100

Objectives	This laboratory course is designed to make students effective communicators and addressing issues like speaking inhibitions, accomplished by individual and team activities based on the four skills of language (LSRW).
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language.
Teaching Scheme	Regular laboratory classes with various tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Module 1: Analyzing communication situations through role-plays.
2	Module 1: Barriers in communication: video analysis
3	Module 2: Developing pronunciation skills – speech sounds and stress
4	Module 2: Developing pronunciation skills: listening to native English speech
5	Module 3: Reading comprehension – extensive: short story
6	Module 3: Reading comprehension – intensive: editorial
7	Module 4: Models of oral business communication: role-plays
8	Module 4: Oral presentations
9	Module 4: Oral presentations
10	Module 4: Oral presentations
11	Module 5: Written Communication – paragraph development
12	Module 5: Business Writing – email
13	Module 5: Business Writing – letter

Text Books:

- T1. M. A. Rizvi, *Effective Technical Communication*, 2nd Edition, Tata McGraw Hill, 2017.
- T2. T. Balasubramaniam, *English Phonetics for Indian Students*, Trinity Press.
- T3. M. Raman and S. Sharma, *Technical Communication: Principles and Practices*, Oxford University Press.

Reference Books:

- R1. S. Samantray, *Business Communication and Communicative English*, S. Chand & Co.
- R2. J. Seeley, *The Oxford Guide to Writing and Speaking*, Oxford University Press.
- R3. B. K. Mitra, *Communication Skills for Engineers*, Oxford University Press, 2011.
- R4. B. K. Das, *An Introduction to Professional English & Soft Skills*, Cambridge Univ. Press, 2009.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Speak in public and overcome their inhibitions to speak.
CO2	Develop English pronunciation skills through practice.
CO3	Comprehend and critically appreciate technical texts.
CO4	Work effectively as a member of a team or as a leader through group presentation assignments.
CO5	Critically analyse texts of various kinds and compose effective business messages.

Program Outcomes Relevant to the Course:

PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1								2	3	3	3	3	1	3	1
CO2									1	3	1	3		2	1
CO3									1	3	2	3	1	3	1
CO4								2	3	3	3	3	1	3	1
CO5								1	1			3	1	3	1

Part II
2nd Year B. Tech. (ECE)

Curriculum Structure

(This is for indicative purpose only and may be updated in due course)

Semester III								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
BS	BTBS-T-BS-040	Mathematics-III for Electrical Sciences	3	0	0	3	0	0
ES	BTCS-T-ES-005	OOP Using Java	3	0	0	3	0	0
PC	BTEE-T-PC-003	Circuit Theory	3	0	0	3	0	0
PC	BTEC-T-PC-005	Electromagnetic Waves	3	0	0	3	0	0
PC	BTEI-T-PC-001	Analog Electronic Circuits	3	0	0	3	0	0
PC	BTEC-T-PC-007	Signal & Systems	3	0	0	3	0	0
PRACTICAL								
ES	BTCS-P-ES-006	OOP Using Java Lab	0	0	2	0	0	1
PC	BTEE-P-PC-004	Circuit Theory Lab	0	0	2	0	0	1
PC	BTEC-P-PC-006	Electromagnetic Waves Lab	0	0	2	0	0	1
PC	BTEI-P-PC-002	Analog Electronic Circuits Lab	0	0	2	0	0	1
PJ	BTII-P-PJ-001	Summer Internship - I	0	0	0	0	0	1
SUB-TOTAL			18	0	8	18	0	5
TOTAL			26			23		

Semester IV								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
BS	BTBS-T-BS-025	Mathematics-IV for Electrical Sciences	3	0	0	3	0	0
ES	BTBS-T-ES-013	Basics of Mechanical Engineering	3	1	0	3	1	0
PC	BTEC-T-PC-010	Digital Electronic Circuits	3	0	0	3	0	0
PC	BTEC-T-PC-008	Analog Communication	3	0	0	3	0	0
PC		Control Systems Engineering	3	0	0	3	0	0
OE		Open Elective - I	3	0	0	3	0	0
MC	BTBS-T-MC-020	Universal Human Values & Professional Ethics	2	0	0	0	0	0
PRACTICAL								
PC	BTEC-P-PC-011	Digital Electronic Circuits Lab	0	0	2	0	0	1
PC	BTEC-P-PC-009	Analog Communication Lab	0	0	2	0	0	1
PC		Control Systems Engineering Lab	0	0	2	0	0	1
PC		Corporate Communication Lab	0	0	2	0	0	1
MC	BTBS-P-MC-017	Yoga	0	0	2	0	0	0
SUB-TOTAL			20	1	10	18	1	4
TOTAL			31			23		

Note: Courses offered under each elective are given in "List of Electives" on Page 53.

List of Electives

Code	Elective # and Subjects
<i>Open Elective - I</i>	
	[EEE] Basics of Power Systems
BTBS-T-OE-027	[BSH] Applied Linear Algebra
BTBS-T-OE-028	[BSH] Fluid Mechanics
BTCS-T-OE-036	[CSE] Operating Systems
BTCS-T-OE-039	[CSE] Programming in Python
BTEI-T-OE-020	[EIE] Biomedical Instrumentation & Signal Processing

Note: *Open Electives* are choice-based courses offered by other departments as indicated within brackets.

Part III
3rd Year B. Tech. (ECE)

Curriculum Structure

(This is for indicative purpose only and may be updated in due course)

Semester V								
Type	Code	Course Title	WCH			Credits		
			L	T	P	L	T	P
THEORY								
HS		Engineering Economics	3	0	0	3	0	0
PC		Microprocessors & Microcontrollers	3	0	0	3	0	0
PC		Digital Signal Processing	3	0	0	3	0	0
PC		Digital Communication	3	0	0	3	0	0
PE		Professional Elective - I	3	0	0	3	0	0
OE		Open Elective - II	3	0	0	3	0	0
PRACTICAL								
HS		Soft Skills & Inter-Personal Skills Lab	0	0	4	0	0	2
PC		Microprocessors & Microcontrollers Lab	0	0	2	0	0	1
PC		Digital Signal Processing Lab	0	0	2	0	0	1
PC		Digital Communication Lab	0	0	2	0	0	1
PJ		Summer Internship - II	0	0	0	0	0	1
		SUB-TOTAL	18	0	10	18	0	6
		TOTAL	28			24		

Semester VI								
Type	Code	Course Title	WCH			Credits		
			L	T	P	L	T	P
THEORY								
BS		Biology for Engineers	3	0	0	3	0	0
HS		Fundamentals of Management	3	0	0	3	0	0
PC		Microwave Engineering	3	0	0	3	0	0
PC		Digital VLSI Design	3	1	0	3	1	0
PE		Professional Elective - II	3	0	0	3	0	0
PE		Professional Elective - III	3	0	0	3	0	0
OE		Open Elective - III	3	0	0	3	0	0
PRACTICAL								
PC		Microwave Engineering Lab	0	0	2	0	0	1
PC		Digital VLSI Design Lab	0	0	2	0	0	1
PJ		Skill Lab & Project - I	0	0	4	0	0	2
		SUB-TOTAL	21	1	8	21	1	4
		TOTAL	30			26		

Note: Courses offered under each elective are given in "List of Electives" on Page 56.

List of Electives

Code	Elective # and Subjects
<i>Professional Elective - I</i>	
	MEMS & Sensor Design
	Basics of Instrumentation
	Soft Computing Techniques
	Electronic Devices & Modelling
<i>Professional Elective - II</i>	
	Information Theory & Coding
	IoT & Applications
	Robotics & Robot Applications
<i>Professional Elective - III</i>	
	Digital Image & Video Processing
	Analog VLSI Design
	Fiber Optic Communications
<i>Open Elective - II</i>	
	[EEE] Renewable Energy Systems
	[BSH] Numerical Optimization
	[BSH] Organizational Behaviour
	[CSE] Fundamentals of DBMS
	[EIE] Industrial Automation & Control
<i>Open Elective - III</i>	
	[EEE] Power Station Engineering
	[BSH] Stochastic Processes
	[BSH] Project Management
	[CSE] Internet Technology & Applications
	[CSE] Advanced Java Programming
	[EIE] Virtual Instrumentation

Note: *Open Electives* are choice-based courses offered by other departments as indicated within brackets.

Part IV
4th Year B. Tech. (ECE)

Curriculum Structure (Regular)

(This is for indicative purpose only and may be updated in due course)

Semester VII								
Type	Code	Course Title	WCH			Credits		
			L-T-P			L-T-P		
THEORY								
PE		Professional Elective - IV	3	0	0	3	0	0
OE		Open Elective - IV	3	0	0	3	0	0
OO		MOOC Course (Self Study)	0	0	0	3	0	0
PRACTICAL								
PC		Emerging Technologies Lab	0	0	2	0	0	1
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	6	0	2	9	0	2
		TOTAL	8			11		

Semester VIII								
Type	Code	Course Title	WCH			Credits		
			L-T-P			L-T-P		
THEORY								
PE		Professional Elective - V	3	0	0	3	0	0
PE		Professional Elective - VI	3	0	0	3	0	0
OO		MOOC Course (Self Study)	0	0	0	3	0	0
PRACTICAL								
PJ		Presentation Skills & Technical Seminar	0	0	4	0	0	2
PJ		Project - II	0	0	16	0	0	8
VV		Comprehensive Viva	0	0	0	0	0	1
		SUB-TOTAL	6	0	20	9	0	11
		TOTAL	26			20		

		GRAND TOTAL (8 SEMESTERS)	199			162		
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Note:

1. Approved list of MOOC Courses for self study shall be published by the department.
2. Courses offered under each elective are given in "List of Electives" on Page 61.

Curriculum Structure (PS-7)
(For Students opting for Practice School / Industry Internship in the 7th Semester)
(This is for indicative purpose only and may be updated in due course)

Semester VII								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
OO		MOOC Course (Self Study)	0	0	0	3	0	0
PRACTICAL								
PS		Practice School / Industry Internship	0	0	0	0	0	16
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	0	0	0	3	0	17
		TOTAL	0			20		

Semester VIII								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
PE		Professional Elective - IV	3	0	0	3	0	0
OE		Open Elective - IV	3	0	0	3	0	0
OO		MOOC Course (Self Study)	0	0	0	3	0	0
PRACTICAL								
PC		Emerging Technologies Lab	0	0	2	0	0	1
VV		Comprehensive Viva	0	0	0	0	0	1
		SUB-TOTAL	6	0	2	9	0	2
		TOTAL	8			11		

		GRAND TOTAL (8 SEMESTERS)	173			162		
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Note:

1. *Approved list of MOOC Courses for self study shall be published by the department.*
2. *Courses offered under each elective are given in "List of Electives" on Page 61.*

Curriculum Structure (PS-8)
(For Students opting for Practice School / Industry Internship in the 8th Semester)
(This is for indicative purpose only and may be updated in due course)

Semester VII									
Type	Code	Course Title	WCH L-T-P			Credits L-T-P			
THEORY									
PE		Professional Elective - IV	3	0	0	3	0	0	
OE		Open Elective - IV	3	0	0	3	0	0	
OO		MOOC Course (Self Study)	0	0	0	3	0	0	
PRACTICAL									
PC		Emerging Technologies Lab	0	0	2	0	0	1	
PJ		Summer Internship - III	0	0	0	0	0	1	
		SUB-TOTAL	6	0	2	9	0	2	
		TOTAL	8			11			

Semester VIII									
Type	Code	Course Title	WCH L-T-P			Credits L-T-P			
THEORY									
OO		MOOC Course (Self Study)	0	0	0	3	0	0	
PRACTICAL									
PS		Practice School / Industry Internship	0	0	0	0	0	16	
VV		Comprehensive Viva	0	0	0	0	0	1	
		SUB-TOTAL	0	0	0	3	0	17	
		TOTAL	0			20			

		GRAND TOTAL (8 SEMESTERS)	173			162		
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Note:

1. Approved list of MOOC Courses for self study shall be published by the department.
2. Courses offered under each elective are given in "List of Electives" on Page 61.

List of Electives

Code	Elective # and Subjects
<i>Professional Elective - IV</i>	
	Speech & Audio Processing
	Mobile Communication & Networks
	Embedded System Design
<i>Professional Elective - V</i>	
	Antennas & Wave Propagation
	Wireless Sensor Networks
	Adaptive Signal Processing
<i>Professional Elective - VI</i>	
	Mixed Signal Design
	Satellite Communication Systems
	Bio-Medical Electronics
<i>Open Elective - IV</i>	
	[EEE] Energy Studies
	[BSH] Simulation & Modeling
	[BSH] Entrepreneurship Development
	[CSE] Artificial Intelligence
	[CSE] Introduction to Machine Learning
	[EIE] Industrial Instrumentation

Note: *Open Electives* are choice-based courses offered by other departments as indicated within brackets.



Department of Electronics & Communication Engineering
Silicon Institute of Technology
Silicon Hills, Patia, Bhubaneswar - 751024