

Silicon Institute of Technology
| An Autonomous Institute |

Curriculum Structure and Detailed Syllabus

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



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

Effective From Academic Year 2020-21

Version: 1.20 (Build: 14-12-2021)

Approval History

ACM#	Date	Resolutions
AC-4	18/08/2020	The curriculum structure and detailed syllabus of 1st Year as proposed by the Boards of Studies is approved by the Academic Council.
AC-6	09/10/2021	The curriculum structure and detailed syllabus of 2nd 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, formulate, and solve various complex engineering problems related to sensors, process instrumentation, VLSI, Biomedical and Real-time Embedded Systems by applying fundamental concepts of electronics and instrumentation.
- PSO2. Imbibe the skills in modern technologies, tools & platforms to become a successful professional or entrepreneur, develop a passion for innovation & higher studies, and contribute as a responsible citizen with effective communication, strong moral values & professional ethics.
- PSO3. Appreciate and adapt to emerging technologies in electronics and related domains to design and create efficient systems for process automation in the real world using appropriate sensors, instruments, tools, and platforms to meet the challenges of the future.

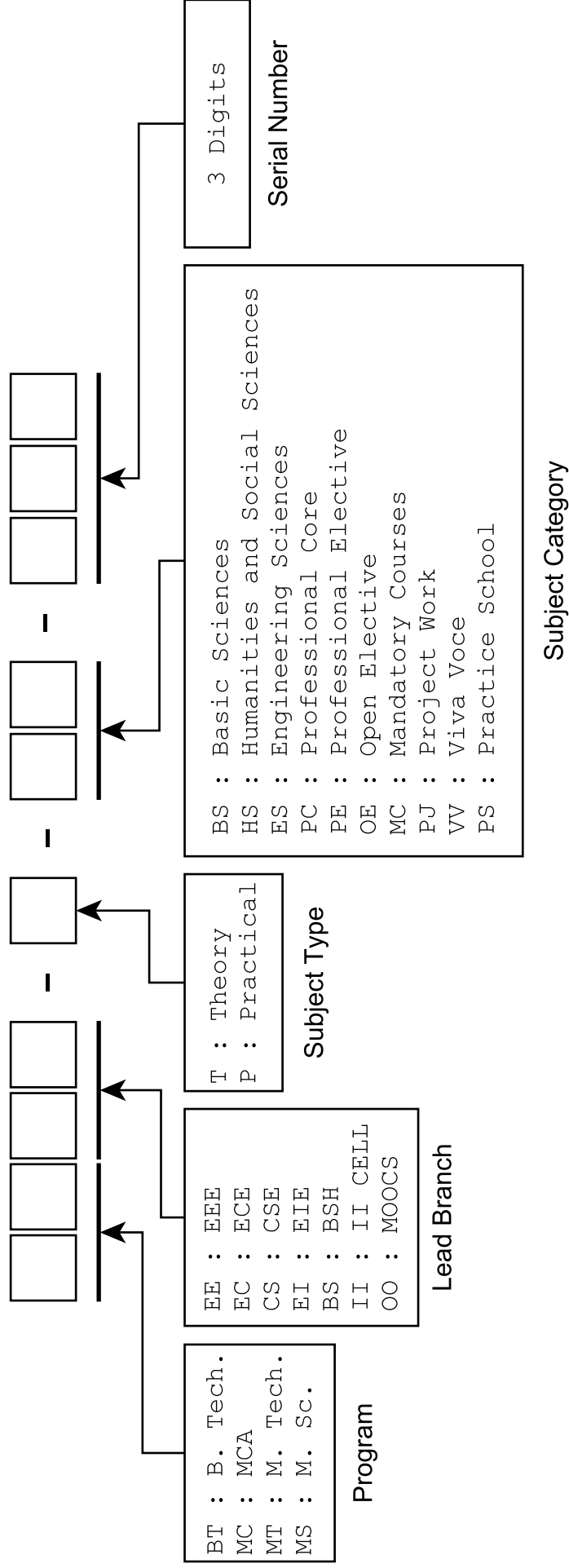
Program Educational Objectives (PEOs)

- PEO1. *Fundamental Knowledge & Core Competence:* To apply the knowledge of science, mathematics and principles of electronics & instrumentation engineering essential for a successful professional and inculcate competent problem-solving ability.
- PEO2. *Proficiency for the Real World:* To inculcate the skills required to analyze, formulate, design, develop, test and optimize efficient and cost-effective electronics and instrumentation systems useful in various real world scenarios.
- 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-P-ES-004	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	3	0	0	3	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	16	0	12	14	0	6
		TOTAL	28			20		

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.	8 Hours
Module-2	First order ordinary differential equations and applications.	7 Hours
Module-3	Second order ordinary differential equations and applications to electrical circuits.	12 Hours
Module-4	Matrix algebra, system of linear equations, rank and inverse of matrices.	8 Hours
Module-5	Eigen values and Eigen vectors, complex matrices, diagonalization of matrices.	7 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.

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	Understand the graphs of functions (curves) by knowing their characteristics like asymptotes and curvature.
CO2	Solve first order ordinary differential equations using various methods and apply them to physical problems.
CO3	Learn methodology to Solve second order ordinary differential equations and apply them to solve applied problems of electrical circuits.
CO4	Develop understanding of the concepts and methods of system of linear equations and apply them to solve a system.
CO5	Study and use the eigen values and eigen vectors of matrices, its properties and 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.
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					1	1	
CO2	3	2	1	1	1	2	1						1	1	
CO3	2	2	1	1	2	2	1	1					2	1	
CO4	2	2	1	1	1	1	1						2	1	
CO5	2	2	1	1	2	2	1	1					2	1	

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	3	3
CO2	3	2	1	2	1							1	3	2	1
CO3	3	2		1								1	3	2	1
CO4	3	2		1								1	3	2	1
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	1
CO2	3	2	3	1									2	2	2
CO3	2	2	2	1									3	3	2
CO4	3		3										2	2	1
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	Communicative & Technical English	L-T-P	Credits	Marks
HS	BTBS-T-HS-010		3-0-0	3	100

Objectives	The objectives of this course are to develop the students' communication skills with proficiency in Technical English, to make them aware of the importance of cross-cultural communication, to develop analytical skills to read and comprehend texts, and to help compose effective 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 Technical Communication: General vs Technical Communication; Factors, participants, code, channels, message, feedback, Effective Business Communication; Importance of technical communication; Communication across cultures and common problems; Barriers to effective communication.	6 Hours
Module-2	Sounds of English: vowels, diphthongs, consonants and consonant clusters, problem sounds, phonemic transcription, syllabic division and stress, weak forms and rhythm, intonation.	5 Hours
Module-3	Effective Business Communication: Structure of a business organization; purpose of business organization; Technology in communication; use of bias-free language; channels of communication: upward, downward, diagonal, grapevine, open door communication; forms of technical communication: internal, external, formal, informal, oral, written. Language structures for day-to-day business communication: persuasion, negotiation, argumentation, making suggestions, assertive communication. Public speaking and presentation skills; content development; clarity of speech; emotions displayed by body language, personal space and zones, personal appearance and attitude to time.	9 Hours
Module-4	Critical Reading: sub-skills of reading; reading a feature article; reading an editorial; skimming through a short report; reading contemporary essays; reading prescribed English short stories.	11 Hours
Module-5	Effective Business Writing: constituents of effective writing: ; paragraph development: coherence, cohesion, progression of ideas, elements of style, clarity and precision, avoiding redundancy, circumlocution, jargons; Dealing with positive and negative messages; business writing: writing a memo; writing an e-mail, writing business letters, notice, writing different types of reports, writing a proposal.	11 Hours
Total		42 Hours

Text Books:

- T1. M. A. Rizvi, *Effective Technical Communication*, McGraw Hill.
- T2. T. Balasubramaniam, *English Phonetics for Indian Student*, Trinity Press.
- T3. B. K. Das, *An Introduction to Professional English and Soft Skills*, Cambridge Univ. Press, 2009.
- T4. D. K. Das, A. Kumari, K. K. Padhi, *Anthology of Modern English Prose*, Trinity 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 Univ. Press.
- R3. B. K. Mitra, *Communication Skills for Engineers*, Oxford Univ. Press, 2011.
- R4. M. Raman, S. Sharma, *Technical Communication: Principles & Practice*, Oxford Univ. Press.

Online Resources:

1. <http://www.cambridgeindia.org>
2. <http://www.cambridgeenglish.org/exams/business-certificates/business>
3. <https://steptest.in>
4. <https://www.coursera.org/specializations/business-english>
5. <http://www.academiccourses.com/Courses/English/Business-English>

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

CO1	Understand the elements of technical communication and communication across cultures.
CO2	Learn about aspects of English pronunciation and speak using a neutral accent.
CO3	Learn about the channels of business communication and business hierarchies in order to communicate effectively in a business set up.
CO4	Enhance their reading skills and be able to critically analyse texts of various kind.
CO5	Compose different types of 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	2	3	2	3	1	3	1
CO2									1	3	1	3	1	2	1
CO3								1	3	3	2	3		3	1
CO4										3		3	1	3	1
CO5								2	1	3	1	3		3	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.

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	2	1
CO2	1					2	2	2	2		1		1	2	1
CO3	1					1	2	1	1		1		1	2	2
CO4	1					2	3	1	2		1		1	2	1
CO5	1					3	3	3	2		1			2	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	Laplace transform, Inverse Laplace transform, shifting theorems, Transform of derivatives and integrals, Unit step function and Dirac delta function, applications to differential equations.	7 Hours
Module-2	Differentiation & Integration of Transforms, Convolution and integral equations, Use of partial fraction, system of differential equations.	7 Hours
Module-3	Random Experiment & Probability, Conditional Probability, Bayes' Rule, Random variable & Probability Distribution, Mean, Variance.	8 Hours
Module-4	Uniform Discrete Distributions: Binomial, Poisson, Geometric Random Variable, Continuous Uniform Distribution: Normal Distribution, Exponential Distribution.	8 Hours
Module-5	Joint Distribution, Covariance, Sampling & sampling distributions, maximum likelihood estimation, Estimation of mean, Confidence Interval of mean, variance.	7 Hours
Module-6	Testing of Hypothesis about mean, variance, Testing goodness of fit, Linear regression, least square line, correlation coefficient.	5 Hours
Total		42 Hours

Text Books:

T1. E. Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley India, 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, MC Graw Hill, 2017.

Online Resources:

1. <http://www.nptel.ac.in/courses/111105035/32>
2. <http://www.nptel.ac.in/courses/122104017>
3. <http://nptel.ac.in/courses/122102009>
4. www.edx.org/Probability
5. <https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/>

6. <https://ocw.mit.edu/courses/mathematics/18-03sc-differential-equations-fall-2011/unit-iii-fourier-series-and-laplace-transform/laplace-transform-basics/>

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

CO1	Study and use the concepts of probability and random variables and applying them to evaluate probabilities of different events.
CO2	Know different discrete and Continuous probability models and apply those to solve probability problems of day to day activities.
CO3	Understand the applications of joint & sampling distributions.
CO4	Learn methodology to apply statistical testing and regression.
CO5	Study the concepts of Laplace Transform and to apply those for solving ODE.
CO6	Develop understanding of convolution and its application to integral equations.

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								3	2	1
CO2	3	3	3	3	3								3	2	1
CO3	3	2	3	2	2								2	1	1
CO4	3	3	3	3	2								2	1	1
CO5	3	3	2	2	3								2	1	1
CO6	3	3	2	2	3								2	1	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	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	
CO2	2	2		1	2		2		2	2			1	1	
CO3	3	2		1	2		1		2	2			1	1	
CO4	3	3		1	1		2		2	2			1	1	
CO5	3	2		1	1		1		1	1			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	2	2	1
CO3	2	1		2									3	2	2
CO4	2	2		3	1								3	2	2
CO5	3	1		1								1	2	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 of fitting practice and tools used in fitting jobs.
2	Exercise involving measuring, marking, cutting and filing practice.
3	Fitting of male and female mating parts.
4	Introduction of Lathe, exercise involving facing, straight turning, step turning, taper turning and thread cutting in Lathe machine.
5	Introduction of Milling and Shaping machines.
6	Preparing single step on a square block in Milling machine.
7	Preparing a key way on a square block in Shaping machine.
8	Introduction to basic principles of Arc and Gas welding.
9	Preparing lap joint by Gas welding and butt joint by Arc welding.
10	Sheet metal forming and joining operations.

Text Books:

- T1. P. Kanniah and K. L. Narayana, *Workshop Manual*, Sceitech Publishers, 2009.
- T2. S. K. Hajra Choudhury, *Elements of Workshop Technology*, Vol-1 and Vol-2, MPP..

Reference Books: *There are no reference books for this subject.*

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)

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

CO1	Study and practice use of hand tools and their operations in a fitting shop.
CO2	Design and model various basic prototypes in fitting, such as a Paper weight.
CO3	Design and model and use of various suitable tools form a chining processes like facing, straight turning, step turning, taper turning and thread cutting.

Cont'd...

CO4	Identify and use suitable tools for cutting of a mild steel work piece with the help of shaping and milling machines.
CO5	Design and model various basic prototypes in welding such as a Lap joint and Butt joint.
CO6	Design and model various basic prototypes using sheet metal forming and joining operations.

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.
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.
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.
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.
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			1			3		3	2		1	1
CO2	1		2			1			3		3	2		1	1
CO3	1		2			1			3		3	2		1	1
CO4	1		2			1			3		3	2		1	1
CO5	1		2			1			3		3	2		1	1
CO6	1		2			1			3		3	2		1	1

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

Objectives	To create awareness and emphasize the need for Engineering Graphics in all the branches of engineering, to follow basic drawing standards and conventions, to develop skills in three-dimensional visualization of engineering component, to solve specific geometrical problems in plane geometry involving lines, plane figures and special curves, to produce orthographic projection of engineering components working from pictorial drawings.
Pre-Requisites	Basic understanding of Geometry
Teaching Scheme	Regular laboratory classes using drawing tools under supervision of the teacher. Demonstration will be given for each drawing assignment using ICT as when required.

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, usage of various drawing instruments, lettering, dimensioning principles.
2	Conics and Engineering Curves.
3	Orthographic Projections: Principles of orthographic projections - conventions, projections of points and lines.
4	Auxiliary projection Technique: Projection of Points and lines on Auxiliary Planes.
5	Projections of Planes: projections of planes in simple position & inclined to both planes.
6	Projection of Solids: projection of solids in simple position & inclined to both planes.
7	Principles of Isometric projection, isometric scale, isometric views, conventions, isometric views of lines & planes.
8	Isometric projections of solids, conversion of isometric views to orthographic views.
9	Development of surface and intersection of surfaces.
10	Sections and sectional views of simple and compound solids.
11	Introduction to AUTOCAD tools.

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. R. K. Dhawan, *A Text Book of Engineering Drawing*, S. Chand Publications, 2007.
- T4. K. L. Narayana, P. Kanniah, *Text Book on Engineering Drawing*, Scitech Publishers, 2008.

P.T.O

Reference Books:

- R1. T. E. French, C. J. Vierck, R. J. Foster, *Graphic Science and Design*, 4th Edition, McGraw-Hill.
- R2. W. J. Luzadder, J. M. Duff, *Fundamentals of Engineering Drawing*, 11th Edition, PHI, 1995.
- R3. K. Venugopal, *Engineering Drawing and Graphics*, 3rd Edition, New Age International, 1998.

Online Resources:

1. <http://nptel.ac.in/courses/112103019>
2. <https://freevideolectures.com/course/3420/engineering-drawing>
3. <http://www.engineeringdrawing.org/>
4. https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing-i-spring-2009/related-resources/drawing_and_sketching/

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 Engineering Curves.
CO2	Recognize and be familiar with the Orthographic projections of points, lines.
CO3	Develop the concept of Orthographic projections of planes and solids.
CO4	Differentiate between isometric scale, isometric projections and views.
CO5	Have a broad overview of various sheet-metal work by the concept of development of surfaces and solids and Sectional Views of Simple and compound solids.
CO6	Draw various machine components and building structure drawing 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.

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	1
CO2	3	3	2	1									2	2	2
CO3	2	2	2	1									3	2	2
CO4	2	2	3										3	2	1

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	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	Ice-breaking activities: dealing with inhibitions to speak (team activity)
2	Just a Minute (individual activity)
3	Role Play on channels of communication in the business world (team activity)
4	Speech activity 1: content development (individual activity)
5	Speech activity 2: for fluency, delivery and appropriate body language (individual activity)
6	Ear training: developing pronunciation skills (individual activity)
7	Listening comprehension: listening for overall and specific information (individual activity)
8	Oral presentations: preparing for public speeches (team activity)
9	Reading comprehension 1 (individual activity)
10	Reading comprehension 2 (individual activity)
11	Group presentation (team activity)
12	Writing Activity 1 (individual activity)
13	Writing Activity 2 (individual activity)

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	Communicate in simulated business contexts.
CO3	Develop English pronunciation skills through practice.
CO4	Work effectively as a member of a team or as a leader through group presentation assignments.
CO5	Critically analyse texts of various kind 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								1	1	3	1	3	1	2	1
CO2								1	3	3	2	3	1	2	1
CO3										3		3	1	2	1
CO4								2	3	3	2	3	1	3	2
CO5								1	1	3		3	1	2	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

Part II

2nd Year B. Tech. (EIE)

Curriculum Structure

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	BTEI-T-PC-999	Basics of Instrumentation	3	0	0	3	0	0
PC	BTEE-T-PC-003	Circuit Theory	3	0	0	3	0	0
PC	BTEI-T-PC-001	Analog Electronic Circuits	3	0	0	3	0	0
PRACTICAL								
ES	BTCS-P-ES-006	OOP Using Java Lab	0	0	2	0	0	1
PC	BTEI-P-PC-999	Basics of Instrumentation Lab	0	0	2	0	0	1
PC	BTEE-P-PC-004	Circuit Theory Lab	0	0	2	0	0	1
PC	BTEI-P-PC-002	Analog Electronic Circuits Lab	0	0	2	0	0	1
MC	BTBS-P-MC-017	Yoga	0	0	2	0	0	0
PJ	BTII-P-PJ-001	Summer Internship - I	0	0	0	0	0	1
SUB-TOTAL			15	0	10	15	0	5
TOTAL			25			20		

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	BTEI-T-PC-003	Transducers & Measurement Systems	3	0	0	3	0	0
PC	BTEE-T-PC-005	Control Systems Engineering	3	0	0	3	0	0
OE		Open Elective - I	3	0	0	3	0	0
PRACTICAL								
PC	BTEC-P-PC-011	Digital Electronic Circuits Lab	0	0	2	0	0	1
PC	BTEI-P-PC-004	Transducers & Measurement Systems Lab	0	0	2	0	0	1
PC	BTEE-P-PC-006	Control Systems Engineering Lab	0	0	2	0	0	1
SUB-TOTAL			18	1	6	18	1	3
TOTAL			25			22		

Note: Courses offered under each elective are given in "List of Electives" on Page 52.

List of Electives

Code	Elective # and Subjects
<i>Open Elective - I</i>	
BTEE-T-OE-032	[EEE] Basics of Power Systems
BTBS-T-OE-027	[BSH] Applied Linear Algebra
BTBS-T-OE-028	[BSH] Fluid Mechanics
BTEC-T-OE-099	[ECE] Information Theory & Coding
BTCS-T-OE-040	[CSE] Fundamentals of DBMS

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

Type	Code	Mathematics-III for Electrical Sciences	L-T-P	Credits	Marks
BS	BTBS-T-BS-040		3-0-0	3	100

Objectives	The objective of this course is to provide the knowledge of Fourier Transforms, analytic functions, poles & zeros, residue calculus, and other special functions important for study of electrical sciences.
Pre-Requisites	Knowledge of calculus of single variable, coordinate geometry of two and three dimensions, matrix algebra, and ordinary differential equations is 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	Basics of Complex Numbers, Derivatives, Analytic Functions, C-R Equations, Basic elementary Complex functions.	8 Hours
Module-2	Complex Line Integration, Integral Theorems, Complex Power Series and Taylor Series.	8 Hours
Module-3	Laurent Series, Residue Integration and its application for evaluation of real integrals.	8 Hours
Module-4	Periodic function and Fourier series, Euler formula, Even and odd functions, Half range expansions, Fourier integrals, Fourier cosine transform, Fourier sine transform, Fourier transform.	10 Hours
Module-5	Power series solutions to ordinary differential equations, Legendre Equation, Bessel's function and its properties, Gamma function, Beta function, Error function.	8 Hours
Total		42 Hours

Text Books:

T1. E. Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley India, 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:

- <http://www.nptel.ac.in/courses/111105035>
- <http://www.nptel.ac.in/courses/122104017>
- <http://nptel.ac.in/courses/122102009>
- <http://nptel.ac.in/courses/111107063>
- <https://www.coursera.org/learn/linearalgebra2>
- <https://www.coursera.org/learn/differentiation-calculus>
- <https://www.coursera.org/learn/single-variable-calculus>
- <https://alison.com/courses/Algebra-Functions-Expressions-and-Equations>

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

CO1	Understand the concepts of Analytic function.
CO2	Evaluate complex line integral and find the Taylor's series expansion of analytic functions.
CO3	Expand functions in Laurent's Series and evaluate integrations using residues.
CO4	Find the Fourier series and Fourier transforms of functions.
CO5	Understand the concepts of power series solution and some important special functions.

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								2	1	1
CO3	3	3	3	3	1								2	1	1
CO4	3	3	3	2	3								3	1	1
CO5	3	3	2	2	2								2	1	1

Type	Code	OOP Using Java	L-T-P	Credits	Marks
ES	BTCS-T-ES-005		3-0-0	3	100

Objectives	The objective of this course is to introduce the key concepts of object-oriented programming (OOP) using Java as the programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with a 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	Object oriented concepts: Object oriented systems development life cycle; Java Overview: Java Virtual Machine, Java buzz words, Data types, Operators, Control statements, Class fundamentals, Objects, Methods, Constructors, Overloading, Access modifiers.	8 Hours
Module-2	Inheritance: Basics of Inheritance, using super and final keyword, method overriding, Abstract classes, defining and importing packages, access protection, interfaces;	8 Hours
Module-3	Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling; Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading, inter thread communication.	9 Hours
Module-4	Input/Output: Files, stream classes, reading console input; String manipulation: Basics of String handling, String class, StringBuilder, StringBuffer, StringTokenizer; Collection overview, Collection interfaces, Collection classes - ArrayList, LinkedList, Set, Tree; Accessing a collection using iterator & for-each statement.	8 Hours
Module-5	Introduction to GUI Programming: working with windows, frames, graphics, color, and font. AWT Control fundamentals; Event handling: Delegation event model, event classes, sources, listeners, Adapter class, Swing overview.	9 Hours
Total		42 Hours

Text Books:

- T1. H. Schildt, *Java: The Complete Reference*, 10th Edition, McGraw-Hill, 2017.
- T2. Y. D. Liang, *Introduction to Java Programming*, 9th Edition, Pearson Education, 2012.

Reference Books:

- R1. B. Bates, K. Sierra, *Head First Java*, 2nd Edition, O'Reilly Media, 2005.
- R2. E. Balaguruswamy, *Programming with Java - A Primer*, 4th Edition, McGraw-Hill, 2009.
- R3. T. Budd, *An Introduction to Object-Oriented Programming*, 3rd Edition, Pearson Education, 2009.

R4. I. Horton, *Beginning Java*, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. <https://nptel.ac.in/courses/106105191/>
2. <https://docs.oracle.com/javase/tutorial/>
3. <http://www.javatpoint.com/java-tutorial>
4. <http://www.w3schools.in/java/>
5. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/>

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

CO1	Apply object oriented principles to develop Java programs for real life applications.
CO2	Employ inheritance techniques for developing reusable software.
CO3	Develop robust & concurrent programs using exception handling and multi-threading.
CO4	Design programs using I/O operations, string classes, and collection framework.
CO5	Design GUI applications using AWT and Swing.

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.

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	3	1		1						2	3		3
CO2	3	2	2	1		1						2	3		3
CO3	3	2	2	2		1						2	3		3
CO4	3	2	3	2		1						2	3		3
CO5	3	2	3	1		1						2	3		3

Type	Code	Basics of Instrumentation	L-T-P	Credits	Marks
PC	BTEI-T-PC-999		3-0-0	3	100

Objectives	The objective of this course is to introduce the basic principles & uses of different electrical & electronic measuring instruments including applications of transducers, storage, display and data acquisition systems.
Pre-Requisites	Basic knowledge of intermediate physics, Mathematics, Basic Electrical Engineering and Basic Electronics Engineering is 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	Qualities of Measurement: Static & dynamic characteristics, standards of measurement, input and output impedance, loading effects of series and shunt connected instruments; Errors in Measurement: types of error, normal distribution of errors and concept of calibration and curve fitting, linear & weighted regression.	8 Hours
Module-2	Bridge Circuits: DC and AC Bridges, Errors in bridge circuits, Quality factor (Q) and dissipation factor (D), General equations for bridge balance; Application of DC and AC bridges: Resistance measurement (low, medium and high resistance), Insulation resistance measurement, Mega Ohm, Inductance measurement (Maxwell's, Hay's, and Anderson bridge) and Capacitance measurement (Wien's, Owens's and Schering Bridge), Shielding & grounding.	9 Hours
Module-3	Measuring Instruments: DC galvanometer, PMMC and Moving Iron instruments, DC Potentiometer, voltmeters, ammeters, ohmmeters and extension of range of instruments, AC indicating instruments: EDM type instruments, EDM Wattmeter (single-phase & three-phase) and errors present, Energy meter; Basics of instrument transformer, Digital CRO, Digital voltmeter, Digital counter, Digital frequency meter, and Spectrum Analyzer.	9 Hours
Module-4	Primary Sensing Elements: Sensors, Transducers and its classification & selection of transducers. Basic sensing elements for displacement, temperature, velocity, speed, vibration, acceleration, force, torque and pressure measurement; Liquid and solid level & flow measurement, IC based sensor, Push-pull type Capacitive, Oscillator based measurements, Hall effect based sensors.	9 Hours
Module-5	Basic concepts of smart sensors and applications; Signal conditioning, Modulation and Demodulation Techniques, basic of telemetry system and data acquisition systems.	7 Hours
Total		42 Hours

Text Books:

- T1. E. W. Golding and F. C. Widdis, *Electrical Measurements and Measuring Instruments*, 5th Edition, Reem Publication, 2015.
- T2. A. K. Ghosh, *Introduction to Instrumentation and Control*, 4th Edition, PHI Learning, 2012.
- T3. H. S. Kalsi, *Electronic Instrumentation and Measurements*, 4th Edition, McGraw-Hill Education, 2019.
- T4. A. K. Sawhney, *A Course in Electrical and Electronics Measurements & Instrumentation*, Dhanpat Rai & Co, 2015.

Reference Books:

- R1. J. J. Carr, *Elements of Electronics Instrumentation Measurement*, 3rd Edition, Pearson Education, 2003.
- R2. D. A. Bell, *Electronic Instrumentation and Measurements*, 3rd Edition, Oxford University Press, 2013.
- R3. A. D. Helfrick and W. D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, 1st Edition, Pearson Education, 2015.
- R4. J. B. Gupta, *A Course in Electrical and Electronic Measurements & Instrumentation*, 1st Edition, S. K. Kataria & Sons, 2013.
- R5. D. V. S. Murthy, *Transducers and Instrumentation*, 2nd Edition, PHI Learning, 2008.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105153/>: by Prof. A. Chatterjee, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/105/108105062/>: by Prof. S. Mukhopadhyay and Prof. S. Sen, IIT Kharagpur
3. <https://nptel.ac.in/courses/108/105/108105064/>: by Prof. A. Barua, IIT Kharagpur

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

CO1	Explain the characteristics, errors and calibration concepts of different measuring instruments.
CO2	Evaluate the values of R, L, C using suitable bridges and their applications.
CO3	Analyze the construction, characteristics and working principles of various measuring instruments.
CO4	Explain the construction, characteristics and working principles of different sensing elements used in different measuring instruments.
CO5	Explore the concepts of smart sensors and their applications in modern industrial instrumentation.

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.

Cont'd...

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.
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	2	2	1		1							3	2	3
CO2	3	3	1	2			1						3	3	2
CO3	3	3	2	3		1							2	2	1
CO4	3	3	2	2		1	1						3	2	1
CO5	3	2	3	2		1	1					1	3	2	2

Type	Code	Circuit Theory	L-T-P	Credits	Marks
PC	BTEE-T-PC-003		3-0-0	3	100

Objectives	The objective of this course is that the student should be able to analyze any circuit configuration, synthesize circuits with any given specifications or network functions, test and improve the design as required.
Pre-Requisites	Basics of Circuit analysis, Laplace transform, Fourier transform and Differential equations 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	Network Theorems: Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Compensation theorem (AC & DC Networks); Coupled Circuits: Introduction to coupled Circuit, Dot Convention, coefficient of coupling, Electrical equivalent of magnetically coupled coils, Series and parallel connection of coupled coils. Transformer as a magnetically coupled circuit; Resonance: Introduction, Series Resonance, Parallel Resonance, Quality factor, Bandwidth and Selectivity for series resonant and parallel resonant circuits, Frequency Response Curve.	10 Hours
Module-2	Fundamentals of Laplace & Inverse Laplace Transform, initial and final value theorem; Fundamentals of Switching behaviour of RL, RC & RLC circuits. Application Of Laplace Transform to Transient Analysis: Response of RL, RC & RLC network with step, sinusoidal, impulse and ramp input.	10 Hours
Module-3	Representation of Signals (Continuous Time), Fundamentals of Fourier Transform and Fourier series, Fourier Series Analysis of CT signals, Fourier Transform Analysis of CT Signals, Circuit analysis with Fourier Series, Circuit analysis with Fourier Transform.	8 Hours
Module-4	Two Port Network Functions & Responses: Introduction, z, y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks; Network Functions & Response: Transfer function and driving point function for one & two port networks, Concept of poles and zeros, Significance & Restriction on location of Poles and Zeros, Time domain behaviour from Pole-Zero plots.	9 Hours
Module-5	Network Synthesis: Hurwitz polynomial and its Properties, Positive real functions and their properties, Concepts of network synthesis, Realization of simple R-L, R-C and L-C functions in Cauer-I, Cauer-II, Foster-I and Foster-II forms. Filter Transfer functions and cut off frequencies.	7 Hours
Total		44 Hours

Text Books:

- T1. M. E. Van Valkenburg, *Network Analysis*, 3rd Edition, Pearson Education, 2015.
- T2. C. K. Alexander and M. N. O. Sadiku, *Fundamentals of Electric Circuits*, 5th Edition, Tata McGraw-Hill, 2013.
- T3. W. H. Hayt, J. Kemmerly, J. D. Phillips, and S. M. Durbin, *Engineering Circuit Analysis*, 9th Edition, McGraw-Hill Education, 2020.

Reference Books:

- R1. S. Ghosh, *Network Theory: Analysis And Synthesis*, 1st Edition, Prentice Hall of India, 2009.
- R2. P. K. Satpathy, P. Kabisatapathy, S. P. Ghosh, and A. K. Chakraborty, *Network Theory*, 1st Edition, Tata McGraw-Hill, 2009.
- R3. A. Chakrabarti, *Circuit Theory: Analysis and Synthesis*, 7th Edition, Dhanpat Rai & Co., 2013.
- R4. J. D. Irwin and R. M. Nelms, *Basic Engineering Circuit Analysis*, 11th Edition, Wiley, 2015.

Online Resources:

1. <https://nptel.ac.in/courses/108102042/>: by Prof. S. C. Dutta Roy, IIT Delhi
2. <https://nptel.ac.in/courses/108106075/>: by Prof. V. G. K. Murti, IIT Madras
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/lecture-notes/>

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

CO1	Understand the concepts of network theorems, coupled circuits, resonant circuits & apply in solving complex networks problems.
CO2	Understand the switching phenomena of electrical circuits and evaluate transient and steady state performance using Laplace Transformation.
CO3	Analyze sinusoidal & non-sinusoidal signals using Fourier series and transform and apply in electrical & electronics circuit analysis.
CO4	Determine two-port network parameters and their practical application to electrical and electronic circuits.
CO5	Identify Network Functions and synthesize one port network using Foster and Cauer forms and analyze filter circuits..

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.

Cont'd...

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.

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	2	1						1	3	1	
CO2	3	3	1	2	2	2						1	3	1	
CO3	3	3	1	2	2							1	3	1	
CO4	3	3	1	2	2							1	3	1	
CO5	3	3	1	2	1							1	3	1	

Type	Code	Analog Electronic Circuits	L-T-P	Credits	Marks
PC	BTEI-T-PC-001		3-0-0	3	100

Objectives	The objective of this course is to be familiar with Transistor (BJT, JFET and MOSFET) amplifiers, differential amplifiers and their implementations along with studying their characteristics & applications.
Pre-Requisites	Basic knowledge of semiconductor diodes and Bipolar Junction Transistors (BJT) is 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	Bipolar Junction Transistor (BJT) and its AC Analysis: Introduction to BJT DC Biasing Circuits, Design of different Biasing Circuits, Bias Stability, Introduction to BJT small signal model, r_e and h -models of different configurations (CB, CE, and CC), r_e and h -models of different biasing circuits, Effect of R_S and R_L , Standard ICs.	9 Hours
Module-2	Field Effect Transistor (FET) and its AC Analysis: JFET DC Biasing Circuits (Fixed, Self and Voltage divider), MOSFET DC Biasing Circuits, Introduction to JFET and MOSFET small signal model, Small signal model of different configurations (CG, CD, and CS), Small signal model of different biasing circuits of MOSFET, Effect of R_S and R_L , Standard ICs.	9 Hours
Module-3	Compound Configurations: CMOS and its circuit realization, Darlington pair, Current Mirror, Cascade & Cascode configuration. Frequency Response Analysis: Low Frequency Response of BJT, High Frequency Response of BJT, Low Frequency Response of FET, Miller's Effect, Multistage Frequency Effects, Gain-Bandwidth Relation.	8 Hours
Module-4	Operational Amplifiers: Introduction to OP-AMP, Applications of OP-AMP: Summing, Buffer, Log Differentiator, Schmitt Trigger and Integrator, Introduction to Differential Amplifier, DC and AC Analysis of Differential Amplifier, Instrumentation Amplifier, Active Filters, Standard ICs.	8 Hours
Module-5	Feedback Amplifiers: Introduction to Feedback Amplifiers, Feedback Topologies, Derivation of different parameters (Z_i , Z_o , A_v , A_i), Practical feedback circuits, Standard ICs. Oscillators: Introduction to Oscillators, High Frequency Oscillators: Hartley and Crystal Oscillators, Standard ICs. Power Amplifiers: Introduction to Power Amplifiers, Classification of Power Amplifiers: Class A, Class B, Class C, Push-Pull Amplifiers, Standard ICs.	8 Hours
Total		42 Hours

Text Books:

- T1. A. S. Sedra and K. C. Smith, *Microelectronic Circuits: Theory and Applications (International Version)*, 6th Edition, Oxford University Press, 2013.
- T2. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 10th Edition, Pearson Education, 2009.
- T3. J. V. Wait, L. P. Huelsman, and G. A. Korn, *Introduction to Operational Amplifier Theory and Applications*, McGraw-Hill USA, 1992.
- T4. J. Millman and A. Grabel, *Microelectronics*, 2nd Edition, McGraw-Hill Education, 2017.

Reference Books:

- R1. J. Millman and C. C. Halkias, *Integrated Electronics: Analog and Digital Circuits and Systems*, 2nd Edition, TMH Publications, 2017.
- R2. A. Malvino and D. J. Bates, *Electronic Principles*, 7th Edition, McGraw-Hill, 2017.
- R3. P. Horowitz and W. Hill, *The Art of Electronics*, 2nd Edition, Cambridge University Press, 1989.
- R4. P. R. Gray, P. J. Hurst, R. G. Meyer, and S. H. Lewis, *Analysis and Design of Analog Integrated Circuits*, 5th Edition, John Wiley & Sons, 2009.

Online Resources:

1. <https://nptel.ac.in/courses/117101106/>
2. <https://nptel.ac.in/courses/108102095/>
3. <http://www.electrical4u.com/circuit-analysis.htm>
4. <http://www.allaboutcircuits.com>
5. <https://www.electronics-tutorials.ws/>

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

CO1	Design different biasing methods and small signal models of BJT and estimate the performance parameters of different amplifier configurations.
CO2	Analyze the structural behavior, characteristics and different biasing configurations of JFET and MOSFET.
CO3	Understand and analyze the structural configuration of multi-stage amplifier and plot its frequency response.
CO4	Study the construction and characteristics of an Op-Amp and design circuits for various linear applications using Op-Amp.
CO5	Design various industrial circuits such as oscillators & negative feedback amplifiers using transistors and validate their experimental results.

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.
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	3	2	3	3								3	1	1
CO2	3	3	3	3	2							1	3	2	2
CO3	3	3	2	3	2							1	3	2	3
CO4	3	3	3	2	3							1	3	1	2
CO5	3	3	3	3	3							1	3	3	3

Type	Code	OOP Using Java Lab	L-T-P	Credits	Marks
ES	BTCS-P-ES-006		0-0-2	1	100

Objectives	The objective of the course is to apply object oriented programming principles and implement object oriented programming using JAVA language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other object oriented programming language will be beneficial.
Teaching Scheme	Regular laboratory classes with the use of ICT whenever required, demonstration through practical simulation of code using IDE.

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	Understanding Java platform, compilation, and execution of a java program.
2	Overview of Eclipse IDE.
3	Use of class, use of control statements, data types, operators.
4	Implement class, object, constructor, methods, and other OOP features.
5	Inheritance Basics, more uses of constructor, method overriding, use of final.
6	Object class, practical use of abstract class.
7	Using Interface for achieving multiple inheritance, implementation of package.
8	Exception handling fundamentals, java built-in exceptions, Use of Scanner class for console input, use of own Exception subclass.
9	Java thread life cycle model and implementation approach, thread priority, implementation of synchronization.
10	I/O Basics, byte stream and character streams, reading and writing files, text processing using Java pre-defined stringBuilder and stringBuffer classes.
11	Basics of Java collection framework, implementation of collections in Java with different programs.
12	GUI basics and Window fundamentals, working with different Component, Container and Layout Managers.
13	Event handling for interactive GUI application.
14	Final lab test and viva voce.

Text Books:

- T1. H. Schildt, *Java: The Complete Reference*, 9th Edition, McGraw-Hill, 2011.
- T2. Y. D. Liang, *Introduction to Java Programming*, 9th Edition, Pearson Education, 2012.

Reference Books:

- R1. B. Bates, K. Sierra, *Head First Java*, 2nd Edition, O'Reilly Media, 2005.
- R2. T. Budd, *An Introduction to Object-Oriented Programming*, 3rd Edition, Pearson Education, 2009.
- R3. I. Horton, *Beginning Java*, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. <https://nptel.ac.in/courses/106105191/>
2. <https://docs.oracle.com/javase/tutorial/>
3. <http://www.javatpoint.com/java-tutorial>
4. <http://www.w3schools.in/java/>
5. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/>

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

CO1	Apply object oriented programming to develop Java programs for real-life applications.
CO2	Employ inheritance techniques for developing reusable software.
CO3	Develop robust and concurrent programs using exception handling and multi-threading.
CO4	Design programs using I/O operations, String classes and collection framework.
CO5	Design GUI applications using AWT and Swing.

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.

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	3	1		1						2	3		3
CO2	3	2	2	1		1						2	3		3
CO3	3	2	2	2		1						2	3		3
CO4	3	2	3	2		1						2	3		3
CO5	3	2	3	1		1						2	3		3

Type	Code	Basics of Instrumentation Lab	L-T-P	Credits	Marks
PC	BTEI-P-PC-999		0-0-2	1	100

Objectives	The objective of this laboratory course is to practically understand the concepts of static characteristics, dynamic characteristics, error analysis tools, principles, testing & calibration of different measuring instruments.
Pre-Requisites	Basic knowledge of different electrical and magnetic circuits. Topics taught in Basics of Instrumentation 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 in the pre-lab session.

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	Study of static and dynamic characteristics of a Measuring Instrument.
2	Statistical analysis of errors in measurement.
3	Measurement of Low Resistance using Kelvin's Double Bridge.
4	Measurement of Self Inductance using Anderson's Bridge.
5	Calibration of capacitance sensor using Schering Bridge.
6	Measurement of frequency using Wien's Bridge.
7	Measurement of R, L, and C using Q-meter (bandwidth of a resonance circuit and Q-meter).
8	Study and testing of energy meter and clamp meter.
9	Study of Lissajous pattern and measurement of unknown frequency.
10	Study the response of vibration sensor.
11	Measurement of force using strain gauge.
12	Displacement measurement using LVDT.
13	Level measurement using capacitive transducer & its calibration.
14	Time duration measurement using DAQ system and LabView.

Text Books:

- T1. E. W. Golding and F. C. Widdis, *Electrical Measurements and Measuring Instruments*, 5th Edition, Reem Publication, 2015.
- T2. A. K. Ghosh, *Introduction to Instrumentation and Control*, 4th Edition, PHI Learning, 2012.

Reference Books:

- R1. D. A. Bell, *Electronic Instrumentation and Measurements*, 3rd Edition, Oxford University Press, 2013.
- R2. A. D. Helfrick and W. D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, 1st Edition, Pearson Education, 2015.
- R3. J. B. Gupta, *A Course in Electrical and Electronic Measurements & Instrumentation*, 1st Edition, S. K. Kataria & Sons, 2013.
- R4. D. V. S. Murthy, *Transducers and Instrumentation*, 2nd Edition, PHI Learning, 2008.

R5. A. K. Sawhney, *A Course in Electrical and Electronics Measurements & Instrumentation*, Dhanpat Rai & Co, 2015.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105153/>: by Prof. A. Chatterjee
2. <https://nptel.ac.in/courses/108/105/108105062/>: by Prof. S. Mukhopadhyay and Prof. S. Sen, IIT Kharagpur
3. <https://nptel.ac.in/courses/108/105/108105064/>: by Prof. A. Barua, IIT Kharagpur

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

CO1	Investigate performance characteristics and evaluate errors of a measuring instrument.
CO2	Accurately measure various electrical parameters using appropriate instruments.
CO3	Measure physical parameters using relevant sensors and measuring instruments.
CO4	Perform analysis on time domain signals to measure unknown parameters.
CO5	Investigate the response of measuring systems.

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.
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	3	3	2	3							3	3	1	1
CO2	3	3	3	3	3							2	3	1	2
CO3	3	2	2	1	1							3	3	3	2
CO4	3	2	1	2	1							2	3	1	1
CO5	3	2	1	2	3							2	3	2	3

Type	Code	Circuit Theory Lab	L-T-P	Credits	Marks
PC	BTEE-P-PC-004		0-0-2	1	100

Objectives	The objective of the course is to provide practical working knowledge of network theory and recording the experimental data effectively and correctly.
Pre-Requisites	Basic knowledge of electrical & electronics engineering, Laplace transform and differential equations is required.
Teaching Scheme	Regular laboratory experiments to be conducted using hardware and software tools under the supervision of the teacher. Demonstration along with required safety measures will be explained 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	Verification of Network Theorems (Superposition, Thevenin, Norton, Maximum Power Transfer) both in DC & AC.
2	Determination of two port network parameters: Open Circuit(z), Short Circuit(y), Hybrid(h) and Transmission (ABCD) parameters
3	Frequency response of Low pass and High Pass Filters.
4	Determination of self-inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.
5	Study of resonance in R-L-C series & parallel circuit.
6	Verification of Network Theorems by modelling and simulation (Superposition, Thevenin, Norton, Maximum Power Transfer) both in DC & AC.
7	Modelling of two port networks and determination of parameters by simulation.
8	Frequency response of Low pass, High pass and Band pass Filters using simulation.
9	Modelling and simulation of DC and AC Transients in electrical circuits.
10	To study the characteristics of Single tuned and double tuned circuit.
11	Spectral analysis of a non-sinusoidal waveform.

Text Books:

- T1. M. E. Van Valkenburg, *Network Analysis*, 3rd Edition, Pearson Education, 2015.
- T2. C. K. Alexander and M. N. O. Sadiku, *Fundamentals of Electric Circuits*, 5th Edition, Tata McGraw-Hill, 2013.
- T3. W. H. Hayt, J. Kemmerly, J. D. Phillips, and S. M. Durbin, *Engineering Circuit Analysis*, 9th Edition, McGraw-Hill Education, 2020.

Reference Books:

- R1. S. Ghosh, *Network Theory: Analysis And Synthesis*, 1st Edition, Prentice Hall of India, 2009.
- R2. P. K. Satpathy, P. Kabisatpathy, S. P. Ghosh, and A. K. Chakraborty, *Network Theory*, 1st Edition, Tata McGraw-Hill, 2009.
- R3. A Chakrabarti, *Circuit Theory: Analysis and Synthesis*, 7th Edition, Dhanpat Rai & Co., 2013.
- R4. J. D. Irwin and R. M. Nelms, *Basic Engineering Circuit Analysis*, 11th Edition, Wiley, 2015.

Online Resources:

1. <https://nptel.ac.in/courses/108102042/>: by Prof. S. C. Dutta Roy, IIT Delhi
2. <https://nptel.ac.in/courses/108106075/>: by Prof. V. G. K. Murti, IIT Madras
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/lecture-notes/>

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

CO1	Gain knowledge on procedures to conduct experiments safely, analyze results and develop technically sound report of outcomes.
CO2	Relate the co-relation between frequency and circuit parameters at resonance condition.
CO3	Design and analyze different configurations in electrical networks using modern software.
CO4	Employ concept of coupled circuits to electrical machines.
CO5	Analyze sinusoidal & non-sinusoidal signals using Fourier series and transform.
CO6	Design various filters and tuned amplifiers, and examine their frequency response.

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.
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.

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	1	1	1						2	3	1	1
CO2	2	1	1	2	1							1	2	1	
CO3	2	2	2	3	3							1	2	2	1
CO4	1	1	1	1	1							1	1		
CO5	3	3	1	1	1							2	2	1	
CO6	3	2	1	3	2	1						2	2	1	

Type	Code	Analog Electronic Circuits Lab	L-T-P	Credits	Marks
PC	BTEI-P-PC-002		0-0-2	1	100

Objectives	The objective of the course is to design, implement and test transistor biasing, amplifying action and frequency response. Also study the linear and nonlinear applications of amplifiers.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge of Basic electronics is required.
Teaching Scheme	Regular laboratory experiments to be conducted under supervision of the teacher with focus on implementation in hardware/software tools.

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	Design and simulate BJT bias circuit and compare the results.
2	Design and simulate JFET/MOSFET bias circuit and compare the results.
3	Design and simulate BJT common-emitter circuit and compare DC and AC performance.
4	Design and simulate JFET/MOSFET common-source circuit and compare DC and AC performance.
5	Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.
6	Differential amplifier circuits: DC bias & AC operation with & without current source.
7	Study of Darlington connection and current mirror circuits.
8	OP-Amp Frequency Response and Compensation.
9	Application of Op-Amp as differentiator, integrator, square wave generator.
10	Obtain the band width of FET/BJT using Square wave testing of an amplifier.
11	RC phase shift oscillator/Wien-Bridge Oscillator using Op-Amp/Crystal Oscillator.
12	Class A and Class B Power Amplifiers.

Text Books:

- T1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 10th Edition, Pearson Education, 2009.

Reference Books:

- R1. L. K. Maheshwari and M. M. S. Anand, *Laboratory Experiments and PSPICE Simulations in Analog Electronics*, PHI Learning, 2006.
 R2. L. K. Maheshwari and M. M. S. Anand, *Laboratory Manual for Introductory Electronics Experiments*, John Wiley & Sons, 1980.
 R3. K. A. Navas, *Electronics Lab Manual, Vol-2*, 6th Edition, PHI Learning, 2018.

Online Resources:

1. <http://www2.ece.ohio-state.edu/ee327/>
2. https://wiki.analog.com/university/courses/alm1k/alm_circuits_lab_outline
3. <https://wiki.analog.com/university/courses/electronics/labs>

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

CO1	Design, assemble and test BJT biasing circuits.
CO2	Analyze the Dc and Ac performance of BJT and FET.
CO3	Understand the frequency response of single & multi-stage BJT and compare the results.
CO4	Study operational amplifier and its various applications.
CO5	Analyze and design various wave shaping circuits.
CO6	Implement different oscillator circuits and analyze power amplifier characteristics.

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.
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	3	2	3	2							1	3	1	1
CO2	3	3	2	3	2								3	1	1
CO3	3	3	2	3	3								3	2	2
CO4	3	3	3	3	3								3	1	2
CO5	3	2	2	3	2							1	3	2	3
CO6	3	2	3	3	3								3	3	2

Type	Code	Mathematics-IV for Electrical Sciences	L-T-P	Credits	Marks
BS	BTBS-T-BS-025		3-0-0	3	100

Objectives	The objective of this course is to provide the knowledge of vector calculus, partial differential equations & numerical methods, along with the applications of these methods in engineering.
Pre-Requisites	Knowledge of calculus of single variable, coordinate geometry of two and three dimensions, and ordinary differential equations is 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	Partial derivatives, Chain rule Maxima minima in several variables; Vector and scalar functions and fields, derivatives, Directional derivative & gradient of a scalar field, Divergence & Curl of a vector field.	8 Hours
Module-2	Vector line integrals, Line integrals independent of path, Double integrals, Green's theorem in the plane Surfaces, Surface integrals, Triple integrals, Gauss divergence theorem, Stoke's theorem.	10 Hours
Module-3	Basic Concepts of PDEs, One Dimensional Wave Equation and its solutions, One Dimensional Heat Equation and its solutions, Two dimensional heat equation, Laplace Equation, Solution of Laplace equation in cylindrical and spherical coordinates.	10 Hours
Module-4	Error Analysis, Solution of Nonlinear Equations, Bisection Method, Fixed-Point Iteration Method, Secant Method, Newton Method, Interpolation by Polynomials: Lagrange Interpolation, Newton Divided Differences, Newton's forward & backward Interpolation.	7 Hours
Module-5	Numerical Differentiation and Integration, Trapezoidal, Simpson's Rules, Composite Rules, Error Formulae, Gaussian Quadrature Rules, Solution of Differential Equations by Euler Method, Modified Euler Method, and Runge-Kutta Methods.	7 Hours
Total		42 Hours

Text Books:

T1. E. Kreyszig, *Advanced Engineering Mathematics*, 8th Edition, Wiley India, 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	Understand the concepts vector differential calculus and their applications.
CO2	Understand the concepts vector integral calculus and their applications.
CO3	Solve partial differential equations for engineering applications and interpret the solution.
CO4	Find the root of non-linear and transcendental equations using numerical methods and interpolate a data.
CO5	Perform numerical integration and solve ordinary differential equations using various numerical methods.

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	1	1
CO3	3	3	3	3	1								2	1	1
CO4	3	3	3	2	3								3	1	1
CO5	3	3	2	2	2								3	1	1

Type	Code	Basics of Mechanical Engineering	L-T-P	Credits	Marks
ES	BTBS-T-ES-013		3-1-0	4	100

Objectives	The objectives of this course is to introduce basics of mechanical engineering, such as, statics, force equilibrium, free body diagrams, analysis of beams and associated stresses, laws of Thermodynamics and their applications in Power Plants and IC engines, and elements of fluid statics, which are essential and useful in every branch of engineering.
Pre-Requisites	Basic analytical and logical skills, a working knowledge of Physics and Mathematics including introductory calculus 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 Engineering Mechanics: Basic concepts, System of Forces, Coplanar Concurrent Forces, Resultant-Moment of Forces and its application; Couples, Moment (about point and about axis), Varignon's theorem, Resultant of concurrent and non-concurrent coplanar forces, Static equilibrium, Free body diagram, Reactions; Friction, Laws of Coulomb friction; Problems involving large and small contact surfaces (Ladder and Wedges); Square threaded screws (self-locking, screw jack); Belt friction; Rolling resistance.	12 Hours
Module-2	Mechanical Properties of Materials: Stress-Strain behaviour, Brittle and Ductile materials, selection of materials, Impact Test; Analysis of Beams: Centre of Gravity and Moment of Inertia of a plane and composite sections; Types of Beams, Loads and Reactions, Shear Forces, Bending Moments; Bending of Beams, Bending Stresses and Shear Stresses in beams, Failure of Beams (in brief).	12 Hours
Module-3	Basics of Thermodynamics: System, Control Volume, Surrounding, Boundaries, Macroscopic and Microscopic approaches, Thermodynamic Equilibrium, State, Property, Process, Point and Path functions, Cycle, Reversibility and Irreversibility; Properties of pure substances and phase change, Property diagrams, Use of Steam Tables; Brief discussion on Zeroth Law, First law and Second Law of Thermodynamics.	12 Hours
Module-4	Applications of Thermodynamics: Brief description and working principles of Air Compressors, Steam Power Plant, Refrigerators and Heat Pump, I.C. Engines (two-stroke and four-stroke, petrol and diesel engines).	10 Hours
Module-5	Fluid Properties and Fluid Statics: Properties of a Fluid; Pascal's Law, Simple and Differential manometers, Hydrostatic forces on submerged surfaces, Buoyancy, Bernoulli's theorem.	10 Hours
Total		56 Hours

Text Books:

- T1. S. Timoshenko, D. H. Young, S. Pati, and J. V. Rao, *Engineering Mechanics*, 5th Edition, McGraw-Hill, 2013.
- T2. G. H. Ryder, *Strength of Materials*, 3rd Edition, Macmillan Press, 1969.
- T3. R. E. Sonntag, C. Borgnakke, and G. J. Van Wylen, *Fundamentals of Thermodynamics*, 9th Edition. John Wiley & Sons, 2017.
- T4. S. K. Som, G. Biswas, and S. Chakraborty, *An Introduction to Fluid Mechanics and Fluid Machines*, 3rd Edition, McGraw- Hill Education, 2012.

Reference Books:

- R1. P. K. Nag, *Engineering Thermodynamics*, 4th Edition, McGraw-Hill, 2008.
- R2. R. K. Rajput, *Strength of Materials: Mechanics of Solids*, 7th Edition, S. Chand Publications, 2018.
- R3. R. K. Bansal, *A Textbook of Fluid Mechanics and Hydraulic Machines*, 9th Edition, Laxmi Publications, 2010.

Online Resources:

1. <https://nptel.ac.in/courses/122104015/>: Engineering Mechanics by Prof. M. Harbola, IIT Kanpur.
2. <https://nptel.ac.in/courses/112/105/112105123/>: Basic Thermodynamics by Prof. S. K. Som, IIT Kharagpur
3. <https://nptel.ac.in/courses/112/105/112105171/>: Basics of Fluid Mechanics by Prof. S. K. Som, IIT Kharagpur
4. <https://nptel.ac.in/courses/105/105/105105108/>: Strength of Materials by Prof. S. Bhattacharya, IIT Kharagpur)

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

CO1	Explain and analyze the principles of mechanics to solve problems in statics.
CO2	Articulate mechanics of deformable bodies and mechanical properties of materials.
CO3	Understand and solve problems in thermodynamics of pure substances.
CO4	Explain the design and operation of various devices based on thermodynamic principles.
CO5	Analyze the behavior of fluids and apply the concepts to solve problems in hydrostatics.

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)

CO1	3	2	2	2	1									1	1
CO2	2	2	2	2	1									1	1
CO3	3	3	3	2	1									1	1
CO4	1	2	3	1	1									1	1
CO5	3	1	2	2	1									2	2

Type	Code	Digital Electronic Circuits	L-T-P	Credits	Marks
PC	BTEC-T-PC-010		3-0-0	3	100

Objectives	The objective of this course is to understand the concepts & techniques associated with digital systems and their design & implementations in VLSI technology.
Pre-Requisites	Knowledge of Basic Electronics and fundamentals of Number Systems is 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	Fundamental Concepts: Introduction, Digital Signals, Basic Digital Circuits, Different Logic Gates and their Logic Operations, Universal Logic Gates, Complete Logic Sets. Examples of IC Gates; Logic Families – TTL and CMOS Logic Families, Implementation of logic gates using TTL and CMOS logic; Number Systems and Codes: Number Systems, Binary Number System, Signed Binary Numbers, Binary Arithmetic, 1's and 2's Complement Arithmetic, Octal Number System, Hexadecimal Number System, Codes, Error Detecting and Correcting Codes.	8 Hours
Module-2	Combinational Logic Design: Boolean Algebra and Identities, Algebraic Reduction and Realization using Logic Gates and Universal Logic Gates; Standard Representation for Logic Functions: Sum-of-Products (SOP) and Product-of-Sums (POS) forms, Canonical SOP and POS forms; K-map representation and simplification of logic functions using K-map, Minimization of 2, 3, 4 variable logical functions; Don't care conditions; Combinational Logic Components: Multiplexer, De-Multiplexer, Decoders, Encoder (Priority Encoder), Design of Combinational Circuits using Multiplexer and Decoder, Adders, Subtractors, Carry-Look-Ahead Adder, Binary Multiplier, An Equality Detector and Comparator, BCD to 7-Segment Display Decoder.	9 Hours
Module-3	Sequential Logic Design(Flip-Flops and FSMs): Flip Flops – A 1-bit memory, Bistable latch (SR and D), the clocked SR flip flop, J-K, T and D type flip-flops, Race Around Condition, Master Slave JK-flip flop, Conversion of flip-flops; Finite State Machines (FSMs) – Mealy and Moore models of Finite State Machines.	9 Hours
Module-4	Sequential Logic Design (Shift Registers and Counters): Shift Registers – SISO, SIPO, PISO, PIPO and Universal Shift Register, Applications of Shift Registers (Serial to Parallel Converter, Parallel to Serial Converter), Ring Counter, Twisted Ring Counter (Johnson Counter); Counters – Design of Ripple (Asynchronous) Counters (Up/Down Counter, Mod-N Counter), Design of Synchronous Counters, Gray Code Counter and Random Sequence Counter using State Diagrams.	8 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Complex Programmable Logic Devices (CPLDs); Semiconductor Memories: Basics of ROM, SRAM & DRAM; Basic Hardware Description Language: Introduction to VHDL programming language, Different Modeling Styles (Dataflow, Behavioral and Structural), Data types and Objects, VHDL/Verilog program for combinational and sequential circuits.	8 Hours
Total		42 Hours

Text Books:

- T1. M. M. Mano and M. D. Ciletti, *Digital Design: With an Introduction to Verilog HDL*, 5th Edition, Pearson Education, 2013.
- T2. L. K. John and C. H. Roth Jr., *Digital System Design using VHDL*, 2nd Edition, Cengage Learning, 2012.

Reference Books:

- R1. D. V. Hall, *Digital Circuits and Systems*, International Student Edition, McGraw-Hill Education, 1989.
- R2. A. A. Kumar, *Fundamentals of Digital Circuits*, 3rd Edition, PHI Learning, 2014.
- R3. R. P. Jain, *Modern Digital Electronics*, 4th Edition, McGraw-Hill Education, 2009.
- R4. W. H. Gothmann, *Digital Electronics - An Introduction to Theory and Practice*, 2nd Edition, PHI Learning, 1982.
- R5. J. F. Wakerly, *Digital Design: Principles and Practices*, 4th Edition, Pearson Education, 2008.
- R6. J. P. Uyemura, *A First Course in Digital System Design : An Integrated Approach*, Vikas-Thomson Learning, 2002.
- R7. R. J. Tocci, N. S. Widemer, and G. L. Moss, *Digital Systems - Principles and Applications*, 11th Edition, Pearson Education, 2010.
- R8. A. Agarwal and J. Lang, *Foundations of Analog and Digital Electronic Circuits*, 1st Edition, Morgan Kaufmann, 2005.

Online Resources:

1. <https://nptel.ac.in/courses/117106086/>
2. <https://swayam.gov.in/course/1392-digital-circuits-and-systems>
3. <https://nptel.ac.in/courses/117103064/>
4. <https://nptel.ac.in/courses/117105080/3>
5. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/video-lectures/>
6. <http://www.allaboutcircuits.com>
7. <https://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/>

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

CO1	Become familiar with various number systems, codes and Boolean algebra.
CO2	Design and analyze combinational logic circuits.
CO3	Design & analyze various sequential logic circuits and be familiar with counter design.
CO4	Design, analyze and implement memory array using sequential network for digital logic & investigate performance of CMOS based logic circuits in modern VLSI technology.
CO5	Simulate and synthesize various digital circuits using VHDL in industry standard tools such as Xilinx, Mentor Graphics 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.
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.

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	2	3	2	1							3	1	
CO2	2	3	2	3	3	1							3	1	
CO3	2	3	2	3	3	1							3	1	
CO4	2	3	2	3	2	1							3	1	
CO5	2	3	2	3	2	1							3	1	

Type	Code	Transducers & Measurement Systems	L-T-P	Credits	Marks
PC	BTEI-T-PC-003		3-0-0	3	100

Objectives	The objective of this course is to study the characteristics of different types of measurement systems and industrial applications of various transducers & sensors for design & construction of precise measuring instruments.
Pre-Requisites	Basic knowledge of physics, mathematics, electrical and electronics is 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: Significance of measurement, functional elements of generalized measurement systems, deflection & null type instruments, analog/digital mode of operation, classification of transducers; Static Characteristics: Systematic and statistical characteristics, calibration; Dynamic Characteristics: Transfer functions of typical sensing elements, step & frequency response of first & second order elements, dynamic errors, dynamic compensation, loading effect, introduction to signal & noise.	10 Hours
Module-2	Resistive Transducer: Resistive potentiometers, strain gauges; Inductive Transducers: Variable reluctance displacement sensor, LVDT, RVDT, Hall effect sensors; Capacitive Transducers: Variable separation, area & dielectric displacement transducer, pressure, humidity and level measurement; Translational and Rotational Velocity Measurement: Moving coil moving magnet pickups, Eddy current magnetic & photoelectric pulse counting; Seismic Measurement: Seismic displacement, velocity & acceleration pickups.	10 Hours
Module-3	Temperature Measurement: Thermal expansion methods - Bimetallic, Liquid in glass, Thermocouples (Laws, Characteristics, Installation), RTDs (3-wire & 4-wire type), Thermistors, IC temperature sensors, Radiation detectors, Radiation pyrometer (narrowband & broadband), Optical pyrometer.	9 Hours
Module-4	Force Measurement: Bourdon tube, bellows, diaphragm, load cell; Torque Measurement: Torsion bar; Pressure Measurement: Units of pressure, dead weight gauges, Manometers, Mc-Leod gauge, Thermal conductivity and Ionization gauges; Flow Measurement: Variable Head (Orifice, Venturi, Pitot static), Variable area (Rotameters), Turbine meters, Electromagnetic flow meters, Ultrasonic flow meters, Doppler velocity meters, Hot wire anemometer and mass flow meter; Miscellaneous Sensors: Optical sensors, Principle, intensity and phase modulated sensors, FBG sensor.	7 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	Signal Conditioning System: DC Bridge - Wheatstone Bridge, Calibration of the bridge, AC bridges, Linearization by Bridge circuit, Cold junction compensation of Thermocouple, Modulation and Demodulation Techniques, Signal Conditioning System, Signal Transmission.	6 Hours
Total		42 Hours

Text Books:

- T1. A. K. Ghosh, *Introduction to Instrumentation and Control*, 4th Edition, PHI Learning, 2012.
- T2. J. P. Bentley, *Principles of Measurement Systems*, 4th Edition, PHI Learning, 2005.
- T3. C. D. Johnson, *Process Control Instrumentation Technology*, 8th Edition, PHI Learning, 2014.

Reference Books:

- R1. D. Patranabis, *Sensors and Transducers*, 2nd Edition, PHI Learning, 2013.
- R2. D. V. S. Murthy, *Transducers and Instrumentation*, 2nd Edition, PHI Learning, 2008.
- R3. E. O. Doebelin, *Measurement Systems - Applications and Design*, 6th Edition, McGraw Hill, 2007.
- R4. C. Rangan, G. Sarma, and V. S. V. Mani, *Instrumentation : Devices and Systems*, 2nd Edition, McGraw Hill, 2017.
- R5. B. G. Liptak, *Instrument Engineers' Hand Book (Process Measurement & Analysis)*, 4th Edition, CRC Press, 2006.
- R6. A. K. Sawhney, *A Course in Electrical and Electronics Measurements & Instrumentation*, Dhanpat Rai & Co, 2015.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105088/>: by Prof. S. Mukhopadhyay, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/105/108105062/>: by Prof. S. Mukhopadhyay and Prof. S. Sen, IIT Kharagpur
3. <https://nptel.ac.in/courses/108/105/108105064/>: by Prof. A. Barua, IIT Kharagpur
4. <https://nptel.ac.in/courses/108/108/108108147/>: By Prof. H. J. Pandya, IISc Bangalore

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

CO1	Describe the principles and characteristics of measuring instruments.
CO2	Explain the use of resistance, inductance and capacitance principles in transducers.
CO3	Identify and utilize various temperature sensors used in industrial applications.
CO4	Articulate the principles and uses of different force, torque, pressure sensors and flow meters.
CO5	Analyze the design of signal conditioning circuits and evaluate their performance.

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.

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	1	1	1								3	2	1
CO2	2	3	2	2	1								3	3	2
CO3	2	1	2	1	1								3	2	2
CO4	2	3	2	3	3								3	2	3
CO5	2	2	2	1	3								3	2	2

Type	Code	Control Systems Engineering	L-T-P	Credits	Marks
PC	BTEE-T-PC-005		3-0-0	3	100

Objectives	The objective of the course is to create an understanding of how modern-day control systems operate along with a thorough knowledge of mathematical modeling and stability analysis. This course also covers fundamentals of state-space methods.
Pre-Requisites	Mathematical background of differential equation, Laplace transforms, Basic electrical engineering, Dynamic equations of physical systems 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 Control Systems: Concept of control system, Definition, Open Loop/Closed-loop, Feedback, Effect of feedback, Review of complex variables, Laplace Transform, Transfer function and impulse response of linear systems, Concepts of State, State Variables and State-space Model; Block diagram, Signal flow graphs, Signal flow graphs, Mason's Gain formula, Mathematical modelling of dynamical systems using transfer function and state space approaches; Control System Components: Potentiometer, Synchros, AC/DC Servo motors.	11 Hours
Module-2	Time Response Analysis: Standard Test Signals, Time response of first order systems, Time Response of Second order systems, Type & order of a system, Steady State Errors and Static Error Constants of different types of systems, Effect of adding pole and zero to a system, Design specification of second order system, Performance indices. Introduction to Controllers: Proportional Derivative Error Control (PD Control), Proportional Integral Controller (PI Control), Proportional, Integral and Derivative Controller (PID Control), Derivative Output Control, Tuning Rules for PID controllers (Z-N Tuning).	8 Hours
Module-3	Concepts of Stability: Necessary conditions for stability, Hurwitz Stability Criterion, Routh Stability Criterion, Relative Stability Analysis; The Root Locus Technique: Introduction, Root locus concepts, Construction of Root locus, Root Contours, Systems with transportation lag.	8 Hours
Module-4	Stability in Frequency Domain: Mathematical Preliminaries, Frequency Response Analysis: Correlation between Time and Frequency Response, Polar plots; Nyquist Stability Criterion, Assessment of Relative stability using Nyquist Criterion, Closed loop Frequency Response, Bode plots, All Pass and Minimum-Phase Systems.	9 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	State Variable Analysis: Concept of state, State variable model of dynamic system using physical variable, Phase Variables and Canonical Models, Derivation of Transfer Function, Solution of State Equation, State Transition Matrix, Controllability and Observability, Design of pole placement by state feedback.	6 Hours
Total		42 Hours

Text Books:

- T1. I. J. Nagrath and M. Gopal, *Control Systems Engineering*, 5th Edition, New Age Intl., 2010.
 T2. K. Ogata, *Modern Control Engineering*, 5th Edition, PHI Learning, 2010.

Reference Books:

- R1. B. C. Kuo, *Automatic Control Systems*, 7th Edition, Prentice Hall India, 2010.
 R2. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 8th Edition, Addison Wesley, 2003.
 R3. U. A. Bakshi and V. U. Bakshi, *Control System Engineering*, 1st Edition, Technical Publications, 2010.

Online Resources:

- <https://nptel.ac.in/courses/108102043/>
- <https://nptel.ac.in/courses/108106098/>
- <https://www.youtube.com/channel/UCq0imnsn84ShAe9PBOfnoIrg>: Lectures by Brian Douglas
- <https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/lecture-notes-labs/>

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

CO1	Explain and apply basic concepts of control systems to develop mathematical models of various physical systems in engineering and study of feedback characteristics.
CO2	Apply standard test signals to determine performance characteristics of first and second-order systems and understand the design of conventional controllers used in industry to control these performance parameters.
CO3	Classify stability using time domain techniques and analyze a system's performance using the graphical approach.
CO4	Identify the methods of frequency domain analysis and apply it to determine different types of stability in the frequency domain.
CO5	Develop an understanding of state-space approach in various forms to model a system and apply the state feedback method to design a controller using pole-placement.

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.
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							1	3	2	2
CO2	3	2	2	1	1								3	1	2
CO3	2	2	1	1	1								3		1
CO4	3	3	1	1	2							1	3	1	2
CO5	3	2	1	1	1								3		1

Type	Code	Basics of Power Systems	L-T-P	Credits	Marks
OE	BTEE-T-OE-032		3-0-0	3	100

Objectives	The objective of this course is to study different aspects of power systems, the complete path of electrical energy from generation up to the consumers, and various components used in operation & control of modern power systems.
Pre-Requisites	Knowledge of Basic Electrical Engineering is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on real world examples and case studies.

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	Generation of Electrical Energy: Basics of electrical generation sources - Thermal, Hydro, Nuclear; their layout, basic components, advantages & disadvantages; Renewable Energy: Wind, Solar; their layout, basic components; Grid connected renewable sources, operational issues.	8 Hours
Module-2	Transmission Lines & Substations: Components of transmission lines - conductors & supporting structures, insulators, air gaps, and shielding; DC & AC transmission lines, comparison, underground cables, design parameters, benefits of high-voltage transmission; Substation Equipment - transformers, regulators, circuit breakers, isolators, their relationship to system protection, maintenance & system control; digital substation equipment for modernization & reliability.	9 Hours
Module-3	Distribution System: Primary & secondary, overhead & underground, Consumers - residential, commercial, industrial; voltage classifications, common equipment; modernization & automation, intelligent electronic devices, outage management, customer information systems; Consumption: Wiring to the consumer's load, emergency generators, uninterruptible power supply (UPS), Systems to enhance reliable power service & their operating issues, Smart meters, service reliability indicators, common problems & solutions for large power consumers.	10 Hours
Module-4	System Protection: System vs. Personal protection, protection against equipment failures, faults on power lines, lightning strikes, inadvertent operations, other causes of system disturbances, Protective relays, Protection against faults, lightning strikes, minimization of major system disturbances; Personal protection & safe working procedures in and around high-voltage power systems; Common safety procedures and methods; Equipotential grounding, Ground potential rise, Touch potential, Step potential; precautions around high-voltage power lines, substations, and around the home.	8 Hours

Cont'd...

Module-#	Topics	Hours
Module-5	Interconnected Power Systems: Concept of Interconnection, Hierarchical Grid arrangements, Cascade Tripping, Islanding, Load dispatch center, use of SCADA (Supervisory Control and Data Acquisition) and EMS (Energy Management Systems) for reliable operation of large power systems.	7 Hours
Total		42 Hours

Text Books:

- T1. S. W. Blume, *Electric Power System Basics for the Nonelectrical Professional*, 2nd Edition, John Wiley & Sons, 2017.

Reference Books:

- R1. V. K. Mehta and R. Mehta, *Principles of Power Systems*, 4th Edition, S. Chand, 2005.
 R2. D. P. Kothari and I. J. Nagrath, *Power System Engineering*, 2nd Edition, McGraw-Hill, 2007.
 R3. A. v'Meier, *Electric Power Systems - A Conceptual Introduction*, John Wiley & Sons, 2006. (eBook available at <https://www.personal.psu.edu/sab51/vls/vonmeier.pdf>).

Online Resources:

- <https://nptel.ac.in/courses/108/104/108104052/>: by Dr. S. N. Singh, IIT Kanpur
- <https://nptel.ac.in/courses/108/101/108101040/>: by Dr. A. M. Kulkarni, IIT Bombay

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

CO1	Describe various renewable & nonrenewable sources of energy for generation of electrical power.
CO2	Explain fundamental aspects of transmission systems and substation equipment.
CO3	Elaborate the components of a distribution systems and transmission of electrical power up to the consumers' premises.
CO4	Develop an understanding of the basics of electrical protection systems in terms of system protection and personal safety.
CO5	Articulate the concepts, advantages and challenges in operation of large interconnected power systems and role of energy management systems(EMS) for reliable operation of large power systems.

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.

Cont'd...

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.
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		2	1				1			
CO2	1	2	1	1	2		2	1				1			
CO3	1	2	1	1	2		2	1				1			
CO4	1	2	1	1	1		2	1				1			
CO5	1	2	1	1	1		2	1				1			

Type	Code	Applied Linear Algebra	L-T-P	Credits	Marks
OE	BTBS-T-OE-027		3-0-0	3	100

Objectives	The objectives of this course is to gain mathematical maturity by equipping the students to handle computation with matrices, difference equation and similarity transformation for various engineering applications.
Pre-Requisites	Knowledge of complex numbers, matrix algebra, and vector space is 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	Geometry of Linear Equations, Gauss Elimination, Concept of Matrices with Applications, Vector Spaces and Subspaces, Echelon Form, Solution in Matrix Method, L.I, Basis & Dimension, Four Fundamental Subspaces, Linear Transformations.	9 Hours
Module-2	Orthogonal Vectors & Subspaces, Cosines & Projections onto Lines, Projections & Least Squares, Orthogonal Bases and Gram-Schmidt Process.	8 Hours
Module-3	Introduction & Properties of Determinants, Formulas for Determinant, Applications of Determinants, Introduction to Eigenvalues & Eigenvectors, Diagonalization of Matrix, Difference Equations, Complex Matrices, Similarity Transformations.	8 Hours
Module-4	Maxima, Minima & Saddle Points, Tests for Positive Definiteness, Singular Value Decomposition, Minimum Principles.	8 Hours
Module-5	Introduction to Computations with Matrices, Matrix Norm & Condition Number, Computation of Eigenvalues, Iterative Methods.	9 Hours
Total		42 Hours

Text Books:

T1. G. Strang, *Linear Algebra and Its Applications*, 4th Edition, Cengage Learning, 2007.

Reference Books:

R1. G. Strang, *Introduction to Linear Algebra*, 3rd Edition, Wellesley-Cambridge, 2003.

Online Resources:

1. <https://nptel.ac.in/courses/111/106/111106051/>: by Dr. K. C. Sivakumar, IIT Madras
2. <https://nptel.ac.in/courses/111/102/111102011/>: by Dr. R. K. Sharma and Dr. W. Shukla, IIT Delhi
3. <https://nptel.ac.in/courses/111/108/111108066/>: by Prof. V. Rao, IISc Bangalore
4. <https://nptel.ac.in/courses/111/107/111107106/>: by Prof. P. N. Agrawal and Prof. D. N. Pandey, IIT Roorkee

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

CO1	Explain and apply matrix methods for solving a system of linear equations.
CO2	Describe orthogonal & projection in vector space and apply it to least square solution.
CO3	Identify and apply Eigen values and Eigen vectors to diagonalization.
CO4	Explain and apply Singular Value Decomposition and to obtain pseudo inverse of a matrix.
CO5	Develop algorithms and write programs to solve linear algebra problems on computers.

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	3	2								2	1	1
CO2	3	2	2	3	2								2	1	1
CO3	3	3	2	2	2								2	1	1
CO4	3	3	3	3	3								2	1	1
CO5	3	3	3	3	3								2	1	1

Type	Code	Fluid Mechanics	L-T-P	Credits	Marks
OE	BTBS-T-OE-028		3-0-0	3	100

Objectives	The objective of this course is to study the properties and behavior of fluids including fluid statics, kinematics, dynamics, inviscid flow, flow of viscous fluids, measuring instruments and fluid motive devices.
Pre-Requisites	Basic knowledge of the material properties of solids, liquids and gases and some knowledge of calculus and differential equations are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on engineering applications.

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	Fluid Properties - Density, Specific weight, Specific gravity, Viscosity, Vapor pressure, Compressibility, Pressure at a point, Pascal's law, Pressure variation with temperature, Density & altitude, Simple & differential manometers, Piezometer, Pressure gauges, Hydrostatic forces on submerged surfaces, Forces on horizontal & vertical submerged plane surfaces, Buoyancy & flotation, Archimedes' principle, stability of immersed & floating bodies, Determination of metacentric height.	10 Hours
Module-2	Kinematics of fluid flow, Acceleration of fluid particles, Lagrangian and Eulerian descriptions, Conservation of mass - continuity equation, Differential equation of continuity, Stream line, Path line, Streak lines & Stream tube, Classification of fluid flow - Steady & unsteady, uniform & non uniform, Laminar & turbulent, Rotational & irrotational, one, two- and three-dimensional flows, Continuity equation in 3D flow, Stream function, Velocity potential function.	8 Hours
Module-3	Dynamics of Inviscid flows, Surface and body forces, Euler's equation, Bernoulli's equation, Applications - Venturi meter, Orifice meter, Current meter, Pitot tube, Momentum balance equation, Control volume approach, Dynamics of Viscous Fluids; Navier-Stokes equations (explanation only), Navier-Stokes equations in Cartesian form, Application to simple geometries, Couette and Poiseuille flow.	8 Hours
Module-4	Pipe flow, Friction losses, Moody's diagram and hydraulic diameter, Water level, Velocity and discharge measurements, Notch and weir, Impact of Jet, and relevant equations.	8 Hours
Module-5	Hydraulic turbines, Impulse turbine - construction and working, Hydraulic turbines, Reaction & Mixed flow turbines - construction and working, Hydraulic pumps, Centrifugal Pumps - construction and working, Hydraulic pumps, Positive Displacement types - construction and working, Principles of Dimensional Analysis and Similarity.	8 Hours
Total		42 Hours

Text Books:

- T1. S. K. Som, G. Biswas, and S. Chakraborty, *An Introduction to Fluid Mechanics and Fluid Machines*, 3rd Edition, McGraw-Hill, 2012.
- T2. E. Rathakrishnan, *Fluid Mechanics - An Introduction*, 3rd Edition, Prentice Hall India, 2012.

Reference Books:

- R1. R. K. Rajput, *Fluid Mechanics and Hydraulic Machines*, 4th Edition, S. Chand Publications, 2008.
- R2. R. K. Bansal, *A Textbook of Fluid Mechanics and Hydraulic Machines*, 9th Edition, Laxmi Publications, 2010.

Online Resources:

1. <https://nptel.ac.in/courses/105/103/105103192/>: by Prof. S. Dutta, IIT Guwahati
2. <https://nptel.ac.in/courses/112/105/112105269/>: by Prof. S. Chakraborty, IIT Kharagpur

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

CO1	Explain and apply the principles of fluid mechanics to solve problems in hydro-statics.
CO2	Describe the principles of fluid mechanics to solve problems in fluid kinematics.
CO3	Apply the concepts to fluid dynamics for the flow measuring devices.
CO4	Analyze and design free surface and pipe flows for real-world applications.
CO5	Design the working proportions of hydraulic 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.
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	3	2	2								1	1	1	
CO2	3	3	2	2								1		1	
CO3	3	2	2	2	1							1	1	2	1
CO4	3	2	3	2	1							1	1	1	1
CO5	3	3	3	3								1	1	2	1

Type	Code	Information Theory & Coding	L-T-P	Credits	Marks
OE	BTEC-T-OE-099		3-0-0	3	100

Objectives	The objective of the course is to study the concepts of information theory, measuring information using traditional & modern coding techniques including linear block, cyclic, and convolutional codes for error control.
Pre-Requisites	Fundamental knowledge of probability theory, random variables and basics of linear algebra is 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	Information Theory: Information and entropy, Entropy for discrete ensembles, Properties of entropy of a binary memory less source, Measure of information, Source coding, Shannon's noiseless coding theorem, Shannon-Fano coding, Entropy rate of a stochastic process.	8 Hours
Module-2	Source Coding and Decoding Techniques: Kraft-McMillan Inequality and Compact Codes, Huffman codes and uniquely detectable codes, Arithmetic Coding, Predictive Coding, Lempel Ziv coding.	9 Hours
Module-3	Channel Capacity: Markov Source, Joint and Conditional Information Measures, Properties of Joint and Conditional Information Measures and a Markov Source, Differential entropy, Channel models, Channel capacity, Channel coding, Information capacity theorem, the Shannon Limit Theorem, Channel capacity for MIMO systems.	9 Hours
Module-4	Channel Coding: Introduction to cyclic codes, Polynomials, the Division Algorithm for polynomials, Method for generating cyclic codes, Matrix description of cyclic codes, Burst error correction, Fire codes, Golay codes.	8 Hours
Module-5	Error Control Coding: Introduction to convolutional codes, Tree codes & Trellis codes, Polynomial description of convolutional codes, the Generating Function, Matrix description of convolutional codes, Viterbi decoding of convolutional codes.	8 Hours
Total		42 Hours

Text Books:

- T1. R. Bose, *Information Theory, Coding and Cryptography*, 2nd Edition, Tata McGraw-Hill, 2008.
- T2. N. Abramson, *Information and Coding*, McGraw-Hill Education, 1963.

Reference Books:

- R1. M. Mansurpur, *Introduction to Information*, McGraw Hill, 1987.
- R2. R. B. Ash, *Information Theory*, Dover Publications, 1990.
- R3. S. Lin and D. J. Costello Jr., *Error Control Coding*, Prentice Hall, 1983.

Online Resources:

1. <https://nptel.ac.in/courses/108/103/108103112/>: by Prof. P. K. Bora, IIT Guwahati
2. <https://nptel.ac.in/courses/117/108/117108097/>: by Prof. P. S. Nuggehalli, IISc Bangalore
3. <https://nptel.ac.in/courses/117101053/>: by Prof. S. N. Merchant, IIT Bombay
4. <https://nptel.ac.in/courses/117/104/117104120/>: by Prof. A. Banerjee, IIT Kanpur
5. <https://nptel.ac.in/courses/117/104/117104121/>: by Prof. A. Banerjee, IIT Kanpur
6. <https://nptel.ac.in/courses/117/106/117106031/>: by Dr. A. Thangaraj, IIT Madras

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

CO1	Describe the concept of information and entropy of a source.
CO2	Explain the Shannon's theorem for coding and source coding techniques.
CO3	Analyze conditional information measure and Markov source.
CO4	Analyze different channels and calculation of channel capacity.
CO5	Apply channel coding techniques for error control.

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	2	1	2	1										
CO2	3	3	1	3	1										
CO3	3	2	2	2	2										
CO4	3	3	2	3	2										
CO5	3	2	3	3	3										

Type	Code	Fundamentals of DBMS	L-T-P	Credits	Marks
OE	BTCS-T-OE-040		3-0-0	3	100

Objectives	The objective of the course is to introduce the fundamental aspects involved in the design, implementation, and operation of relational database systems, learn & use data manipulation language, explore the details of transaction processing, concurrency control, and recovery techniques.
Pre-Requisites	Basic knowledge of data structures, algorithms, and proficiency in any programming language is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on real-world examples.

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 Database Systems: Basic concepts and definitions, three schema architecture, data independence, data models, types of data models, database languages, integrity, database users, Entity-Relationship model, Constraints & Keys, Extended Entity Relationship model, Relational model, Mapping of E-R model to relational schema, System structure of DBMS, Codd's 12 Rules.	10 Hours
Module-2	Query Languages: Relational Algebra, basic operations, join operations, grouping & aggregation, Tuple Relational Calculus, Domain Relational Calculus, Query-By-Example, Structured Query Language (SQL): Create/Alter Tables, Constraints, Selection, Insertion, Modification, Deletion, Functions, Joins, Views.	10 Hours
Module-3	Database Design: Functional dependencies, Armstrong axioms, Attribute closure, Normalization: Dependency & attribute preservation, lossless join; Normal Forms: 1NF, 2NF, 3NF, BCNF, Testing for lossless design, Multi-Valued Dependency (MVD), 4NF and 5NF.	8 Hours
Module-4	Storage Strategies: Storage Architecture, File and Record Organization, Types of Indexes, B-Tree, B+ Tree, Index Files, Hashing; Query processing and optimization: Evaluation of Relational Algebra expressions, Query Optimization.	7 Hours
Module-5	Transaction Processing: Basic concepts, ACID Properties, Serializability, Concurrency Control Schemes – Lock-based & Timestamp-based protocols, Deadlock handling, deadlock prevention, detection and recovery; Database Recovery: types of database failures, Recovery techniques: log-based recovery, checkpoints, shadow paging.	7 Hours
Total		42 Hours

Text Books:

- T1. A. Silberschatz, H. F. Korth, and S. Sudarshan, *Database System Concepts*, 6th Edition, McGraw-Hill, 2013.

- T2. R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, 7th Edition, Pearson Education, 2016.
- T3. I. Bayross, *SQL, PL/SQL - The Programming Language of Oracle*, 1st Edition, BPB Publications, 2010.

Reference Books:

- R1. R. Ramakrishnan and J. Gekhre, *Database Management Systems*, 3rd Edition, McGraw-Hill, 2003.
- R2. R. P. Mahapatra and G. Verma, *Database Management Systems*, 1st Edition, Khanna Publishing, 2013.
- R3. C. J. Date, *Introduction to Database Systems*, 8th Edition, Pearson Education, 2003.

Online Resources:

1. <https://nptel.ac.in/courses/106104135/>: by Prof. A. Bhattacharya, IIT Kanpur
2. <https://nptel.ac.in/courses/106105175/>: by Prof. P. P. Das, IIT Kharagpur
3. <https://cs145-fa18.github.io/>
4. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-databasesystems-fall-2010/lecture-notes/>
5. <https://docs.oracle.com/database/121/SQLRF/toc.htm>: Oracle SQL Reference

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

CO1	Explain the significance of database management system, its functional components, create E-R model and relational schema for databases of real world applications.
CO2	Construct queries using Relational Algebra, Relational Calculus, and perform various database operations using structured query language (SQL).
CO3	Design relational databases based on real-world requirements and normalize the designs using different normalization techniques.
CO4	Get an insight to storage structures, various indexing techniques and access methods using those indexes, and devise optimal query execution strategies for efficient query processing.
CO5	Resolve concurrency control issues in transaction processing, and recover a database to its current state in case of failures.

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.

Cont'd...

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.

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	2	1		2						1			
CO2	3	3	3	2	1	1						2			
CO3	3	3	3	2		1						2			
CO4	2	2	2	2	1	1						1			
CO5	2	3	3	2		2						1			

Type	Code	Digital Electronic Circuits Lab	L-T-P	Credits	Marks
PC	BTEC-P-PC-011		0-0-2	1	100

Objectives	The objective of the course is to hands-on exposure on logic gates, implementation using Boolean algebra, designing digital circuits like counters, registers and apply the knowledge to formulate digital systems using HDL.
Pre-Requisites	Knowledge of Basic Electronics is required.
Teaching Scheme	Regular laboratory experiments to be conducted under supervision of the faculty with use of ICT as and when required, sessions are planned to be interactive with focus on implementation in hardware / software tools.

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	Digital Logic Gates: Investigate logic behaviour of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NAND Gate.
2	Combinational Circuit Design: Design, assemble and test: adders and subtractors.
3	Combinational Circuit Design: Code Converters, Gray code to Binary and 7 Segment Display.
4	Universal Gates: Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number of Gates.
5	Multiplexer and De-multiplexer: Design with multiplexers and de-multiplexers.
6	Flip-Flop: Assemble, test and investigate operation of SR, D & J-K flip-flops.
7	Shift Registers: Design and investigate the operation of all types of shift registers.
8	Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallel load.
9	Parallel Adder and Accumulator: Design, implement and test.
10	Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce an 8-bit product.
11	Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16×4 RAM: testing, simulating and memory expansion.
12	Clock-pulse generator: Design, implement and test.
13	Verilog/VHDL Simulation and implementation of Experiments 2 to 12.

Text Books:

- T1. M. M. Mano and M. D. Ciletti, *Digital Design: With an Introduction to Verilog HDL*, 5th Edition, Pearson Education, 2013.

Reference Books:

- R1. A. M. Michelén, *Digital Electronics Laboratory Manual*, Pearson Education, 2000.
 R2. J. W. Stewart and C. -Y. Wang, *Digital Electronics Laboratory Experiments: Using the Xilinx XC95108 CPLD with Xilinx Foundation : Design and Simulation Software*, 2nd Edition, Pearson, 2004.

Online Resources:

1. <https://www2.mvcc.edu/users/faculty/jfiore/Resources/DigitalElectronics1LaboratoryManual.pdf>
2. <https://www.elprocus.com/top-digital-electronic-projects-for-electronics-engineering-students/>
3. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-111-introductory-digital-systems-laboratory-spring-2006/>

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

CO1	Analyse the function of logic gates and implementation of Boolean functions.
CO2	Realize Universal gates and Implementation of minimized Boolean Expressions.
CO3	Design and analyze different combinational circuits.
CO4	Design various asynchronous and Synchronous Sequential Circuits.
CO5	Acquire knowledge about internal circuitry and logic behind any digital system.
CO6	Simulate various digital circuits using VHDL in industry standard tool such as Xilinx.

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.
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.

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	2	3	2	1							3	1	
CO2	2	3	3	3	3	1							3	1	
CO3	2	3	3	3	3	1							3	1	
CO4	2	3	2	3	2	1							3	1	
CO5	2	3	2	3	2	1							3	1	
CO6	2	3	2	3	2	1							3	1	

Type	Code	Transducers & Measurement Systems Lab	L-T-P	Credits	Marks
PC	BTEI-P-PC-004			0-0-2	1

Objectives	The objective of this laboratory course is to get practical exposure to transducers and measurement systems for accurately measuring temperature, weight, position/displacement, pressure, flow, level, etc.
Pre-Requisites	Basic knowledge of physics, mathematics, electrical and electronics is required. Topics taught in TMS 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 in the pre-lab session.

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	Study of the characteristics of RTD and Thermistor.
2	Temperature sensing using semiconductor type temperature sensor.
3	Weight measurement using strain gauge Load cell.
4	LVDT and its signal conditioning for position/displacement measurement.
5	Pressure measurement using Bourdon tube and diaphragm type sensor.
6	Temperature measurement using thermocouple.
7	Flow measurement using turbine type flow sensor.
8	Level measurement using capacitive transducers.
9	Speed measurement using optical and variable reluctance type transducers.
10	Design of active 2nd order low pass filter.
11	Calibration of capacitive level sensor.
12	Design of Instrumentation amplifier.
13	Design of Phase sensitive detector.
14	Study of the characteristics of Fiber Bragg Grating (FBG) sensor.

Text Books:

- T1. J. P. Bentley, *Principles of Measurement Systems*, 4th Edition, PHI Learning, 2005.
- T2. A. K. Ghosh, *Introduction to Instrumentation and Control*, 4th Edition, PHI Learning, 2012.

Reference Books:

- R1. D. Patranabis, *Sensors and Transducers*, 2nd Edition, PHI Learning, 2013.
- R2. D. V. S. Murthy, *Transducers and Instrumentation*, 2nd Edition, PHI Learning, 2008.
- R3. E. O. Doebelin, *Measurement Systems - Applications and Design*, 6th Edition, McGraw Hill, 2007.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105088/>: by Prof. S. Mukhopadhyay, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/105/108105062/>: by Prof. S. Mukhopadhyay and Prof. S. Sen, IIT Kharagpur

3. <https://nptel.ac.in/courses/108/105/108105064/>: by Prof. A. Barua, IIT Kharagpur
4. <https://nptel.ac.in/courses/108/108/108108147/>: By Prof. H. J. Pandya, IISc Bangalore

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

CO1	Analyze the characteristics of RTD and Thermistor.
CO2	Measure temperature, weight and position using different sensors.
CO3	Explain the techniques to measure flow, level and speed using various types of sensors.
CO4	Conceptualize and design different types of active filters.
CO5	Design instrumentation amplifiers and phase sensitive detectors.

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.
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.
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	2	1	2		1		1			1	3	3	2
CO2	2	2	1	1	1		1		1			1	3	2	2
CO3	2	2	1	1	2		1		1			1	3	2	2
CO4	1	1	1	1	2				1				3	1	1
CO5	2	1	1	1	2				1				3	2	3

Type	Code	Control Systems Engineering Lab	L-T-P	Credits	Marks
PC	BTEE-P-PC-006		0-0-2	1	100

Objectives	The objective of the course is to understand and practice modeling, simulation, and implementation of a physical dynamical system along with an insight to the design of controllers and compensators in modern control system applications.
Pre-Requisites	Knowledge of Dynamic equations of physical systems, Basic Electrical Engineering, Laplace Transform, and Matrix Theory is required.
Teaching Scheme	Regular laboratory experiments to be conducted using hardware and software tools under the supervision of teachers. Demonstration will be given for each experiment in the pre-lab session.

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	Study of Position control system using DC Servo motor and determination of its transfer function.
2	Study the characteristics of Synchro Transmitter and Receiver.
3	Observe the time response of a second order process with P, PI and PID controller using process control simulator.
4	Analyze a 2nd order system by plotting its step response using simulation & programming.
5	Verify the effect of P, PI, PD and PID Controller of a 2nd order system using simulation & programming.
6	Study of speed-torque characteristics of two-phase ac servomotor and determination of its transfer function.
7	Determination of controllability and Observability of a given system using Simulation and programming.
8	Stability analysis of a given system using time domain and frequency domain plots using Simulation and programming.
9	Study of frequency response of compensator networks and analysis of system stability with compensator using simulation & programming.
10	Study the frequency response of lead, lag compensator network.
11	Study and validate the controllers (ON/OFF and PID) for a temperature control system.
12	Obtain reduced order model of a higher order system using simulation & programming.

Text Books:

- T1. I. J. Nagrath and M.Gopal, *Control Systems Engineering*, 5th Edition, New Age Intl., 2010.
 T2. K. Ogata, *Modern Control Engineering*, 5th Edition, PHI Learning, 2010.

Reference Books:

- R1. B. C. Kuo, *Automatic Control Systems*, 7th Edition, Prentice Hall India, 2010.
- R2. R. C. Dorf and R. H. Bishop, *Modern Control Systems*, 8th Edition, Addison Wesley, 2003.
- R3. U. A. Bakshi and V. U. Bakshi, *Control System Engineering*, 1st Edition, Technical Publications, 2010.

Online Resources:

1. <https://nptel.ac.in/courses/108102043/>: by Prof. M. Gopal, IIT Delhi
2. <https://nptel.ac.in/courses/108106098/>: by Prof. P. Ramkrishna, IIT Madras
3. <https://www.youtube.com/channel/UCq0imsn84ShAe9PBOFnoIrg>: Lectures by Brian Douglas
4. <https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-2013/lecture-notes-labs/>

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

CO1	Evaluate the parameters and transfer function of various control components and interpret their application in real world.
CO2	Understand the design of compensators and recognize their use for various applications in interdisciplinary domain.
CO3	Classify between linear and non-linear control actions used in a closed loop system and relate the use of appropriate control scheme for industrial applications.
CO4	Differentiate between Transfer Function and State-space representation of any system dynamics using software tools.
CO5	Analyze and compare the performance of first and second order systems in time domain using hardware and software tools.

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.
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.

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	3	2	1	2								3	1	2
CO3	2	2	1	1									3		1
CO4	3	3	1	1	2	1						1	3	1	2
CO5	2	1		1	2								3		1

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

Curriculum Structure

Semester V								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
BS		Biology for Engineers	3	0	0	3	0	0
PC		Fundamentals of Microprocessor & Microcontrollers	3	0	0	3	0	0
PC		Instrumentation Devices & Systems	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
MC		Universal Human Values & Professional Ethics	2	0	0	0	0	0
PRACTICAL								
HS		Soft Skills & Inter-Personal Skills Lab	0	0	4	0	0	2
PC		Fundamentals of Microprocessor & Microcontrollers Lab	0	0	2	0	0	1
PC		Instrumentation Devices & Systems Lab	0	0	2	0	0	1
PJ		Summer Internship - II	0	0	0	0	0	1
		SUB-TOTAL	17	0	8	15	0	5
		TOTAL	25			20		

Semester VI								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
HS		Engineering Economics	3	0	0	3	0	0
PC		Digital VLSI Design	3	1	0	3	1	0
PC		Introduction to Digital Signal Processing	3	0	0	3	0	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		Digital VLSI Design Lab	0	0	2	0	0	1
PC		Introduction to Digital Signal Processing Lab	0	0	2	0	0	1
PJ		Skill Lab & Project - I	0	0	4	0	0	2
		SUB-TOTAL	18	1	8	18	1	4
		TOTAL	27			23		

Note: Courses offered under each elective are given in "List of Electives" on Page 109.

List of Electives

Code	Elective # and Subjects
<i>Professional Elective - I</i>	
	IoT & Applications
	Optoelectronic Devices & Instrumentation
	Energy Conversion Devices
	Computer Organization & Architecture
	System Design Using Verilog
<i>Professional Elective - II</i>	
	Advanced Sensor Technology
	Power Electronics
	Analog VLSI Design
	PLC, Distributed Control System & SCADA
<i>Professional Elective - III</i>	
	Biomedical Electronics
	Soft Computing Techniques
	Virtual Instrumentation
<i>Open Elective - II</i>	
	[EEE] Power Station Engineering
	[BSH] Numerical Optimization
	[BSH] Organisational Behaviour
	[ECE] Digital Communication
	[CSE] Operating Systems
	[CSE] Programming in Python
<i>Open Elective - III</i>	
	[EEE] Renewable Energy Systems
	[BSH] Stochastic Processes
	[BSH] Project Management
	[ECE] Advanced Communication Systems
	[ECE] Speech & Audio Processing
	[CSE] Internet Technology & Applications
	[CSE] Advanced Java Programming

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

Part IV

4th Year B. Tech. (EIE)

Curriculum Structure (Regular)

Semester VII								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
HS		Fundamentals of Management	3	0	0	3	0	0
PC		Communication Systems Engineering	3	0	0	3	0	0
PC		Industrial Automation and Control	3	0	0	3	0	0
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		Communication Systems Engineering Lab	0	0	2	0	0	1
PC		Industrial Automation and Control Lab	0	0	2	0	0	1
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	15	0	4	18	0	3
		TOTAL	19			21		

Semester VIII								
Type	Code	Course Title	WCH L-T-P			Credits 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		

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 114.*

Curriculum Structure (PS-7)
 (For Students opting for Practice School / Industry Internship in the 7th Semester)

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								
HS		Fundamentals of Management	3	0	0	3	0	0
PC		Communication Systems Engineering	3	0	0	3	0	0
PC		Industrial Automation & Control	3	0	0	3	0	0
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		Communication Systems Engineering Lab	0	0	2	0	0	1
PC		Industrial Automation & Control Lab	0	0	2	0	0	1
VV		Comprehensive Viva	0	0	0	0	0	1
		SUB-TOTAL	15	0	4	18	0	3
		TOTAL	19			21		

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 114.

Curriculum Structure (PS-8)
(For Students opting for Practice School / Industry Internship in the 8th Semester)

Semester VII								
Type	Code	Course Title	WCH L-T-P			Credits L-T-P		
THEORY								
HS		Fundamentals of Management	3	0	0	3	0	0
PC		Communication Systems Engineering	3	0	0	3	0	0
PC		Industrial Automation & Control	3	0	0	3	0	0
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		Communication Systems Engineering Lab	0	0	2	0	0	1
PC		Industrial Automation & Control Lab	0	0	2	0	0	1
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	15	0	4	18	0	3
		TOTAL	19			21		

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		

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 114.

List of Electives

Code	Elective # and Subjects
<i>Professional Elective - IV</i>	
	Advanced Electronic Circuits
	Adaptive Signal Processing
	Industrial Instrumentation
	VLSI Design Verification & Testing
<i>Professional Elective - V</i>	
	MEMS & Sensor Design
	Digital Image & Video Processing
	Advanced Control Systems
<i>Professional Elective - VI</i>	
	Satellite Communication Systems
	Mobile Communication & Networks
	Industry 4.0
<i>Open Elective - IV</i>	
	[EEE] Energy Studies
	[BSH] Simulation & Modeling
	[BSH] Entrepreneurship Development
	[ECE] Mixed Signal Design
	[ECE] Fiber Optic Communication
	[ECE] Robotics & Robot Applications
	[ECE] Embedded System Design
	[CSE] Artificial Intelligence
	[CSE] Introduction to Machine Learning

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



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