Silicon Institute of Technology
| An Autonomous Institute |

Curriculum Structure and Detailed Syllabus

Bachelor of Technology in Computer Science & Technology

Department of Computer Science & Engineering
Silicon Institute of Technology
Silicon Hills, Patia, Bhubaneswar - 751024

Effective From Academic Year 2020-21

Version: 1.20 (Build: 18-10-2021)

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, and develop efficient software solutions to problems of varying complexity related to algorithms, system software, multimedia, web applications, data processing, and networking by applying fundamental concepts of computer science.

PSO2. Develop the skills in different computer languages, environments, tools & platforms to become a successful software professional or entrepreneur, develop a zest for innovation & higher studies, and contribute as a responsible citizen with effective communication, strong moral values and professional ethics.

PSO3. Adapt to the evolutionary changes in computing and embrace modern practices of software development to deliver user-friendly expert systems with for business success in the real world to meet the challenges of the future.

Program Educational Objectives (PEOs)

PEO1. *Fundamental Knowledge & Core Competence*: To apply fundamental knowledge of mathematics, science and engineering required for a successful computer professional and inculcate competent problem solving ability using efficient algorithms.

PEO2. *Proficiency for the Real World*: To foster the skills and creative ability to analyze, design, test and implement cost effective software applications and digital support systems for the changing needs of the real world.

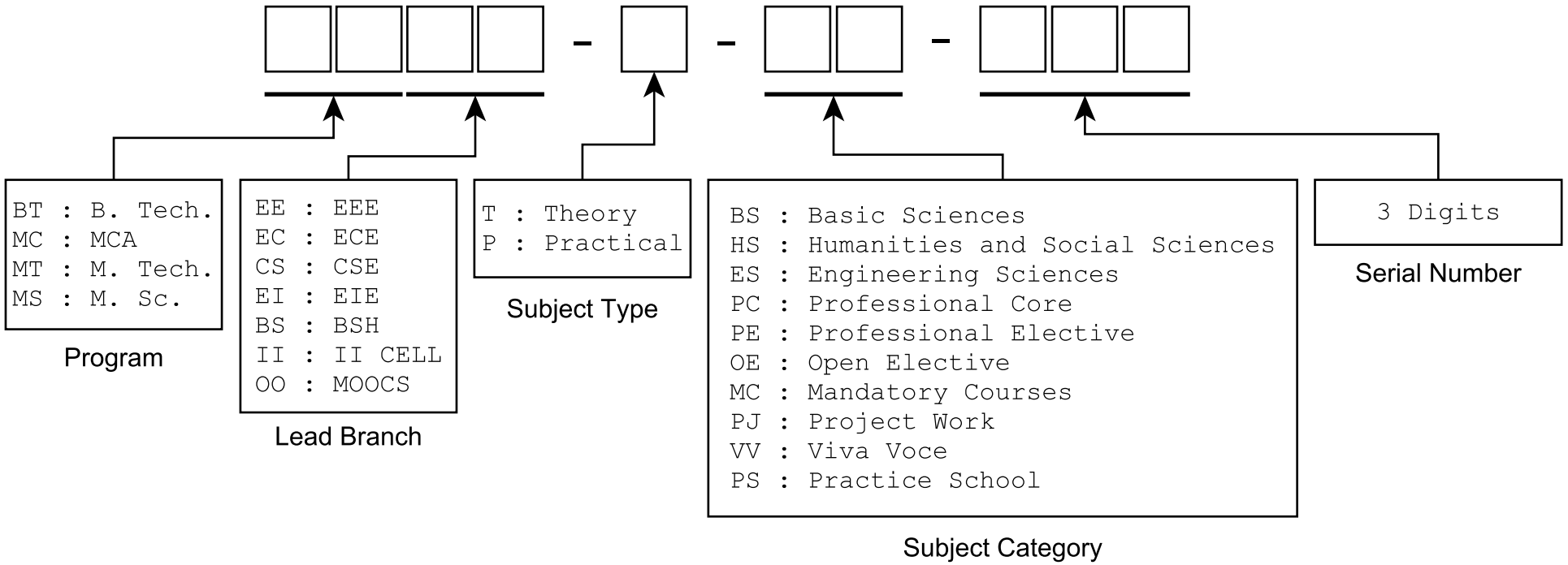
PEO3. *Leadership & Social Responsibility*: To exhibit leadership capability with professional, ethical, interpersonal skills, social & economic commitment with a sense of responsibility towards public policies, community services, humanity and environment.

PEO4. *Life-long Learning*: To grow professionally through continued education & training of technical and management skills, pursue higher studies, and engage in life-long learning.

Course Types & Definitions

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

Subject Code Format



Contents

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

1. https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Exemplars/Corrosion/Corrosion_Basics
2. https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/infrared/infrared.htm
3. http://nptel.ac.in/courses/103105110/ - Fuel & Combustion
4. http://nptel.ac.in/courses/105104102/hardness.htm
5. http://nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
6. 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	2
CO2	3	2	1	1	1	2	1						1	2	1
CO3	2	2	1	1	2	2	1	1					1	1	2
CO4	2	2	1	1	1	1	1						2	2	1
CO5	2	2	1	1	2	2	1	1					2	1	2

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

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

Evaluation Scheme

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

Detailed Syllabus

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

Cont'd...

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

Text Books:

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

Reference Books:

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

Online Resources:

1. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/
2. http://www.ilectureonline.com/lectures/subject/PHYSICS
3. https://ocw.mit.edu/courses/physics
4. https://nptel.ac.in/courses/115102026/
5. 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	1	1
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	2	1

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										1	1	1
CO2	3	2	3	1									2	2	2
CO3	2	2	2	1									2	2	2
CO4	3		3										1	1	2
CO5	2	1	2										1	1	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									1	1	1
CO2	3	3	2	3										1	1
CO3	3	2	1	1			2						1	1	1
CO4	3	2	2				1						1		1
CO5	3	3	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	3
CO2	3	3	2	2								1	3	2	3
CO3	3	3	2	2								1	3	2	3
CO4	3	2	2	2								1	3	2	3
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***, Triniti 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 Assesment (LCA), Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS).	**6 Hours**
Module-5	Environmental gradients & Laws: Environmental gradients, tolerance levels of environment factors, Indian environmental laws, Human population & the environment, Activities including seminar presentations by students.	**5 Hours**
	Total	**28 Hours**

Text Books:

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

Reference Books:

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

Online Resources:

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

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

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

Program Outcomes Relevant to the Course:

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

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

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

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

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

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

Evaluation Scheme

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

Detailed Syllabus

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

Text Books:

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

Reference Books:

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

Online Resources:

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

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

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

Program Outcomes Relevant to the Course:

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

P.T.O

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

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

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
	At least 10 Experiments
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-Martein's 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 the demonstrate of 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:

1. https://www.metrohm.com/en/industries/petro-lubricants/: Lubricant analysis according to international standards
2. 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 viscocity or flash point which gives their nature & flammability for various industrial applications.
CO4	Analyse various fractions present in coal by proximate analysis for better use of carbon based compounds in industrial applications.
CO5	Study the importance of green synthesis by way of synthesising metal/ metal oxide based nano-particles for various material applications.

Program Outcomes Relevant to the Course:

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

Cont'd...

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

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

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

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

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

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

Evaluation Scheme

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

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction 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. Kannaiah 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	
CO2	1		2			1			3		3	2		1	
CO3	1		2			1			3		3	2		1	
CO4	1		2			1			3		3	2		1	
CO5	1		2			1			3		3	2		1	
CO6	1		2			1			3		3	2		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. Kannaiah, ***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
CO2	3	2	1	1	1					2	1	1			1
CO3	3	2	1	1	1					2	1	1			1
CO4	3	1	1	1	1					2	1	1			1
CO5	3	2	2	2	3					2	2	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										1	1	1
CO2	3	3	2	1									2	2	2
CO3	2	2	2	1									2	2	2
CO4	2	2	3										2	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:

1. www.nptel.iitm.ac.in/electricalengineering
2. 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	1
CO2	2			2		1		2	1	1	2	1	1	1	1
CO3	1			3		2		2	1	1	1	1	1	1	2
CO4	1			2		2		1	1	2	2	1		1	1
CO5	1			1		1		1	1	1	1	1	1	1	1

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	3	2	2

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

Part II

2nd Year B. Tech. (CST)

Curriculum Structure

Semester III									
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY									
BS	BTBS-T-BS-016	Mathematics-III for Computer Sciences	3	0	0	3	0	0
BS	BTBS-T-BS-014	Biology for Engineers	3	0	0	3	0	0
ES	BTCS-T-ES-005	OOP Using Java	3	0	0	3	0	0
ES	BTEC-T-ES-003	Digital Electronics	3	0	0	3	0	0
ES	BTBS-T-ES-013	Basics of Mechanical Engineering	3	1	0	3	1	0
PC	BTBS-T-PC-015	Discrete Mathematics	3	1	0	3	1	0
PRACTICAL									
ES	BTCS-P-ES-006	OOP Using Java Lab	0	0	2	0	0	1
ES	BTEC-P-ES-004	Digital Electronics 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	**18**	**2**	**6**	**18**	**2**	**3**
		TOTAL	**26**			**23**		

Semester IV									
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY									
BS	BTBS-T-BS-019	Mathematics-IV for Computer Sciences	3	0	0	3	0	0
HS	BTBS-T-HS-018	Engineering Economics	3	0	0	3	0	0
PC	BTCS-T-PC-011	Design & Analysis of Algorithms	3	1	0	3	1	0
PC	BTCS-T-PC-009	Database Management Systems	3	1	0	3	1	0
PC	BTCS-T-PC-007	Computer Organization & Architecture	3	0	0	3	0	0
PRACTICAL									
PC	BTCS-P-PC-012	Design & Analysis of Algorithms Lab	0	0	4	0	0	2
PC	BTCS-P-PC-010	Database Management Systems Lab	0	0	4	0	0	2
PC	BTCS-P-PC-008	Computer Organization & Architecture Lab	0	0	2	0	0	1
		SUB-TOTAL	**15**	**2**	**10**	**15**	**2**	**5**
		TOTAL	**27**			**22**		

Type	Code	Mathematics-III for Computer Sciences	L-T-P	Credits	Marks
BS	BTBS-T-BS-016		3-0-0	3	100

Objectives	The objective of this course is to familiarize the CSE students with topics like calculus of functions of more than one variable, Fourier Series, Fourier Integral and Fourier Transform. Also the students will be introduced to stochastic processes to handle time-dependent probabilistic models.
Pre-Requisites	Knowledge of differential and integral calculus of one variable, coordinate geometry of two and three dimensions, matrix algebra and elementary probability theory 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	Gradient, Double and Triple integration, Vector Calculus.	**8 Hours**
Module-2	Minima, Maxima and saddle points, test for positive definiteness of a matrix, singular value decomposition.	**8 Hours**
Module-3	Matrix Differentiation, Analysis of Variance.	**8 Hours**
Module-4	Stochastic Process and Markov chain.	**8 Hours**
Module-5	Periodic function and Fourier series, Euler formula, Even and odd functions, Half range expansions, Fourier integrals, Fourier cosine transform, Fourier since transform, Fourier transform.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. E. Kreyszig, ***Advanced Engineering Mathematics***, 8th Edition, Wiley India, 2015.
T2. G. Strang, ***Linear Algebra and Its Applications***, 4th Edition, Cengage Learning, 2015.
T3. R. E. Walpole and R. H. Myers, ***Probability and Statistics for Engineers and Scientists***, 8th Edition, Pearson Education, 2007.
T4. S. M. Ross, ***Introduction to Probability Models***, 9th Edition, Academic Press, 2006.
T5. K. B. Petersen and M. S. Pedersen, ***The Matrix Cookbook***, Technical University of Denmark (e-Book), 2012.

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. https://nptel.ac.in/courses/111104075/
2. https://nptel.ac.in/courses/111104078/
3. https://nptel.ac.in/courses/111104092/
4. https://nptel.ac.in/courses/122104017/
5. https://nptel.ac.in/courses/122104017

6. https://nptel.ac.in/courses/111102111/
7. https://nptel.ac.in/courses/111105035/287
8. https://nptel.ac.in/courses/111105035/28
9. https://www.coursera.org/learn/differentiation-calculus
10. https://www.coursera.org/learn/single-variable-calculus
11. https://atmos.washington.edu/~dennis/MatrixCalculus.pdf

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

CO1	Understand the concepts of calculus of several variables and its application to maxima & minima.
CO2	Gain knowledge regarding singular value decomposition of a matrix and apply it to solve engineering problems.
CO3	Acquire skill of performing analysis of variance.
CO4	Understand the stochastic model and apply it to study real life problems.
CO5	Apply Fourier series and Fourier Transform of a given function appropriately.

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								2	1	1
CO5	3	3	2	2	2								2	1	1

Type	Code	Biology for Engineers	L-T-P	Credits	Marks
BS	BTBS-T-BS-014		3-0-0	3	100

Objectives	The objective of this course is to integrate the knowledge of traditional engineering and modern biology to solve problems encountered in living systems, allow engineers to analyze a problem from both an engineering and biological perspective, anticipate specific issues in working with living systems, and evaluate possible solutions.
Pre-Requisites	Basic knowledge of biology, chemistry, and physics is adequate.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are 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**: Importance of Biology for Engineers, Chemical foundations and basic chemistry of cell – Carbon compounds and cell as a unit of life; Physical and chemical principles involved in maintenance of life processes; Cell Structure & Functions (Prokaryotic and Eukaryotic cells), structure and functions of cellular components cell wall, plasma membrane, endoplasmic reticulum. Transport across the cell membrane, Cell signaling, nerve impulse conduction.	**8 Hours**
Module-2	**Metabolisms & Cell Division**: Exothermic and endothermic versus endergonic and exergoinc reactions; Concept of Keq and its relation to standard free energy, Spontaneity, ATP as an energy currency, break down of glucose (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis), Energy yielding and energy consuming reactions, Concept of Energy charge. Morphology of Chromosome, Cell theory, Cell cycle and phases; Mitosis and meiosis.	**8 Hours**
Module-3	**Genetics**: Laws of heredity (Mendelian and Non-Mendelian), Molecular Genetics: Structures of DNA and RNA, Mutations – Cause, types and effects on species, Bioinformatics - brief idea. **Origin of Life**: Haldane and Oparins concepts; Evolution: Modern concept of natural selection and speciation – Lamarkism, Darwinism/Neo-Darwinism.	**8 Hours**
Module-4	**Microbiology**: Concept of single celled organisms, Ecological aspects of single celled organisms, Concept of species and strains, Identification and classification of microorganisms, Microscopy, Sterilization and media compositions, Growth kinetics. Microbial diseases, epidemiology and public health. **Immunology**: Human immune mechanism – Types of immunities; Antigen/Antibody reactions – Applications in human health; Immunological disorders: Autoimmune diseases.	**9 Hours**

Cont'd...

Module-#	Topics	Hours
Module-5	**Biochemistry**: Carbohydrates, Lipids, Nucleic acids, Amino acids & Proteins – Classification based on function and structure; Protein synthesis – Components and regulatory mechanisms; Enzymes – An overview. **Biotechnology**: Basic concepts on Totipotency and Cell manipulation; Plant & Animal tissue culture – Methods and uses in agriculture, medicine and health. Biological indicators, bio-sensors, bio-chips, nanobiomolecules, bio-fuel.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. Wiley Editorial, ***Biology for Engineers***, John Wiley & Sons, 2018.
T2. McGraw-Hill Editorial, ***Biology for Engineers***, McGraw-Hill Education, 2013.

Reference Books:

R1. A. T. Johnson, ***Biology for Engineers***, 1st Edition, CRC Press, 2010.
R2. S. Singh, T. Allen, ***Biology for Engineers***, 1st Edition, Vayu Education of India, 2014.
R3. C. D. Tamparo and M. A. Lewis, ***Diseases of the Human Body***, 6th Edition, F. A. Davis Co., 2016.
R4. N. A. Campbell, L. A. Urry, M. L. Cain, S. A. Wasserman, P. V. Minorsky, and J. B. Reece, ***Biology: A Global Approach***, 10th Edition, Pearson Education, 2014.

Online Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3743984/https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4239820/
2. http://www.euro.who.int/data/assets/pdffile/0013/102316/e79822.pdf
3. https://www.tsijournals.com/articles/world-history-of-modern-biotechnology-and-its-applications.html
4. https://www.tandfonline.com/doi/full/10.1080/21553769.2016.1162753
5. https://www.genome.gov/genetics-glossary/Bioinformatics

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

CO1	Explain the structure, function & interaction of different types of cells and their components.
CO2	Describe the concepts of metabolism, energy cycle and cell theory.
CO3	Comprehend genetics, origin of life and organic evolution.
CO4	Apply the concepts of microbiology & immunology for diagnosis and treatment of diseases.
CO5	Recognize the biological processes like protein synthesis, action of enzymes and tissue culture.

Program Outcomes Relevant to the Course:

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.
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.
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.
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						1		
CO2			1	1		1	1						1		
CO3			1	2	1	2	2		1	1		1	2	1	1
CO4			1	1	1	2	2		1	1		1	2	1	1
CO5			2	2	1	1	2		1	1		1	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, LinkList, 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	Digital Electronics	L-T-P	Credits	Marks
ES	BTEC-T-ES-003		3-0-0	3	100

Objectives	The objective of this course is to introduce the concepts & techniques associated with digital electronic systems and their design & implementations using 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	Number System and their Conversion, Arithmetic Operation using 1's and 2's compliments, Logic Gates, Universal Logic Gates, Realization using logic gates, Boolean Function Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem.	**9 Hours**
Module-2	SOP & POS forms, Canonical forms, Karnaugh maps up to 5 variables, Binary codes and Their application, Code Conversion; MSI devices like Half and Full Adders, Subtractors, Comparators, Multiplexers, De-Multiplexors, Encoder, Decoder.	**9 Hours**
Module-3	Sequential Logic Design: Flip flops - S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Mod-N Counters.	**9 Hours**
Module-4	Shift registers, Finite state machines, Mealy and Moore models; Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, Fan-in, Fan-out, Tristate TTL, ECL, CMOS families and their interfacing.	**8 Hours**
Module-5	VLSI Design flow: Design entry - Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Data flow, Behavioral and Structural Modeling, Synthesis and Simulation, VHDL constructs and codes for combinational and sequential circuits.	**7 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.

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. http://www.allaboutcircuits.com

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 and investigate performance of CMOS based logic circuits applicable to modern VLSI technology.
CO5	Simulate and synthesize various digital circuits using VHDL in industry standard tool 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							2	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							2	1	
CO5	2	3	2	3	2	1							2	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. Bhatacharya, 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 theormodynamics of pure substances.
CO4	Explain the design and operation of various devices based on theormodynamic 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)

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

Type	Code	Discrete Mathematics	L-T-P	Credits	Marks
PC	BTBS-T-PC-015		3-1-0	4	100

Objectives	The objectives of this course is to gain mathematical maturity to handle logical & abstract processes, discrete structures including graph and some important counting techniques which are essential for students of CSE.
Pre-Requisites	Knowledge of Sets, basics of number systems, and matrix 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	Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Proof Strategies.	**10 Hours**
Module-2	Mathematical induction, basics of counting, Pigeonhole principle, Permutations and Combinations, Binomial coefficients, Generalized permutation and combinations; Recurrence Relations, Solving linear Recurrence Relations, Divide and Conquer algorithms, Generating functions, Inclusion and Exclusion with applications.	**11 Hours**
Module-3	Relations and their properties, N-ary Relations & their applications, Representing relations, Closure of relations, Equivalence relations, Partial ordering, Lattice & Boolean algebra.	**12 Hours**
Module-4	Introduction to Graphs, Graph terminology, Representation of graphs & graph isomorphism, Connectivity, Euler & Hamilton paths, Shortest-path problems, Planar graph & Graph coloring; Introduction to trees, Applications of trees, Spanning trees.	**11 Hours**
Module-5	Semigroup, Monoid, Groups, Subgroups, Cosets and Lagrange's theorem, Codes and group codes, Isomorphisms & Automorphisms, Homomorphism & Normal Subgroup, Rings, Integral Domains & Fields.	**12 Hours**
	Total	**56 Hours**

Text Books:

T1. K. H. Rosen, ***Discrete Mathematics and Its Applications***, 6th Edition, Tata McGraw-Hill, 2008.
T2. C. L. Liu, ***Elements of Discrete Mathematics***, 2nd Edition, Tata McGraw-Hill, 2008.

Reference Books:

R1. J. P. Tremblay and R. Manohar, ***Discrete Mathematical Structures with Applications to Computer Science***, 1st Edition, McGraw Hill Education, 2017.
R2. J. R. Mott, A. Kandel, and T. P. Baker, ***Discrete Mathematics for Computer Scientists and Mathematicians***, 2nd Edition, Pearson Education India, 2015.

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://swayam.gov.in/course/1396-discrete-mathematics
6. https://www.coursera.org/learn/linearalgebra2
7. https://www.coursera.org/learn/differentiation-calculus
8. https://www.coursera.org/learn/single-variable-calculus
9. 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 and apply logic and logical inferences.
CO2	Gain knowledge regarding principle of inclusion & exclusion, generating function and recurrence relations.
CO3	Understand the concepts of relation, lattice and Boolean algebra.
CO4	Apply graph theory to real-life problems of computer science & engineering.
CO5	Define and differentiate the discrete structures like semigroup group, ring & field, and apply it to study group codes.

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								3	1	1

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 handing 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 robus 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	Digital Electronics Lab	L-T-P	Credits	Marks
ES	BTEC-P-ES-004		0-0-2	1	100

Objectives	The objective of the course is to understand the internal structure of logic gates, its implementation using Boolean algebra, designing digital circuits like counters, registers and formulating 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, with focus on implementation using 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 behavior of AND, OR, NAND, NOR, EX-OR,EX-NOR, Invert and Buffer gates, use of Universal NAND Gate.
2	Gate-level minimization: Two level and multilevel implementation of Boolean functions.
3	Combinational Circuits: design, assemble and test: adders and subtractors, Code Converters, gray code to binary and 7-segment display.
4	Design, implement and test a given design example with: (a) NAND Gates only, (b) NOR Gates only, and (c) Using minimum number of Gates.
5	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 with parallel load.
8	Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallel load.
9	Memory Unit: Investigate behaviour of RAM and its storage capacity – 16 $\times$ 4 RAM: testing, simulating and memory expansion.
10	Clock-pulse generator: design, implement and test.
11	Parallel adder and accumulator: design, implement and test.
12	Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bit product.
13	Verilog/VHDL simulation and implementation of Experiments listed at #3 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***, Prentice Hall, 2000.

R2. J. W. Stewart, C. -Y. Wang, ***Digital Electronics Laboratory Experiments*** (Using the Xilinx XC95108 CPLD with Xilinx Foundation: Design and Simulation Software), Prentice Hall, 2001.

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/

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							2	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							2	1	
CO5	2	3	2	3	2	1							2	1	
CO6	2	3	2	3	2	1							2	1	

Type	Code	Yoga	L-T-P	Credits	Marks
MC	BTBS-P-MC-017		0-0-2	0	100

Objectives	To impart skills in students for control of mind, body and soul, enhance self-awareness, focus, and concentration, bring together physical and mental wellness, manage stress and anxiety, achieve perfect equilibrium and harmony of body & mind, and promote self-healing.
Pre-Requisites	There are no pre-requisites for this course.
Teaching Scheme	Regular practice classes conducted under supervision of the qualified Yoga teacher with necessary explanation and demonstration for each 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	Introduction to Yoga: Unison with the elements
2	*Prãnãyãma*: performing breathing exercise
3	*Mudrã*: learning various types of *Mudrã*s and their benefits
4	*Bandha*: learning various types of *Bandha*s and their benefits
5	*Chakra*: learning various types of *Chakra*s and their benefits
6	*Chakshu Visrãnt Ãsana Samuha*; eye movement and exercises
7	Twisting set: standing twisting *ãsana*
8	Side stretching set: standing Side stretching *ãsana*
9	Forward bending set: standing Forward bending *ãsana*
10	Backward bending set: standing Backward bending *aãsana*
11	Balancing set: learning *Vrikshãsana*, *Ekpada Pranamãsana* and benefits
12	*Surya Namaskãr*: surya namaskãr mantra and poses
13	*Vajrãsana* set: sitting *ãsana* sets
14	*Padmãsana* set: sitting *ãsana* sets
15	Sleeping ãsana and *Yoga Nidrã*: relaxation postures

Text Books:

T1. E. F. Bryant, ***The Yoga Sutras of Patanjali***, 1st Edition, North Point Press, 2009.

Reference Books:

R1. Swami Satyananda Saraswati, ***Asana Pranayama Mudra Bandha***, 4th Edition, Yoga Publication Trust, Munger (Bihar), India, 2008.

Online Resources: *There are a number of online resources available for this course. The student is advised to search on the Internet and locate the required study materials as per advise of the teacher.*

P.T.O

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

CO1	Promote positive health, get relief from stress and obtain balance of body & mind.
CO2	Acquire knowledge of integral approach of Yoga Therapy to common ailments.
CO3	Develop skills to adopt Yoga practices for health and general well-being.
CO4	Develop overall personality through control of body, mind and soul.
CO5	Enhance scientific attitude and team spirit for creative and constructive endeavors.

Program Outcomes Relevant to the Course:

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

Type	Code	Math-IV for Computer Sciences	L-T-P	Credits	Marks
BS	BTBS-T-BS-019		3-0-0	3	100

Objectives	The objective of this course is to provide a good exposure to linear and non-linear programming with several standard numerical methods, and the right kind of tools to solve large scale optimization problems in engineering.
Pre-Requisites	Knowledge of calculus of several variables, coordinate geometry of two and three dimensions and matrix 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	Linear Programming: Graphical Method, Simplex Method, Big-M Method, Alternate optima, redundancy & degeneracy.	**8 Hours**
Module-2	Simplex Method Algorithm, Revised Simplex Method, Dual Problem, Construction of Dual, Duality Theorem (without proof), Dual Simplex method, Post Optimal analysis.	**9 Hours**
Module-3	Integer Linear Programming: Gomory's cutting Plane Method for different IPP, Branch & Bound Method, Convex Function, Convex Programming Problem.	**8 Hours**
Module-4	Quadratic Programming, Wolfe's method for QPP, Optimality Conditions, Lagrangian & Lagrange Multipliers, KKT Necessary/sufficient optimality conditions, duality in non-linear programming; Unconstrained optimization: Line search methods for uni-modal functions, the Steepest Descent method, Newton's method.	**11 Hours**
Module-5	Constrained Optimization: Frank Wolfe's Method, Rosen's Gradient Projection Method, Penalty function method.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. S. Chandra, Jayadeva, and A. Mehera, ***Numerical Optimization with Applications***, 1st Edition, Narosa Publishing House, 2013.

Reference Books:

R1. D. G. Luenberger and Y. Ye, ***Linear & Nonlinear Programming***, 3rd Edition, Springer, 2008.
R2. S. S. Rao, ***Engineering Optimization***, 4th Edition, New Age Publishers, 2009.
R3. K. Dev, ***Optimization for Engineering Design***, 2nd Edition, Prentice Hall India, 2012.

P.T.O

Online Resources:

1. https://nptel.ac.in/courses/106108056/
2. https://nptel.ac.in/courses/111105100/

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

CO1	Solve linear programming problems using graphical and simplex methods.
CO2	Understand the concept of duality in linear programming and apply the same to solve problems and to perform post optimal analysis.
CO3	Solve integer programming and quadratic programming problems.
CO4	Understand the concepts and conditions to solve a non-linear programming problem and able to solve unconstrained optimization problems.
CO5	Solve constrained optimization problems and understand the Karmakar's Algorithm.

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								2	1	1
CO5	3	3	2	2	2								2	1	1

Type	Code	Engineering Economics	L-T-P	Credits	Marks
HS	BTBS-T-HS-018		3-0-0	3	100

Objectives	The objective of this course is to familiarize the students with elementary principles of economics, provide the tools needed for analyzing time value of money in engineering decision making, profit/revenue data, and make economic analysis for projects and alternatives.
Pre-Requisites	Basic knowledge on interest formula and derivatives is required.
Teaching Scheme	Regular classroom lectures with use of ICT as needed. Each session is planned to be interactive with focus on real-world problem solving.

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	Engineering Economics-its meaning and importance, Basic problems of an economy. The concept of time value of money; Concept of Interest. Time value of equivalence, Compound interest factors; Cash flow diagrams, Calculation of time value of equivalence, Present worth comparison, Future worth comparison, Pay-back period comparison.	**9 Hours**
Module-2	Equivalent annual worth comparison method, Situations for equivalent annual worth comparison, Rate of return, Internal rate of return, Incremental IRR analysis, Depreciation analysis, Methods of depreciation, Straight line method, Declining balance method, SOYD Method and MACRS method of depreciation; After tax comparison, Analysis of public Project, Cost-benefit analysis.	**9 Hours**
Module-3	Introduction to Micro Economics and Macro Economics, Theory of demand, Elasticity of demand, Price elasticity of demand, Measurement of elasticity of demand; Income elasticity and cross elasticity of demand, Demand forecasting; Law of supply, Elasticity of supply.	**8 Hours**
Module-4	Theory of production, Law of variable proportion, Laws of returns to scale, Cost Concepts, Total Costs, Fixed cost, Variable cost, Revenue concepts, Total revenue, Average revenue and marginal revenue, Market (Forms of market), Perfect Competition, Determination of price under perfect competition, Linear Break-even Analysis.	**8 Hours**
Module-5	Inflation, Meaning of inflation, Types, Causes, Measures to control inflation, Commercial Banks, Functions of Commercial Bank, Central bank, Functions of central Bank; National income, Definitions, Concepts of national Income, Methods of measuring National Income.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. J. L. Riggs, D. D. Bedworth, and S. U. Randhawa, ***Engineering Economics***, 4th Edition, Tata McGraw-Hill, 2004.

T2. H. L. Ahuja, ***Principles of Micro Economics***, 16th Edition, S. Chand & Co, 2008.
T3. R. R. Paul, ***Monetary Economics***, 11th Edition, Kalyani Publishers, 2015.

Reference Books:

R1. C. S. Park, ***Contemporary Engineering Economics***, 6th Edition, Pearson Education, 2015.
R2. D. G. Newnan, T. G. Eschenbach, J. P. Lavelle, and N. A. Lewis, ***Engineering Economic Analysis***, 13th Edition, Oxford University Press, 2017.
R3. A. Koutsoyiannis, ***Modern Micro Economics***, 2nd Edition, Palgrave Macmillan UK, 2003.
R4. H. C. Petersen, W. C. Lewis, and S. K. Jain, ***Managerial Economics***, 4th Edition, Pearson, 2005.
R5. N. G. Mankiw, ***Macroeconomics***, 7th Edition, Worth Publishers, 2010.
R6. M. P. Agasty, ***Engineering Economics and Costing***, 2nd Edition, Scitech Publication, 2009.

Online Resources:

1. https://nptel.ac.in/courses/112107209/: Engineering Economic Analysis
2. https://www.icai.org/post.html?post_id=10058: Study Materials by ICAI
3. http://www.icaiknowledgegateway.org/littledms/folder1/chapter-5-part-2.pdf: National Income Accounting
4. http://www.m5zn.com/newuploads/2013/05/28/pdf/ed6f3d1f87b9cd2.pdf: eBook

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

CO1	Understand the concepts of economics, engineering economics and its application in engineering.
CO2	Solve problems related to engineering economics and analyze decision alternatives in engineering projects.
CO3	Evaluate how changes in demand and supply affect market and production.
CO4	Assess the effects of changes in costs, selling price and units sold on the break-even point and target profit.
CO5	Analyze the macroeconomic environment of the business and its impact on society and enterprise.

Program Outcomes Relevant to the Course:

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.
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.

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

Type	Code	Design & Analysis of Algorithms	L-T-P	Credits	Marks
PC	BTCS-T-PC-011		3-1-0	4	100

Objectives	The objectives of this course is to introduce the techniques for designing efficient algorithms, apply them to solve problems, and analyze the complexities in different domains.
Pre-Requisites	Knowledge of Discrete Mathematics and Data Structures is essential.
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, Definition, Characteristics of algorithm, Growth of Functions, Asymptotic analysis, Standard notations and common functions, Recurrences, Solution of recurrences by iterative, recursion tree, substitution and Master method; Algorithm design techniques, Divide and conquer strategy for designing algorithms, Obtaining best, average, worst-case running time of Merge sort, Quick sort and Randomized Quick sort.	**12 Hours**
Module-2	Heaps, Building a Heap, The heap sort algorithm, Priority Queue with their analysis; Lower bounds of sorting; Dynamic Programming, Elements of dynamic programming, Matrix chain multiplication, Longest Common Subsequence, String matching algorithms (Naive, Rabin-Karp, Knuth-Morris-Pratt algorithm).	**10 Hours**
Module-3	Greedy algorithms, Elements of Greedy strategy, Activity selection problem, Fractional Knapsack problem along with correctness proofs, Huffman codes; Backtracking and Branch & Bound techniques (n-Queen, Knapsack, and Travelling Salesman problem); Data structure for disjoint sets, Disjoint set operations, Linked list representation, Path compression, Disjoint set forest.	**12 Hours**
Module-4	Graph algorithms and their characteristics, Breadth-first and depth-first search, Minimum spanning trees, Kruskal and Prim's algorithms, Single-source shortest path algorithms (Bellman-Ford, Dijkstra), All-pair shortest path algorithm (Floyd-Warshall) with their analysis.	**10 Hours**
Module-5	Maximum flow problem, Ford-Fulkerson algorithm and its analysis; NP completeness (Polynomial time, Polynomial time verification, NP completeness and reducibility), Cook's Theorem (without proof), Examples of NP complete problems (without proof) - Circuit satisfiability, 3-CNF satisfiability, Clique, Vertex cover, Ham-cycle, TSP (without proof); Approximation algorithm characteristics, Travelling Salesman Problem, Randomized algorithms (Max3-CNF satisfiability.	**12 Hours**
	Total	**56 Hours**

P.T.O

Text Books:

T1. T. H.Cormen, C.E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.
T2. E. Horowitz, S.Sahni, and S.Rajasekaran, ***Fundamentals of Computer Algorithms***, 2nd Edition, University Press, 2015.
T3. J. Kleinberg and E. Tardos, ***Algorithm Design***, 1st Edition, Pearson Education, 2013.

Reference Books:

R1. M. T. Goodrich and R. Tamassia, ***Algorithm Design: Foundations, Analysis, and Internet Examples***, 1st Edition, John Wiley & Sons, 2001.
R2. U. Manber, ***Introduction to Algorithms: A Creative Approach***, 1st Edition, Addison-Wesley, 1989.
R3. S. Sridhar, ***Design and Analysis of Algorithms***, 1st Edition, Oxford University Press, 2014.
R4. G. Sharma, ***Design & Analysis of Algorithms***, 4th Edition, Khanna Publishers, 2019.

Online Resources:

1. http://www.nptelvideos.in/2012/11/design-analysis-of-algorithms.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
4. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/

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

CO1	Design algorithms, analyze their running time for best, worst, and average-cases, and understand divide & conquer strategy considering quick sort and merge sort as examples.
CO2	Compare Heapsort with other comparison based sorting algorithms and develop dynamic programming algorithms.
CO3	Apply disjoint-set data structure and various algorithm design techniques such as greedy, backtracking, and branch-and-bound in real life problems.
CO4	Model a given engineering problem using graphs and design the corresponding algorithms to solve the problem.
CO5	Compare various pattern matching algorithms, understand NP-Completeness and the need of approximation & randomized 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.
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	2	1	2	2							2	3		3
CO2	3	2	3	3	2	1						1	3		3
CO3	3	3	3	3	2	1						1	3		3
CO4	3	2	3	3	2	1						1	3		1
CO5	2	2	2	3	2	1						2	2		2

Type	Code	Database Management Systems	L-T-P	Credits	Marks
PC	BTCS-T-PC-009		3-1-0	4	100

Objectives	The objective of the course is to understand the aspects of design, implementation, and operation of relational database systems, transaction processing, concurrency control, recovery, and some advanced database concepts.
Pre-Requisites	Basic knowledge of data structures and algorithms 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 to database systems: Basic concepts and definitions, three-schema architecture, data independence, Concept of 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.	**12 Hours**
Module-2	Query languages: Relational Algebra, basic operations, join operations, grouping & aggregation, Relational Calculus; Query processing and optimization: Evaluation of relational algebra expressions, Heuristic-based Query optimization.	**11 Hours**
Module-3	Database design: Functional dependencies, Armstrong axioms, Attribute closure, Equivalence sets of FD, Minimal cover; Normalization: Dependency & attribute preservation, lossless join; Normal Forms: 1NF, 2NF, 3NF, BCNF, Testing for lossless design, Multi-Valued Dependency (MVD), 4NF and 5NF.	**11 Hours**
Module-4	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.	**12 Hours**
Module-5	Storage strategies: Storage Architecture, File and Record Organization, Types of Indexes, B-Tree, B+ Tree, Index Files, Hashing, Data Dictionary; Distributed databases: Homogeneous vs. heterogeneous, Fragmentation & replication, Data transparency; Introduction to NoSQL: Properties, Columnar families, different NoSQL systems.	**10 Hours**
	Total	**56 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. P. J. Sadalage and M. Fowler, ***NoSQL Distilled***, 1st Edition, Pearson Education, 2012.

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/
2. https://nptel.ac.in/courses/106105175/
3. https://cs145-fa18.github.io/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/
5. https://docs.oracle.com/database/121/SQLRF/toc.htm

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

CO1	Understand the significance & components of DBMS and create E-R model for real world applications.
CO2	Construct queries using relational algebra and understand query processing & optimization strategies.
CO3	Design relational databases and normalize the designs using different normalization techniques.
CO4	Resolve concurrency control issues and recover from database failures.
CO5	Visualize storage structures, indexing techniques and explore distributed & NoSQL databases.

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

Type	Code	Computer Organization & Architecture	L-T-P	Credits	Marks
PC	BTCS-T-PC-007		3-0-0	3	100

Objectives	The objective of this course is to familiarize students about hardware design including logic design, basic structure and behaviour of the various functional modules of a modern digital computer and how they interact to provide the processing power to fulfil the needs of the user.
Pre-Requisites	Knowledge of basic digital electronics and computer fundamentals 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	Basic structures of Computers: Computer Architecture vs. Computer Organization, Functional units, Operational concepts, Registers, Bus Structure, Performance Consideration, SPEC rating.	**9 Hours**
Module-2	Memory location and addresses, Big-endian and Little-endian representation, Instruction format, Instruction set Architecture, RISC vs. CISC, Addressing modes, Instruction Sequencing, Subroutines.	**8 Hours**
Module-3	Binary Arithmetic: Addition and subtraction of signed numbers, Design of fast adders, Multiplication of positive numbers, Signed operand multiplication, Fast multiplication, Integer division, Representation of floating point numbers.	**8 Hours**
Module-4	Memory System: Basic Concepts, Speed, Size and cost, Cache memory concepts, Cache memory mapping techniques, Performance consideration; Virtual memory concepts, Translation look-aside buffer, Replacement techniques, Secondary Storage.	**9 Hours**
Module-5	Basic Processing Units: Fundamental concepts, Execution cycle, Single-Bus and Multi-Bus Organization, Execution of complete instruction, Hardwired control, Micro programmed control, Accessing I/O devices.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. C. Hamacher, Z. Vranesic, and S. Zaky, ***Computer Organization***, 5th Edition, McGraw-Hill, 2017.
T2. W. Stallings, ***Computer Organization and Architecture***, 9th Edition, Prentice Hall India, 2012.

Reference Books:

R1. M. M. Mano, ***Computer System Architecture***, 3rd Edition, Pearson Education, 2007.
R2. B. Govindarajalu, ***Computer Architecture and Organization***, 5th Edition, Tata McGraw-Hill, 2004.
R3. N. P. Carter, ***Schaum's Outline of Computer Architecture***, McGraw-Hill Education, 2002.

Online Resources:

1. https://nptel.ac.in/courses/106103068/
2. https://nptel.ac.in/courses/106103180/

3. https://nptel.ac.in/courses/117105078/
4. https://www.cse.iitk.ac.in/users/karkare/courses/2011/cs220/html/notes.html
5. https://homepage.cs.uiowa.edu/~ghosh/6012.html

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

CO1	Explain the architectural concepts of a digital computer, identify various functional units and describe their functionality.
CO2	Represent instructions in various formats and solve problems based on addressing modes.
CO3	Perform various binary arithmetic operations using different techniques and represent floating point numbers and perform various operations on them.
CO4	Explain the working principle of Main memory, Cache memory and Virtual memory organization and solve numerical problems based on memory management.
CO5	Describe the working mechanism of the components of processing unit and discuss the techniques to enhance the 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.
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	2	2	2	3	2							1	2		3
CO2	3	3	2	3	1							1	2	1	2
CO3	3	3	3	2	2							1	2	1	2
CO4	2	3	3	2	1							1	3	2	3
CO5	2	3	3	2	1							1	1		1

Type	Code	Design & Analysis of Algorithms Lab	L-T-P	Credits	Marks
PC	BTCS-P-PC-012		0-0-4	2	100

Objectives	The objective of this course is to design and implement efficient algorithms for a specified application.
Pre-Requisites	Knowledge of Discrete Mathematics and Data Structures are essential.
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	Linear & Binary Search.
2	Conversion of infix to postfix expression using Stack.
3	Binary Search Tree.
4	Sorting: Selection, Bubble and Insertion Sort.
5	Sorting: Quick Sort and Merge Sort.
6	Sorting: Heap Sort.
7	Priority Queue using min-Heap.
8	Matrix Chain Multiplication.
9	Longest Common Subsequence.
10	Naïve string matching algorithm.
11	Rabin-Karp string matching algorithm.
12	Knuth-Morris-Pratt String matching algorithm.
13	0-1 Knapsack problem.
14	Activity Selection problem.
15	Fractional Knapsack problem.
16	Huffman Code.
17	The n-Queen problem.
18, 19	Graph Traversal using BFS & DFS.
20	Kruskal's algorithm for Minimum Spanning Tree.
21	Prim's algorithm for Minimum Spanning Tree.
22	Bellman Ford's single source shortest path algorithm.
23	Dijkstra's single source shortest path algorithm.
24	Warshall's all pair shortest path algorithm.
25	Ford-Fulkerson algorithm.
26	Approximation algorithms for Travelling Salesman problem.
27, 28	Mini Project.

Text Books:

T1. T. H.Cormen, C.E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.
T2. E. Horowitz, S.Sahni, and S.Rajasekaran, ***Fundamentals of Computer Algorithms***, 2nd Edition, University Press, 2015.

Reference Books:

R1. J. Kleinberg and E. Tardos, ***Algorithm Design***, 1st Edition, Pearson Education, 2013.
R2. M. T. Goodrich and R. Tamassia, ***Algorithm Design: Foundations, Analysis, and Internet Examples***, 1st Edition, John Wiley & Sons, 2001.
R3. U. Manber, ***Introduction to Algorithms: A Creative Approach***, 1st Edition, Addison-Wesley, 1989.

Online Resources:

1. http://www.nptelvideos.in/2012/11/design-analysis-of-algorithms.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
4. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/

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

CO1	Implement various searching and sorting algorithms and compare their execution time.
CO2	Understand and develop skill to solve problems using divide and conquer strategy.
CO3	Apply greedy, dynamic programming, backtracking and branch and bound paradigms to solve real life problems.
CO4	Formulate engineering problemsand solve them using graph algorithms.
CO5	Implement approximation algorithms to solve some of the NP-Complete problems.

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

Type	Code	Database Management Systems Lab	L-T-P	Credits	Marks
PC	BTCS-P-PC-010		0-0-4	2	100

Objectives	The objective of this course is to provide a formal foundation in database design, query, and data manipulation, and impart hand-on practice to the students to groom them into well-informed database application developers.
Pre-Requisites	Knowledge of theory of databases and programming skills is 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	Introduction to Oracle databases, simple queries for data retrieval.
2,3	Data retrieval based on conditions and sorting the query results.
4	Using single-row functions in SQL queries for data retrieval.
5	Applying grouping and aggregation functions.
6	Writing complex queries using sub-queries.
7	Create, alter, and manipulate design of tables.
8,9	Data manipulation using various DML statements.
10	Imposing various constraints on tables for maintaining data integrity.
11,12	Retrieve data from multiple tables using various types of Join operations.
13	Create, alter, and manage Views from single & multiple base tables.
14	Create and use other data base objects like sequence, indexes, and synonyms.
15	Controlling user access to database using DCL queries: Grant, Revoke.
16	Perform Set operations on tables: Union, Union All, Intersect, Minus.
17	Write SQL queries by using co-related sub-queries.
18	Introduction to PL/SQL, identifiers, literals, and keywords.
19	Write PL/SQL block by using conditional statements and expressions.
20	Using different types of Loops in a PL/SQL block.
21	Implement Exception Handling in a PL/SQL block.
22	Write PL/SQL block by using numeric, string, and other miscellaneous data types.
23	Introduction to data retrieval using Cursors by providing elementary idea.
24,25	Introduction to Stored procedures, Write PL/SQL block using procedures.
26	Develop functions with in/out parameters and using them in a PL/SQL block.
27, 28	Oracle Triggers – introduction, syntax, types and use.

Text Books:

T1. K. Loney, ***Oracle Database 11g : The Complete Reference***, 1st Edition, McGraw-Hill, 2009.

T2. I. Bayross, ***Teach Yourself SQL/PL SQL Using Oracle 8i and 9i with SQLJ***, 1st Edition, BPB Publications, 2003.

Reference Books:

R1. S. Feuerstein, ***Oracle PL/SQL Programming***, 6th Edition, O'Reilly, 2014.
R2. M. Mclaughlin, ***Oracle Database 11g PL/SQL Programming***, 6th Edition, McGraw-Hill Education, 2014.
R3. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***, 6th Edition, McGraw-Hill Education, 2013.

Online Resources:

1. https://nptel.ac.in/courses/106106095/pdf/4_The_SQL_Standard.pdf
2. https://docs.oracle.com/cd/B28359_01/appdev.111/b28370.pdf
3. https://www.javatpoint.com/oracle-tutorial

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

CO1	Construct queries using SQL and retrieve data from a database using single/multi-row functions, and sub-queries.
CO2	Design relational tables imposing integrity constraints, operate on table using DDL/DML statements.
CO3	Create other database objects like views, sequences and indices.
CO4	Write PL/SQL programs including control structures, loops, and exception handing for real-world applications.
CO5	Implement the techniques using Procedures, Functions, and Parameters in PL/SQL.

Program Outcomes Relevant to the Course:

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

Type	Code	Computer Organization & Architecture Lab	L-T-P	Credits	Marks
PC	BTCS-P-PC-008		0-0-2	1	100

Objectives	The objective of this course is to study the parts of computer and realize computer arithmetic & memory management operations through simulations.
Pre-Requisites	Knowledge of computer basics and programming logic is required.
Teaching Scheme	Regular Laboratory classes with the use of ICT whenever required through demonstration of various computer system components and simulation of some of the concepts using Assembly Language and SciLab.

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 Computer Components
2	Study of Motherboard
3	Assembling and dissembling of a system
4	BIOS setting and installation
5	Introduction to 8085 Simulator and basic Assembly language programming
6	Assembly language programming in 8085 simulator using conditional statements
7	Assembly language programming in 8085 simulator using loop
8	Introduction to SciLab
9	SciLab Functions and Control Structures
10	Script files and Functions in SciLab
11	Implementation of basic logic gates and design of Adders
12	Simulation of Booth Algorithm and Integer division
13	Simulation of Pipelining
14	Simulation of Page Replacement Algorithms

Text Books:

T1. T. Sheth, ***SciLab : A Practical Introduction to Programming and Problem Solving***, 1st Edition, Create Space Independent Publishing Platform, 2016.
T2. S. Nagar, ***Introduction to Scilab For Engineers and Scientists***, 1st Edition, Apress, 2017.

Reference Books:

R1. S. L. Campbell, J. -P. Chancelier, and R. Nikoukhah, ***Modeling and Simulation in Scilab/Scicos with ScicosLab 4.4***, 1st Edition, Springer-Verlag, New York, 2006.
R2. H. Ramachandran and A. S. Nair, ***Scilab (A Free Software to MATLAB)***, 1st Edition, S. Chand & Co., 2011.

Online Resources:

1. https://www.scilab.org/tutorials
2. https://www.scilab.org/sites/default/files/Scilab_beginners_0.pdf
3. https://www.cse.iitb.ac.in/~cs626-449/scilab.pdf

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

CO1	Identify and analyze the components of digital computer and disassemble & assemble a modern digital computer.
CO2	Construct assembly programs using 8085 Simulator.
CO3	Analyze and Develop codes in SciLab using different control structures and functions.
CO4	Implement different logic gates for various binary arithmetic operations.
CO5	Implement different memory management techniques using SciLab.

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

Part III

3rd Year B. Tech. (CST)

Curriculum Structure

Semester V								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
PC		Computer Networks	3	0	0	3	0	0
PC		Formal Languages & Automata Theory	3	0	0	3	0	0
PC		Operating Systems	3	0	0	3	0	0
PE		Professional Elective-I	3	0	0	3	0	0
PE		Professional Elective-II	3	0	0	3	0	0
MC	BTBS-T-MC-020	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		Computer Networks Lab	0	0	2	0	0	1
PC		Operating 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								
PC		Machine Learning	3	1	0	3	1	0
PC		Microcontrollers & Embedded Systems	3	0	0	3	0	0
PC		Software Engineering	3	0	0	3	0	0
PE		Professional Elective-III	3	0	0	3	0	0
PE		Professional Elective-IV	3	0	0	3	0	0
PRACTICAL								
PC		Internet & Web Technnology Lab	0	0	4	0	0	2
PC		Software Engineering Lab	0	0	2	0	0	1
PJ		Skill Lab & Project-I	0	0	4	0	0	2
		SUB-TOTAL	**15**	**1**	**10**	**15**	**1**	**5**
		TOTAL	**26**			**21**		

Note: *Courses offered under each elective are given in "List of Electives" on Page 94.*

List of Electives

Code	Elective # and Subjects
Professional Elective - I	
	Data Mining & Data Warehousing
	Advanced Java Programming
	System Programming
Professional Elective - II	
	Statistical Inference
	Mobile Computing
	Realtime Systems
	Advanced Computer Architecture
Professional Elective - III	
	Artificial Intelligence
	Wireless Sensor Networks
	Distributed Databases
	Compiler Design
Professional Elective - IV	
	Natural Language Processing
	Cloud Computing
	Parallel & Distributed Systems

Part IV

4th Year B. Tech. (CST)

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		Internet of Things	3	0	0	3	0	0
PC		Cryptography & Network Security	3	0	0	3	0	0
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								
PC		Internet of Things Lab	0	0	2	0	0	1
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	**15**	**0**	**2**	**18**	**0**	**2**
		TOTAL	**17**			**20**		

Semester VIII								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
OE		Open Elective - I	3	0	0	3	0	0
OE		Open Elective - II	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 99.*

Curriculum Structure (PS-7)

(For Students opting for Practice School 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		Internet of Things	3	0	0	3	0	0
PC		Cryptography & Network Security	3	0	0	3	0	0
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								
PC		Internet of Things Lab	0	0	2	0	0	1
VV		Comprehensive Viva	0	0	0	0	0	1
		SUB-TOTAL	**15**	**0**	**2**	**18**	**0**	**2**
		TOTAL	**17**			**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 99.*

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		Internet of Things	3	0	0	3	0	0
PC		Cryptography & Network Security	3	0	0	3	0	0
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								
PC		Internet of Things Lab	0	0	2	0	0	1
PJ		Summer Internship - III	0	0	0	0	0	1
		SUB-TOTAL	**15**	**0**	**2**	**18**	**0**	**2**
		TOTAL	**17**			**20**		

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 99.*

List of Electives

Code	Elective # and Subjects
Professional Elective - V	
	Advanced Machine Learning
	Computer Graphics
	Server Side Scripting
Professional Elective - VI	
	Big Data Analytics
	Soft Computing
	Cyber Security & Forensics
Open Elective - I	
	[EEE] Electrical Circuits & Safety
	[BSH] Applied Linear Algebra
	[BSH] Project Management
	[ECE] Signal & Systems
	[EIE] Transducers & Measurement Systems
Open Elective - II	
	[EEE] Energy Conversion Devices
	[BSH] Stochastic Processes
	[BSH] Organizational Behaviour
	[ECE] Communication Systems Engineering
	[EIE] Biomedical Instrumentation & Signal Processing

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

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