K J Somaiya Institute of Engineering and Information Technology, Sion, Mumbai

An Autonomous Institute under University of Mumbai

Autonomy Syllabus Scheme-I (2021-22)

Bachelor of Technology

in

Electronics Engineering (ETRX)

(Third Year Semester V)

(With Effect from AY 2021-22)

From the Principal's Desk:

The academic reforms recently recommended by the AICTE and UGC have effectually strengthened the higher education system in India. To adhere to the status quo and enhance the academic standards and quality of engineering education further, it is essential to assimilate innovation and recurrent revision in curriculum, teaching-learning methodology, examination, and assessment system.

In congruence with it, the University of Mumbai has adapted Outcome-Based Education (OBE) system and has revised the engineering curriculum thrice in the last decade as Rev 2012, Rev 2016, and the recent Rev 2019, 'C' scheme focusing on cutting-edge technology courses.

K. J. Somaiya Institute of Engineering and Information Technology, being an autonomous institute possesses more flexibility in adapting newer approaches to reach higher levels of excellence in engineering education. This first syllabus scheme under the autonomy comprises state-of-the-art courses and laboratory sessions on emerging areas of technology. The syllabus is designed with an objective to foster the students for developing innovative solutions to real-world issues of the society and/or industry through the acquired knowledge. The induction program for the students is deliberated as per guidelines of AICTE and shall be executed over the entire First Year.

With an ideology that the root of innovation is 'interest', the curriculum offers a wide range of elective courses - grouped into core and inter-disciplinary domains. At par with international engineering education, the students can choose to study courses concerning areas of their interests.

The curriculum introduces Skill-Based Learning (SBL), Activity-Based Learning (ABL), and Technology-Based Learning (TBL) as eXposure (SAT) courses - that assure X factor in all the students of the institute. The SAT courses shall be practiced across the first three years of engineering, focusing on graduate attributes like work ethics, responsibilities towards society, problem-solving ability, communication skills, motivation for life-long learning, leadership and teamwork, etc. that may not be copiously imbibed through regular engineering courses. The proficiencies acquired herein shall open huge employment and entrepreneurial opportunities for the students.

Students of the institute are already provided exposure to the work culture and trends in industries through live / collaborative projects / product developments, etc. Under autonomy too, through the component of Project-Based Learning included in the syllabus, the students shall develop Mini, Minor, and Major projects in Second, Third, and Last Year respectively concerning healthcare, agriculture, societal / industrial need-based problems, etc. as well as pursue internships at the end of each semester / year - making them industry-ready engineers. The blend of all these learning components in the curriculum shall strengthen the research and innovation ecosystem in the institute — for best benefits of the students.

This first syllabus shall be effective from Academic Year 2021-22 to all four years at once. It comprises 165 credits, follows the AICTE model curriculum, focuses on learner-centric approach as well as continuous evaluation, and shall offer the ideal learning experience for the students of the institute.

In the coming years, the institute shall also offer an Honours degree for students who are desirous of pursuing their special interest areas in industry-relevant tracks like Artificial Intelligence, Internet of Things, Cyber Security, etc. Through joint efforts of all stakeholders, strategic planning, and efficient execution of neoteric educational practices with hi-tech wizardry, we shall strive to become a role model for all autonomous institutes across the nation.

Dr. Suresh Ukarande
Principal and Chairman - Academic Council

Member Secretary, Academic Council's Preamble:

We, Board of Studies in Computer Engineering (CE), Information Technology (IT), Artificial Intelligence and Data Science (AI-DS), Electronics and Telecommunication (ET) and Electronics Engineering (EX) are very happy to present 4 years of undergraduate and 2 years of post-graduation in Artificial Intelligence (AI), Engineering technology syllabus effective from the Academic Year 2021-22 under the autonomy status granted to our institute, K J Somaiya Institute of Engineering and Information Technology (KJSIEIT). We are sure you will find this syllabus interesting, challenging and meeting the needs of Industry 4.0.

UGC states the benefits of granting academic autonomy to higher education institutes as the freedom to modernize curricula, making it globally competent, locally relevant and skill oriented to promote employability'. Thus exercising academic freedom by eligible and capable institutes is the need for developing the intellectual climate of our country and bringing and promoting academic excellence in higher education system. KJSIEIT under its first autonomous syllabus scheme (KJSIEIT-Scheme I) is keen in providing globally required exposure to its learners focusing sound theoretical background supported by practical experiences in the relevant areas of engineering and technology.

Besides engineering and technology foundation, Industry 4.0 demands modern, industry-oriented education, up-to-date knowledge of analysis, interpretation, designing, implementation, validation, and documentation of not only computer software and systems but also electronics and communication systems, hardware devices and tools, trained professional, ability to work in teams on multidisciplinary projects, etc. Thus KJSIEITs autonomy Scheme-I syllabus has been designed for the learners to successfully acquaint with the demands of the industry worldwide, life-long experiential learning, professional ethics with universal human values and training for needed skillsets and in line with the objectives of higher and technical education, AICTE, UGC and various accreditation and ranking agencies by keeping an eye on the technological developments, innovations, and industry requirements.

The salient features of KJSIEITs autonomy Scheme-I syllabus are:

1. Total 165 credits ensuring extra time for students' experiential learning through extracurricular activities, innovations, and research.
2. Introduction of Skill Based, Activity Based, Technology based and Project Based learning to showcase learners' creativity, interest and talent by developing additional skillsets, social involvement and contributions through activities, case studies, field visits, internships, creative learning, innovative mini, minor and major project developments, strengthen their profile and increasing the chances of employability.
3. Value addition learning through MOOCs platforms such as IBM-ICE, Coursera, NPTEL, SWAYAM, Spoken Tutorial etc.
4. Emerging areas of technology learning in Artificial Intelligence, Machine learning, Data Science, Internet of things, Cyber Security, Block chain, augmented and Virtual reality.

We would like to place on record our gratefulness to the faculty, alumni, students, industry experts and stakeholders for having helped us in the formulation of this syllabus.

Dr. Sunita R Patil

Member Secretary, Academic Council and Vice Principal, KJSIEIT, Sion

Preface by Board of Studies in Electronics Engineering:

We, the members of Board of Studies of B.Tech in Electronics Engineering are very happy to present a syllabus of Third and Last Year of B. Tech in Electronics Engineering with effect from the Academic Year 2021-22. We are assured that you will discover this syllabus interesting and challenging.

There are nine emerging technology thrust areas declared by AICTE, as an Electronics Engineer he/she should have knowledge about all the emerging technologies which will rules the industries in future so we have touched almost every emerging areas while deciding the courses and contents there in. The syllabus focuses on providing a sound theoretical background as well as good practical exposure to students in the relevant areas. Program Educational Objectives are considered while deciding different courses. It is envisioned to deliver a modern, industry-oriented education in Electronics Engineering. It aims at creating skilled engineers who can successfully acquaint with the demands of the industry worldwide. They obtain skills and experience in up-to-date knowledge to analysis, design, employ, technologies, software and systems.

At the beginning of every course we have added two theory lectures for prerequisites and course outline and at the end one theory lecture added for coverage of course conclusion which includes recap of modules, outcomes, applications, and summarization. We have mapped Course outcomes, PBL outcomes, Skills outcomes, Activity outcomes and TBL outcomes module wise throughout the syllabus. Faculty in this program adopted collaborative, co-operative and online teaching learning techniques during coverage of the course; this will help students to understand each course in depth. The designed syllabus promises to achieve the objectives of affiliating University, AICTE, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements.

We would like to show our appreciation to the faculties, students, industry experts and stakeholders assisting us in the design of this syllabus.

Board of Studies in Electronics Engineering are,

Sr. No.	Name	Designation	Sr. No.	Name	Designation
1	Dr. Milind U. Nemade	Head of the Department concerned (Chairman)	9	Prof. Pankaj Deshmukh	Member
2	Dr. Sudhakar Mande	One expert to be nominated by the Vice-Chancellor	10	Prof. Sejal Shah	Member
3	Mr. Saurabh Srivastava	One Representative from Industry /Corporate Sector/ Allied area relating to Placement	11	Prof. Vidya Sagvekar	Member
4	Dr. Vaishali Wadhe	Member	12	Prof. Sheetal Jagtap	Member
5	Prof. Vrinda Ullas	Member	13	Prof. Sarika Mane	Member
6	Prof. Ganesh Wadmare	Member	14	Prof. G.R. Phadke	Member
7	Prof. Mandar Bivalkar	Member	15	Prof. Devanand Bathe	Member
8	Prof. Medha Asurlekar	Member			

Program Structure for Third and Last Year UG Technology with Credit and Examination Scheme

Program Structure for Third Year UG Technology (ET)

Semester- V-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) (TH–P–TUT)	Total (Hrs.)	Credit Assigned (TH–P–TUT)	Total Credits	Course Category
1UETC501	Principles of Control System	3–0–0	03	3–0–0	03	PC
1UETC502	Digital Signal Processing	3–0–0	03	3–0–0	03	PC
1UETC503	Linear Integrated Circuits	3–0–0	03	3–0–0	03	PC
1UETC504	Digital Communication	3–0–0	03	3–0–0	03	PC
1UETDLC505X	Department Level Elective-1	3–0–0	03	3–0–0	03	DLE
1UETC506	Business Communication & Ethics	0–0–1**	01	0–0–1	01	BS
1UETL501	Principles of Control System Lab	0–2–0	02	0–1–0	01	PC
1UETL503	Linear Integrated Circuits Lab	0–2–0	02	0–1–0	01	PC
1UETL504	Digital Communication Lab	0–2–0	02	0–1–0	01	PC
1UETDLL505X	Department Level Elective-1 Lab	0–2–0	02	0–1–0	01	DLE
1UETL506	Business Communication & Ethics	0–2–0	02	0–1–0	01	BS
1UETPR53	Project Based Learning - Minor Project Lab-1	0–2- 0	02*	0–1–0	01	PBL
1UETXS57	Skill Based Learning-VII	0–2#–0	02	0–1–0	01	SAT
1UETXT58	Technology Based Learning-VIII	0–2#–0	02	0–1–0	01	SAT
Total		**15-16-1**	**32**	**15-8-1**	**24**	

*Load of learner, not the faculty, ** 1 hour tutorial can be conducted as Theory for class

SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need.

Semester- V-Examination Scheme

Course Code	Course Name	Examination Scheme								
		Marks								
		CA			ESE	TW	O	P	P&O	Total
		T1	T2	IA						
1UETC501	Principles of Control System	15	15	10	60	--	--	--	--	100
1UETC502	Digital Signal Processing	15	15	10	60	--	--	--	--	100
1UETC503	Linear Integrated Circuits	15	15	10	60	--	--	--	--	100
1UETC504	Digital Communication	15	15	10	60	--	--	--	--	100
1UETDLC505X	Department Level Elective-1	15	15	10	60	--	--	--	--	100
1UETC506	Business Communication & Ethics	--	--	10	--	--	--	--	--	10
1UETL501	Principles of Control System Lab	--	--	--	--	25	25	--	--	50
1UETL503	Linear Integrated Circuits Lab	--	--	--	--	25	--	25	--	50
1UETL504	Digital Communication Lab	--	--	--	--	25	--	--	--	25
1UETDLL505X	Department Level Elective-1 Lab	--	--	--	--	25	--	--	--	25
1UETL506	Business Communication & Ethics	--	--	--	--	25	25	--	--	50
1UETPR53	Project Based Learning - Minor Project Lab-1	--	--	10	--	25	--	25	--	60
1UETXS57	Skill Based Learning-VII	--	--	20	--	--	--	--	--	20
1UETXT58	Technology Based Learning-VIII	--	--	20	--	--	--	--	--	20
Total		**75**	**75**	**110**	**300**	**150**	**50**	**50**	**--**	**810**

Minor Project 1 and 2: Students can form groups with Minimum 2 (Two) and not more than 3 (Three)

Faculty Load: 1 hour per week per four groups

Department Level Elective-1			
Group A: Data Storage and Technology	**Group B: Electronics Core**	**Group C: Artificial Intelligence and Data Science**	**Group D: Computer Domain**
1UETDLC5051	1UETDLC5052	1UETDLC5053	1UETDLC5054
Data Structure	Biomedical Instrumentation	Neural Networks and Fuzzy Logic	Computer Organization and Architecture

Course Code	Course Name	Credits (TH+P+TUT)
1UETC501	Principles of Control System	(3+0+0)

Prerequisite:	1. Differential equations. 2. Laplace transform and Matrices.
Course Objectives:	1. To develop the understanding of fundamental principles of control systems. 2. To disseminate the basic methods for time-domain and frequency-domain analysis of control systems. 3. To develop the concept of stability and its assessment for linear-time-invariant systems. 4. To introduce the design of controllers in frequency-domain and state-space.
Course Outcomes:	After successful completion of the course students will be able to: 1. Derive the mathematical models of physical systems. 2. Sketch various plots in time and frequency domain. 3. Evaluate the stability of control systems in time and frequency domain. 4. Design performance specification based controller for a given system. 5. Analyse the control systems using state-space methods. 6. Design performance specifications based controller for a given system

Module No. & Name	Sub Topics	CO mapped	Hrs. / Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to the Control Problem	1.1 Examples of control systems, introduction to the control problem, open loop and closed loop systems, feed-forward control structure.	CO1	02	06
	1.2 Differential equation models of physical systems, deriving models of physical systems (electrical) Types of models, Impulse response model, Transfer function model for Electrical		02	
	1.3 Block diagram and Signal Flow Graph (SFG) representation of control systems, Block diagram reductions, Mason's gain formula.		02	
2. Time Response Analysis	2.1 Standard test input signals; time response of first and second order systems for standard test inputs; Application of initial and final value theorem. Performance specifications for second order system (no derivation), Error constants and type of the system.	CO2, CO3	03	06
	2.2 Concept of stability; Routh-Hurwitz Criteria, Relative stability analysis; Root-Locus technique and construction of root-loci.		03	
3. Frequency Response Analysis	3.1 Introduction to frequency response, Frequency response plots: Polar plot and Bode plot, Performance specifications in frequency domain.		04	08
	3.2 Stability margins in frequency domain, Mapping contours in s-plane, The Nyquist criterion, Relative stability using Nyquist criterion.		04	

4. Introduction to Controller Design	4.1 Characteristics of feedback: Sensitivity to parametric variation, Disturbance rejection, Steady-state accuracy.	CO4	03	10
	4.2 Feedback controller design using Root-locus, Reshaping the root-locus, Cascade lead, lag and lag-lead compensator.		03	
	4.3 Feedback control design using Bode plot, Reshaping the bode plot, Cascade lead, lag and lag-lead compensator.		04	
5.State-space Analysis	5.1 Concept of state variables, State-space model, Canonical forms, Conversion between canonical forms using similarity transforms.	CO5	03	07
	5.2 Solution of state-space equation; Eigen-values and eigenvectors, Stability in state-space, Concept of controllability and observability.		03	
6.Controller Design in state-space	State-feedback controller design: Pole-placement method, Ackerman's formula.	CO6	02	02
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. M. Gopal, "Control Systems: Principles and Design", 3rd edition, Tata McGraw Hill, 2008. 2. Richard Dorf, Robert Bishop, "Modern Control Systems", 11th edition, Pearson Education, 2008.
Reference Books	1. Golnaraghi Farid, B. C. Kuo, "Automatic Control Systems", 10th edition, McGraw Hill, 2017. 2. K. Ogata, "Modern Control Engineering", 6th edition, Prentice Hall, 2010. 3. I. J. Nagrath, M. Gopal, "Control System Engineering", New Age International, 2009. 4. Norman Nise, "Control Systems Engineering", Wiley, 8th edition, 2019.

Useful Links:

1. https://onlinecourses.nptel.ac.in/noc19_de04/preview
2. https://www.udemy.com/courses/search/?src=ukw&q=control+system

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course " Principles of Control System"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETC502	Digital Signal Processing	(3+0+0)

Prerequisite:	1. Applied Mathematics III (Laplace Transform, Z- Transform with ROC, and differential equation) 2. Signals and Systems.
Course Objectives:	1. To introduce Fourier domain analysis of signals and systems and their efficient implementation. 2. To expose students to various design techniques for FIR/IIR filters. 3. To unveil the students to advance signal processing techniques, digital signal processors and real-world applications.
Course Outcomes:	1. Analyze discrete time systems in frequency domain using Discrete Fourier Transform. 2. Design IIR digital filters to meet given filter specifications and implement the same using lattice structure. 3. Design FIR digital filters to meet given filter specifications and implement the same using lattice structure. 4. Investigate the need of multi-rate digital signal processing and implement multi-rate systems. 5. Explain architecture of DSP processors and examine the effect of hardware limitations on performance of digital filters. 6. Apply DSP techniques in real life problems.

Module No. & Name	Sub Topics	CO mapped	Hrs./ Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Transform Analysis of Linear Time Invariant System	1.1 Transform Analysis of Linear Time Invariant System.	CO1	01	02
	1.2 Invertibility of LTI systems, Minormum-phase, maximum-phase, mixed-phase systems.		01	
2. Discrete Fourier Transform and Fast Fourier Transform	2.1 Definition and Properties of DFT, IDFT, circular convolution of sequences using DFT and IDFT, Relation between Z-transform and DFT, Filtering of long data sequences using Overlap Save and Overlap Add Method.		05	10
	22 Fast Fourier transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, Inverse FFT.		05	
3. Design of Infinite Impulse Response (IIR) Filters	3.1 Introduction to IIR, Design of Infinite Impulse Response (IIR) filters using impulse invariant method and Bilinear transformation method, Butterworth and Chebyshev filter approximation.	CO2	03	08
	3.2 Mapping of S-plane to Z-plane, Impulse invariance method, Bilinear transformation method, Design of IIR digital filters from analog filters with examples (Butterworth, Chebyshev). Realization of		05	

	IIR filters using Lattice structures			
4. Design of Finite Impulse Response (FIR) Filters	4.1 Characteristics of FIR digital filters, Minormum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters, Frequency response and location of zeros for linear phase FIR filters.	CO3	04	08
	4.2 Effect of truncation on ideal filter impulse response, Design of FIR filters using window techniques (Rectangular, Hamming, Blackmann, Bartlet), Design of FIR filters using Frequency Sampling Technique. Realization of FIR filters using Lattice structures.		04	
5. Multi rate Digital Signal Processing and applications	5.1 Introduction and concept of Multi-rate Processing, up- sampling and down- sampling, Decimator and Interpolator, Decimation and Interpolation by Integer numbers, Multistage Approach to Sampling rate converters.	CO4	04	06
	5.2 Sample rate conversion using Polyphase filter structure, Type I and Type II Polyphase Decomposition.		02	
6. Finite word length Effect in DSP Processors and Application of DSP	6.1 Quantization noise – Truncation and Rounding, Coefficient quantization error, dead band, limit cycle oscillations.	CO5, CO6	02	05
	6.2 Overview of TMS320 family DSP Processor, Architecture of TMS320C54X DSP processor and higher processors, Difference between DSP processor & microprocessor, Selection of Digital Signal Processors, Case study of Real Time DSP applications to Speech and Radar Signal Processing and Biomedical Signal Processing.		03	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Alan V. Oppenheim and Ronald Schafer, "Discrete Time Signal Processing", Pearson Education. 2. J. Proakis, D. G. Manolakis, and D. Sharma, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education. 3. Babu R., "Digital Signal Processing", Scitech Publications, Fourth Edition. 4. S.Salivahanan, A Vallavaraj, C Gnanapriya, "Digital Signal Processing", Tata McGraw Hill Edition Private Limited, New Delhi, Edition 2010. 5. L. R. Rabiner and B. Gold, "Theory and Applications of Digital Signal Processing", Prentice- Hall of India, Edition 2006.
Reference Books	1. B. Kumar, "Digital Signal Processing", New Age international Publishers, Edition 2014. 2. P.P. Vaidyanathan, "Multirate Systems and Filter Banks", Pearson. 3. Robert Schilling and Sandra Harris, "Fundamentals of Digital Signal Processing using MATLAB", Cengage Learning. 4. Sanjit K.Mitra, "Digital Signal Processing", McGrawHill education.

Useful Links:

1. www.skyfilabs.com/blog/list-of-good-digital-signal-processing-projects
2. book.jobscaptain.com/view/?pdfid=1sKEazTJieOS_eVwC6Yh5rDLCWNPXFXpa

Minor project to be completed by students on any one topic from below (not limited to).

1. Sobel Edge Detection using DSP
2. Image Fusion
3. Light animation using Arduino and Matlab
4. Automatic certificate generation using MATLAB
5. Traffic signal detection using MATLAB
6. Fruit identification using color analysis
7. Vehicle number plate detection DSP project

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Course Code	Course Name	Credits (TH+P+TUT)
1UETC503	Linear Integrated Circuits	(3+0+0)

Prerequisite:	1. Electronic Devices and Circuits I 2. Electronic Devices and Circuits II
Course Objectives:	1. To teach fundamental principles of standard linear integrated circuits. 2. To develop an overall approach for students for selection of integrated circuits, study its specification, the functionality, design and practical applications.
Course Outcomes:	On successful completion of the course the students will be able to: 1. Demonstrate an understanding of fundamentals of integrated circuits. 2. Analyze the various applications and circuits based on particular linear integrated circuits. 3. Analyze the various applications and circuits based on particular nonlinear integrated circuits. 4. Classify the working principle of data converters. 5. Explain the working of special functions and applications of IC 555. 6. Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs. Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Fundamentals of Operational Amplifier	1.1 Block diagram of op-amp, Characteristics of op-amp, op-amp parameters, high frequency effects on op-amp gain and phase, slew rate limitation, single supply versus dual supply op-amp.	CO1	02	04
	1.2 Configurations of op-amp: open loop and closed loop configuration, Inverting amplifier and Non inverting amplifier.		02	
2. Linear Applications of Operational Amplifier	2.1 Adder, Subtractor, Difference amplifier, Integrator, Differentiator, Three Op-amp Instrumentation amplifier, V-I converter, I-V converter.	CO2	04	07
	2.2 Active Filters: Transfer function, Design of First order and Second order of LPF, HPF, BPF and BRF		02	
	2.3 Oscillators: RC phase shift and Wein bridge oscillators.		01	
3. Non-linear	3.1 Voltage Comparators, Applications of comparator as zero crossing detector, window	CO3	06	08

Applications of Operational Amplifier	comparator, level detector, Schmitt triggers, Half wave and full wave Precision rectifiers, Peak detectors, Sample & Hold circuit, Log and Antilog amplifier.			
	3.2 Waveform generators: Square wave and Triangular wave generator circuit.		02	
4. Data Converters	4.1 Analog to Digital: Performance parameters, Simple ramp, Dual slope, Successive approximation and Flash ADC.	CO4	02	04
	4.2 Digital to Analog: Performance parameters, Binary weighted and R/2R ladder.		02	
5. Special Purpose Integrated Circuits	5.1 Monolithic Timer: NE555, functional block diagram, working, design and applications , Designing sums on IC 555	CO5	05	09
	5.2 Functional block diagram, working, design and applications of Voltage controlled oscillator 566, PLL 565, Function generator XR 2206, Power amplifier LM 380		04	
6. Voltage Regulators	6.1 Functional block diagram of Voltage Regulators, Design of fixed voltage Regulators (78XX and 79XX), three terminal adjustable voltage regulators (LM 317 and LM 337)	CO6	03	07
	6.2 Functional block diagram, working and design of IC 723 with current limit and current foldback protection, Switching regulator topologies		04	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text books	1. S. Salivahanan, V.S. Kanchana , " Linear Integrated Circuits" McGraw Hill Education; 3rd edition 2. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th edition.
Reference books	1. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", Tata McGraw Hill, 3rd edition. 2. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson, 4th edition. 3. David A. Bell, "Operational Amplifiers and Linear Integrated Circuits", Oxford University Press, Indian edition. 4. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th edition.

Useful Links:

https://www.nptel.ac.in

https://swayam.gov.in
https://www.coursera.org/
Assessment:
Continuous Assessment for 40 marks: 1. Test 1 – 15 marks 2. Test 2 – 15 marks 3. Internal assessment - 10 marks Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty
End Semester Examination will be of 60 marks for 3 hours duration.
Term work:
1. Term work should consist of a Minimum of 8 experiments 2. Journal must include at least 2 assignments on content of theory and practical of the course " Linear Integrated Circuits**"** 3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work. 4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETC504	**Digital Communication**	**(3+0+0)**

Prerequisite:	1. Principles of Communication Engineering. 2. Signals & Systems
Course Objectives:	1. Students will understand the elements of a digital communication system and probability theory. 2. Students will identify the necessity of Source encoding and Channel encoding in digital communication. 3. Students will learn the effect of ISI in Baseband transmission of a digital signal. 4. Students will learn how to measure performance of different digital modulation techniques. 5. Students will understand the necessity of matched filter for optimum reception of digital signal.
Course Outcomes:	After successful completion of the course students will be able to: 1. Apply distribution functions to describe random variable in digital communication system. 2. Apply appropriate source coding techniques and evaluate entropy, average code word length and coding efficiency of source code. 3. Analyze the impact of Inter Symbol Interference in Baseband transmission and methods to mitigate its effect. 4. Analyze various digital modulation methods and assess them based on parameters such as spectral efficiency, Power efficiency, Probability of error in detection. 5. Apply channel coding techniques for error detection and correction at receiver, 6. Interpret the optimum reception of digital signals.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction to Digital Communication System and Probability Theory	1.1 Introduction to Digital communication system, significance of AWGN Channel, pulse dispersion in the channel.	CO1	01	07
	1.2 Concept of Probability Theory in Communication Systems: Bay's rule, PDF, CDF, Statistical Averages, Mean and Variance of Random variables, Binary communication channel, Optimum receiver algorithm.		03	
	1.3 Probability models: Gaussian, Rayleigh PDF & Rician Distribution, Binomial Distribution, Central-Limit Theorem.		03	
2.Information Theory and Source Coding	2.1 Measure of Information, Entropy, Information rate, Channel capacity, Shannon –Hartley Capacity Theorem and its Implications.	CO2	02	05
	2.2 Shannon-Fano encoding, Huffman encoding, Code Efficiency and Redundancy examples and applications of source coding.		03	
3. Pulse Shaping for Optimum	3.1 Line codes and their desirable properties, PSD of digital data.	CO3	02	04

Transmission	3.2 Baseband PAM transmission: Concept of Inter symbol interference (ISI), Raised Cosine filter, Nyquist Bandwidth. Concept of equalizer to overcome ISI.		02	
4.Digital Modulation Techniques	4.1 Pass Band Amplitude modulation and Demodulation: - BASK, M-ary PAM, Digital Phase Modulation & Demodulation: BPSK, OQPSK, QPSK, M-ary PSK, QAM, Digital Frequency Modulation and Demodulation: BFSK, MSK, M-ary FSK, Introduction to spread spectrum modulation, OFDM.	CO4	03	10
	4.2 Concept of Binary and M-ary transmission, Coherent and Non- Coherent reception, Power spectral density of Pass-band signal, Signal space Representation and Euclidean distance.		04	
	4.3 Comparison of all techniques based on Spectral efficiency, Power efficiency, Probability of error in detection.		03	
5. Error Control Codes	5.1 Need for channel encoding, Concept of Error detection and correction, Forward Error correction.	CO5	02	09
	5.2 Linear block codes: Hamming Distance, Hamming Weight, Systematic codes, Syndrome Testing.		02	
	5.3 Cyclic codes: Generator polynomial for Cyclic codes, Systematic cyclic codes, Feedback shift register for Polynomial division.		02	
	5.4 Convolution codes: Convolution encoder, Impulse response of encoder, State diagram, Trellis diagram representations.		03	
6. Optimum Reception of Digital Signal	6.1 A baseband signal receiver and its Probability of error.	CO6	02	04
	6.2 The Optimum receiver and Filter.		01	
	6.3 Matched filter and its probability of error.		01	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Simon Haykin, "Communication System", John Wiley and Sons, Fourth Edition. 2. Taub Schilling & Saha, "Principles of Communication Systems", Tata Mc-Graw Hill, Third Edition. 3. B P Lathi & Zhi Ding ,"Modern Digital and Analog communication systems" 4E, Oxford University Press , Indian Edition 4. R N Mutagi, "Digital Communication", Oxford University Press, Second Edition
Reference Books	1. Bernad Sklar,- "Digital communication", Pearson Education, Second Edition 2. Simon Haykin, "Digital communication", John Wiley and Sons 3. Proakis & Salehi, "Communication system Engineering", Pearson Education 4. Amitabha Bhattacharya, "Digital Communication", Tata Mcgraw Hill

Useful Links:

nptel.ac.in/courses/117101053/

2. nptel.ac.in/courses/111104079/

3. nptel.ac.in/courses/IIT-MADRAS/...Of.../Lecture40-41_ErrorControlCoding.pdf

4. https://www.slideshare.net/srkrishna341/digital-modulation-techniques6.

5. https://www.slideshare.net/HILDA519/spread

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course " Digital Communication**"**
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETDLC5051	Data Structure	(3+0+0)

Prerequisite:	Computer Programming.
Course Objectives:	1. To discuss types of different data structures and concept of Abstract Data Type 2. To discuss the concept of stack and queue and apply them to various applications. 3. To describe the concept of link list and apply it to various applications 4. To introduce the different kinds of trees. 5. To discuss graph related concepts and traversals along with application. 6. To teach various searching techniques.
Couse Outcomes:	After successful completion of the course students will be able to: 1. Describe types of data structure and write ADT. 2. Implement stack and different types of queues using array and their applications. 3. Carry out various types of link list operations and their applications. 4. Implement Binary Search Tree, its operations and describe the concepts of AVL tree, Btree and B+Tree. 5. Implement Graph traversals BFS and DFS and application of Graph in topological sorting. 6. Describe various Hashing functions, Collision techniques and compare various searching techniques Linear Search, Binary Search and Hashing.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs. /Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1. Introduction to Data Structures	1.1 Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures	CO1	02	03
	1.2 Concept of array, Static arrays vs Dynamic Arrays, structures.		01	
2. Stack and Queues	2.1 Introduction, ADT of Stack, Operations on Stack, Array Implementation of Stack, Applications of Stack-Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation, Recursion.	CO2	04	08
	2.2 Introduction, ADT of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Introduction of Double Ended Queue, Applications of Queue.		04	
3. Linked List	3.1 Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Circular Linked List, Doubly Linked List, Operations on Singly Linked List and Doubly Linked List	CO3	05	08
	3.2 Stack and Queue using Singly Linked List, Singly Linked List Application-Polynomial Representation and Addition.		**03**	
4. Trees	4.1 Introduction, Tree Terminologies, Binary Tree, Binary Tree Representation, Types of Binary Tree, 4.2 Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree	CO4	06	10

	4.3 Applications of Binary Tree-Expression Tree, Huffman Encoding, Search Trees-AVL, rotations in AVL Tree, operations on AVL Tree, Introduction of B Tree, B+ Tree.		04	
5. Graphs	5.1 Introduction, Graph Terminologies, Representation of Graph, Graph Traversals- Depth First Search (DFS) and Breadth First Search (BFS)	CO5	03	04
	5.2 Graph Application- Topological Sorting.		01	
6. Searching Techniques	Linear Search, Binary Search, Hashing-Concept, Hash Functions, Collision resolution Techniques	CO6	06	06
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication. 2. Reema Thareja, "Data Structures using C", Oxford Press. 3. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", 2ndEdition, CENGAGE Learning. 4. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education 5. Data Structures Using C, ISRD Group, 2ndEdition, Tata McGraw-Hill.
Reference Books	1.Prof. P. S. Deshpande, Prof. O. G. Kakde, "C and Data Structures", DreamTech press. 2. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India. 3. Rajesh K Shukla, "Data Structures using C and C++", Wiley-India 4. GAV PAI, "Data Structures", Schaum's Outlines. 5.Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition

Useful Links:

https://nptel.ac.in/courses/106/102/106102064/

https://www.coursera.org/specializations/data-structures-algorithms

https://www.edx.org/course/data-structures-fundamentals

https://swayam.gov.in/nd1_noc19_cs67/preview

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Data Structure"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETDLC5052	Biomedical Instrumentation	(3+0+0)

Prerequisite:	1.Knowledge of number systems 2 Knowledge of basic electronic circuits 3.Knowledge of Basic instrumentation theory
Course Objectives:	1. To have the basic awareness about basic physiology and functioning of various systems in Human body. 2. To introduce the students to Diagnostic, Pathology, Life support equipment and latest imaging techniques hospitals and the healthcare industry. 3. To motivate the students to take up live projects with medical applications this will help the society at large.
Couse Outcomes:	After successful completion of course student will be able to: 1. Describe the basic structure& functions of parts of cell, generation of action potential and various bioelectric potentials 2. Demonstrate the knowledge of physiological processes such as respiratory, cardiovascular, nervous,& muscular system in human body. 3. Compare various methods used for measurement of various cardiac parameters such as blood pressure, blood flow, blood volume, cardiac outputs and heart sounds. 4. Describe the basic principles of analytic instruments. 5. Discuss use of pathology laboratory instruments like colorimeter, spectrophotometer, blood cell counter and auto analyzer 6. To describe support equipment like pacemakers, defibrillators, heart lung machine, Haemodylesis machine. 7. Discuss imaging techniques such as X-ray, CT scan, MRI and Ultrasound.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Bio Potential Measurement	1.1 Human cell- structure.	CO1	02	06
	1.2 Origin of bio potentials and generation of action potentials.		02	
	1.3 Electrode-electrode interphase and types of bio potential electrodes.		02	
2.Physiological System and Related Measurement	2.1 Cardiovascular System: Structure of Heart, Electrical and mechanical activity of heart, ECG measurements and cardiac arrhythmias, Design of ECG amplifiers Heart sound measurement	CO2	02	08
	2.2 Nervous system: CNS & PNS: Nerve cell, Neuronal communication, Generation of EEG and its measurement, Normal & abnormal EEG, evoked potential, EEG measurements, Electrode placement, Block diagram of EEG machine		02	
	2.3 Respiratory system: Physiology of respiration and measurements of		02	

	respiratory related parameters like respiration rate, lung volumes and capacities			
	2.4 Muscular System Typical muscle fibre action potential, Electromyography: EMG measurement and block diagram		02	
3.Cardiovascular Measurements	3.1 Blood pressure- Direct and indirect types	CO3	02	08
	3.2 Blood flow- Electromagnetic and ultrasonic type		02	
	3.3 Blood Volume-plethysmography: Impedance, capacitive and photoelectric type		02	
	3.4 Cardiac Output: Fick's method, Dye dilution and Thermo-dilution type		02	
4.Analytical Equipment	Beer Lambert's law, Principle of photometry Photo colorimeter: Optical diagram Spectrophotometer: optical diagram, Auto-analyzer schematic diagram	CO4	04	04
5.Life- Saving and Support Equipment	5.1 Pacemaker- Types of pacemakers, Modes of pacing and its applications	CO5	01	05
	5.2 Defibrillator- Types of fibrillations, Modes of operation, DC defibrillators and their applications		01	
	5.3 Heart- Lung machine: System flow diagram and its application during surgery		01	
	5.4 Hemodialysis machine: Principle of operation and system flow diagram		01	
	5.5 Baby incubator and its applications		01	
6.Imaging Techniques	6.1 X-ray – Generation, X-ray tube and its control, X-ray machine and its applications	CO6	02	08
	6.2 CT Scan- CT Number, Block Diagram, scanning system and applications		02	
	6.3 MRI- concept and image generation, block diagram and its applications		02	
	6.4 Ultrasound Imaging – Modes of scanning and their applications		02	
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42
Text Books	1 Handbook of Biomedical Instrumentation : R.S. Khandpur, (P H pub) 2. Medical Instrumentation, Application and Design: J G Webster (John Wiley) 3. Introduction to biomedical equipment Technology: Carr- Brown (PH pub)			
Reference Books	1. Encyclopedia of medical devices and instrumentation: J G Webster Volume I-IV (PH pub).			
Useful Links:				
1. https://www.egr.msu.edu/classes/ece445/mason/Files/6-Biopotentials.pdf				
2.http://www.eolss.net/sample-chapters/c03/e6-59-13-09.pdf				
3. https://www.kgmu.org/download/virtualclass/anatomy/Cardiovascular_system.pdf				
4. https://www.bnl.gov/esh/env/ser/03ser/Appendix_D.pdf				
5. http://protechnologies.com/blog/2017/may/24/considerations-when-designing-life-saving-medical-devices/				
6. https://www.sciencedirect.com/topics/engineering/imaging-modality				
Assessment:				
Continuous Assessment for 40 marks:				

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course " Biomedical Instrumentation"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
IUETDLC5053	Neural Network and Fuzzy Logic	(3+0+0)

Prerequisite:	1. Knowledge of linear algebra, multivariate calculus, and probability theory 2. Knowledge of a programming language (PYTHON/C/C ++/ MATLAB recommended)
Course Objectives:	1. To study basics of biological Neural Network 2. To understand the different types of Artificial Neural Networks 3. To know the applications of ANN 4. To study fuzzy logic and fuzzy systems
Couse Outcomes:	After successful completion of the course students will be able to: 1. Explain fundamentals of Neural Network and its applications. 2. Analyse Supervised Learning Networks and implement it using different learning algorithms. 3. Analyse Unsupervised Learning Networks and implement it using different learning algorithms. 4. Interpret the concepts of Associative memory networks 5. Demonstrate the need for fuzzy logic and control system. 6. Apply the suitable neural network algorithms for real time application.

Module No. & Name	Sub Topics	CO mapped	Hrs. /Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction	1.1 Biological neurons, McCulloch and Pitts models of neuron, Types of activation function, Network architectures, Knowledge representation. Linear & non-linear separable classes & Pattern classes	CO1	02	05
	1.2 Learning processes: Supervised learning, Unsupervised learning and Reinforcement learning		03	
	1.3 Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Correlation Learning Rule, Winner Take-All Learning Rule			
	Applications and scope of Neural Networks			
2.Supervised Learning Networks	2.1 Perception Networks: continuous & discrete, Perceptron convergence theorem, Adaline, Madaline, Method of steepest descent and least mean square algorithm	CO2	04	08
	2.2 Back Propagation Network		02	
	2.3 Radial Basis Function Network		02	
3.Unsupervised learning network	3.1 Fixed weights competitive nets	CO3	02	06
	3.2 Kohonen Self-organizing Feature Maps, Learning Vector Quantization		02	
	3.3 Adaptive Resonance Theory – 1		02	
4. Associative memory networks	4.1 Introduction, Training algorithms for Pattern Association	CO4	02	06
	4.2 Auto-associative Memory Network, Hetero-associative Memory Network, Bidirectional		03	

	Associative Memory.			
	4.3 Discrete Hopfield Networks.		01	
5. Fuzzy Logic	5.1 Fuzzy Sets, Fuzzy Relations and Tolerance and Equivalence.	CO5	04	10
	5.2 Fuzzification, Membership Value Assignment techniques and Defuzzification (Max Membership principle, Centroid method, Weighted average method).		04	
	5.3 Fuzzy Controllers		02	
6. Case study on ANN	Digital Image Compression, Handwritten Digit Recognition, Process Identification, Expert Systems for Low Back Pain Diagnosis	CO6	04	04
II. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	---	01	01
Total hours				42

Books:

Text Books	1. Jacek M. Zurada, "Introduction to Artificial Neural Systems," Jaico Publishing House. 2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd ed. Wiley India. 3. S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing," 2nd ed. Wiley India.
Reference Books	1. Simon Haykin, "Neural Networks A Comprehensive Foundation", Pearson Education. 2. S Rajasekaran and G A Vijayalakshmi Pai, "Neural Networks and Fuzzy Logic and Genetic Algorithms ", PHI Learning

Useful Links:

1.https://nptel.ac.in/courses/127/105/127105006/

2.https://nptel.ac.in/courses/117/105/117105084/

3.https://www.coursera.org/learn/neural-networks-deep-learning

4.https://www.classcentral.com/course/swayam-fuzzy-logic-and-neural-networks-13036

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Neural Network and Fuzzy Logic"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETDLC5054	Computer Organization and Architecture	(3+0+0)

Prerequisite:	1. Digital Logic Circuits 2. Fundamental concepts of processing
Course Objectives:	1. To introduce the learner to organizational aspects of fundamental units of a computer like CPU, memory, I/O and control unit. 2. To introduce the learner to the design aspects this can lead to maximized performance of a computer. 3. To introduce the learner to various concepts related to Parallel Processing. 4. To highlight the various architectural enhancements in modern processor.
Couse Outcomes:	After successful completion of the course students will be able to: 1. Describe the basic organizational features of a computer and design considerations of Processor, Memory and I/O in Computer systems. 2. Solve problems on performance metrics and arithmetic algorithms. 3. Solve problems on design considerations of control unit, cache memory, virtual memory in Computer systems. 4. Apply the principles of pipelining and performance metrics. 5. Analyze the advantages and limitations of Parallelism in systems. 6. Evaluate the various architectural enhancements in a modern processor.

Module No. & Name	Sub Topics	CO mapped	Hrs./ Subtopic	Total Hrs./ Module
I. Prerequisite and Course Outline	Prerequisite Concepts and Course Introduction	---	02	02
1.Introduction to Computer Organization	1.1 Fundamental Units of a Computer	CO1	0.5	06
	1.2 Introduction to Buses		0.5	
	1.3 Number Representation methods- Integer and Floating-point, Booth's Multiplier, Restoring and Non-Restoring Division	CO2	04	
	1.4 Basic Measures of Computer Performance - Clock Speed, CPI, MIPs and MFlops		01	
2. Processor Organization and Architecture	2.1 CPU Architecture, Register Organization, Instruction cycle, Instruction Formats, Addressing Modes	CO1, CO3	02	08
	2.2 Control Unit Design- Hardwired and Micro-programmed Control: Vertical and Horizontal Micro-Instructions, Nano-programming		05	
	2.3 Comparison between CISC and RISC architectures		01	
3. Memory Organization	3.1 Classification of Memories-Primary and Secondary Memories, RAM (SRAM and DRAM) and ROM (EPROM, EEPROM), memory allocation		02	08
	3.2 Memory Hierarchy, cache memory concepts, mapping techniques, write policies, cache coherency		04	
	3.3 Virtual memory management-concept, segmentation, paging, page replacement policies		03	
4. Input / Output	4.1 Types of I/O devices and access methods, Types of	CO1	02	04

Organization	buses, bus arbitration			
	4.2 Direct Memory Access (DMA)		02	
5. Parallelism	5.1 Introduction to parallel processing concepts, Flynn's classification, Amdahl's law	CO4	02	08
	5.2 Pipelining - concept, speedup, efficiency, throughput, types of pipeline hazards and solutions	CO4 CO5 CO6	04	
	5.3 Superscalar architectures, out-of-order execution, multi-core processors, clusters	CO6	02	
6. RISC V	RiSC V -Introduction, RISC V ISA principles, Instructions and RISC-V Hybrid Instruction Encoding, RISC V addressing summary Shakthi Processors	CO6	06	04
7. Conclusion	Overview of important topics	--	02	02
Total hours				42

Books:

Text Books	1. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill, 2002. 2. Mano, M. Morris. Computer system architecture. Prentice-Hall of India, 2003. 3. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
Reference Books	1. J.P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998. 2. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, Tata McGraw-Hill. 3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design-The Hardware/Software Interface", Morgan Kaufmann, 1998.

Useful Links:

1. http://vlabs.iitkgp.ac.in/coa/index.html

2 https://personal.ntu.edu.sg/smitha/ParaCache/Paracache/dmc.html

3 http://www.ecs.umass.edu/ece/koren/architecture/Cache/default.htm

4 https://wepsim.github.io

Assessment:

Continuous Assessment for 40 marks:

1. Test 1 – 15 marks
2. Test 2 – 15 marks
3. Internal assessment - 10 marks

Internal assessment will be based on assignments/quizzes /case study/activity conducted by the faculty

End Semester Examination will be of 60 marks for 3 hours duration.

Term work:

1. Term work should consist of a Minimum of 8 experiments
2. Journal must include at least 2 assignments on content of theory and practical of the course "Computer Organization and Architecture"
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks

Course Code	Course Name	Credits (TH+P+TUT)
1UETC506	Business Communication and Ethics	(0+0+1)

Tutorial Prerequisite:	Fundamental knowledge of Professional Communication Skills as acquired in Semester II
Tutorial Objectives:	1. To develop advanced style of writing and display linguistic correctness in diverse business documentations 2. To evaluate job prospects and imbibe employment dynamics in addition to a prospective entrepreneurial career 3. To deploy trending global technologies to interact effectively in professional situations 4. To display persuasive presentation techniques with enriched diction with the aid of enhanced technology 5. To develop enhanced interpersonal skills that can positively influence the professional relationships 6. To create an ethical professional image with globally accepted etiquettes
Tutorial Outcomes (TO):	1. Exhibit a relevant knowledge on complex corporate documentations in a structured format that facilitates the prospective resources for career growth as executives. 2. Succeed in a stimulating and challenging business environment while building the success of the company resulting in enhanced career opportunities as employees or entrepreneurs. 3. Apply sound competency in business networking skills with cutting-edge technologies to meet varied professional goals. 4. Display polished linguistic competency with effective use of body language in business presentations. 5. Demonstrate multifaceted interpersonal skill-sets that can result in augmented productivity in work groups and teams 6. Build an ambience of trust, ethical values and personal integrity as per the corporate compliances.

Tutorial No.	Tutorial Topics (In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)	TUTO mapped	Hrs./ Topic
1.	Test of English as Foreign Language (TOEFL)	TUTO2	01
2.	Group discussion (Practice session)-I	TUTO2	01
3.	Group discussion (Practice session)-II	TUTO2	01
4.	Final Group discussion-I	TUTO2	01
5.	Final Group discussion-II	TUTO2	01
6.	English Aptitude Test	TUTO2	01
7.	Resume Writing	TUTO2	01
8.	Mock interview	TUTO2	01
9.	Role play techniques for interpersonal skills	TUTO5	01
10.	Project Report Presentation-I	TUTO1	01
11.	Project Report Presentation -II	TUTO1	01
12.	Technical proposal	TUTO1	01
13.	Corporate Ethics/role play/case studies	TUTO6	01

14.	Business Meetings: case studies/role play	TUTO3, TUTO4	01

Useful Video Links:

Sr. No.	Topics	Links
1	TOEFL listening Skill	https://www.youtube.com/watch?v=jSUh0Civuv4
2	MBA Interview	https://www.youtube.com/watch?v=cwW9QBNuwCw
3	How to write a successful CV	https://www.youtube.com/watch?v=U0JAfqEak2c
4	Interview techniques (How to answer tell me about yourself)	https://www.youtube.com/watch?v=m5kR7TPAkSw
5	The 4 types of team members you can hire	https://www.youtube.com/watch?v=5bYYFfpbSqc
6	Every Meeting Ever	https://www.youtube.com/watch?v=K7agjXFFQJU

Internal Assessment (10 Marks):

Internal assessment will be based on assignments /quizzes /case study /activity conducted by the faculty

Lab Code	Lab Name	Credits (P+TUT)
1UETL501	**Principles of Control System Lab**	**(1+0)**

Lab Prerequisite:	Knowledge of MATLAB and Simulink
Lab Objectives:	1. To develop the understanding of fundamental principles of control systems. 2. To disseminate the basic methods for time-domain and frequency-domain analysis of control systems. 3. To develop the concept of stability and its assessment for linear-time-invariant systems. 4. To introduce the design of controllers in frequency-domain and state-space.
Lab Outcomes:	After successful completion of the course students will be able to: 1. Analyse a control system in time and frequency domain. 2. Design a performance specification based controller in time and frequency domain. 3. Develop tune PID controller for given control system. 4. Evaluate controllability and observability of a control system. 5. Design a state feedback controller according to given specifications.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	To study the time response of a first-order and second-order system to standard input signals.	LO1	02
2.	To study the frequency response of a second-order system to standard input signals.		02
3.	To solve a differential equation model using simulation software.		02
4.	To study the steady-state errors for type-0, 1 and 2 systems.		02
5.	To design a controller according to given performance specifications using root-locus.	LO2	02
6.	To design a controller according to given performance specifications using bode plot.		02
7.	To design appropriate lag, lead or lag-lead compensator using bode plot.		02
8.	To perform stability analysis of several control systems using Nyquist plots.		02
9.	To study similarity transforms for state-space canonical forms.	LO4	02
10.	To study controllability and observability of control systems.		02
11.	To design a state feedback controller using pole-placement and ackerman's formula.	LO5	02
12.	To introduce the PID controller and it's tuning.	LO3	02

Virtual Lab Links:

1. http://iitb.vlab.co.in/?sub=8&brch=117
2. http://vlabs.iitkgp.ernet.in/rcs/index.html

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Principles of Control System".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.

4.Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.
Oral : Oral examination will be based on the experiment list and content of the entire theory syllabus.

Lab Code	Lab Name	Credits (P+TUT)
1UETL503	**Linear Integrated Circuits Lab**	**(1+0)**

Lab Prerequisite:	1. Electronic Devices and Circuits I 2. Electronic Devices and Circuits II
Lab Objectives:	1. To teach fundamental principles of standard linear integrated circuits. 2. To develop an overall approach for students from selection of integrated circuits, study its specification, the functionality, design and practical applications.
Lab Outcomes:	On successful completion of the course the students will be able to: 1. Demonstrate an understanding of the fundamentals of integrated circuits using IC 741 2. Design & perform practicals using Linear integrated circuits like adder, subtractor etc 3.Design & perform practicals using nonlinear integrated circuit like comparator, astable, monostable multivibrators etc 4. Design & perform practicals using Timer IC555 5. Design & perform practicals for voltage regulators 6. Design and perform practicals for IC565 / IC566.

Lab No.	Experiment Title	LO Mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	Testing of Different ICs and measurement of opamp parameters	LO1	02
2.	Design inverting, non-inverting amplifiers and buffers using IC 741.		02
3.	Design summing and difference amplifier using op-amp	LO2	02
4.	Design Instrumentation amplifier using 3 Op-Amp.		02
5.	Design Wein bridge and RC phase shift Oscillator.	LO3	02
6.	Design Schmitt trigger using Op-amp		02
7.	Design and analyze second order High pass and Low pass filter		02
8.	Design Astable multivibrator using IC 555 for fixed frequency and variable duty cycle.	LO4	02
9.	Design Low voltage Low current voltage regulator using IC 723	LO5	02
10.	Design High voltage High current voltage regulator using IC 723.		02
11.	Design Frequency Modulator using IC 566	LO6	02
12.	Design FSK Demodulator using IC 565		02

Virtual Lab Links:

1. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/inverting-amplifier-pvg/
2. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/adder-pvg/
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/integrator-pvg/
4. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/differentiator-pvg/
5. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/experiments/inverting-amplifier-pvg/
Term work:
1.Term work should consist of a Minimum of 8 experiments. 2.Journal must include at least 2 assignments on content of theory and practical of the course "Linear Integrated Circuits". 3.The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work. 4.Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.
Practical: Practical examination will be based on experiment list and performance of experiment.

Lab Code	Lab Name	Credits (P+TUT)
1UETL504	Digital Communication Lab	(1+0)

Lab Prerequisite:	Principles of Communication Engineering
Lab Objectives:	1. Analyze different subsystems of digital communication system 2. To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.
Lab Outcomes (LOs):	After successful completion of the course students will be able to: 1. Apply theory of probability in identifying and solving relevant problems. 2. Apply source coding techniques for data compression in various applications. 3. Simulate different modulation and demodulation techniques. 4. Apply error correcting codes for error detection and correction in different applications. 5. Simulate matched filter response.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	To find the mean and variance of uniform random variable X.	LO1	02
2.	Generate statistically independent and identically distributed Rayleigh random variables and plot Rayleigh probability density function.		02
3.	To find the total information, entropy of the source and channel capacity using Shannon Hartley Theorem	LO2	02
4.	To find the entropy, average code word length and the Huffman code for the given messages with their probabilities.		02
5.	Generate Pulse Amplitude Modulation (PAM) signal and spectrum of PAM signal.	LO3	02
6.	Simulate ASK, FSK and PSK Digital Modulation Techniques.		02
7.	Generate parity check matrix, code vector for given message bits, syndrome & correcting code word for receiver using Linear Block Coding method.	LO4	02
8.	Generate systematic cyclic code for given message bit sequence and find syndrome for the received code vector.		02
9.	To generate convolution code for the given message bits.		02
10.	Simulate Square Root Raised Cosine (SRRC) filter and plot response of SRRC filter at transmitter side and Matched SRRC filter at receiver side.	LO5	02

Virtual Lab Links:

1. https://www.etti.unibw.de/labalive/experiment/qpsksignalgeneration/#experiment
2. https://nptel.ac.in/courses/117104121/
3. http://www.nptelvideos.in/2012/11/error-correcting-codes.html

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Digital Communication".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
1UETDLL5051	**Data Structure Lab**	**(1+0)**

Lab Prerequisite:	1. Computer Programming 2. Computer Programming Laboratory
Lab Objectives:	1. To implement basic data structures such as linked lists, stacks and queues 2. To solve problem involving graphs and trees 3. To choose appropriate data structure and apply it to various problems
Lab Outcomes (LOs):	1. Implement linear data structures & be able to handle operations like insertion, deletion, searching and traversing on them. 2. Implement nonlinear data structures & be able to handle operations like insertion, deletion, searching and traversing on them 3. Choose appropriate data structure and apply it in various problems 4. Select appropriate searching techniques for given problems.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
Star (*) marked experiments are compulsory.			
I.	Lab Prerequisite	---	02
1.	Implement Stack ADT using array.	LO1	02
2*.	Convert an Infix expression to Postfix expression using stack ADT.		02
3*.	Evaluate Postfix Expression using Stack ADT		02
4*.	At least 2 applications of Stack from the useful links/any other given below.	LO3	02
5.	Implement Linear Queue ADT using array.	LO1	02
6*.	Implement Circular/Double ended Queue ADT using array.		02
7.	Implement Priority Queue ADT using array.	LO2	02
8.	Implement Singly Linked List ADT.	LO1	02
9*.	Implement Circular Linked List ADT.		02
10*.	Implement Doubly Linked List ADT.		02
11*.	Implement Stack / Linear Queue ADT using Linked List.		02
12*.	Implement Binary Search Tree ADT using Linked List.	LO2, LO3	02
13*.	Implement Graph Traversal techniques:a) Depth First Search b) Breadth First Search		02
14*.	At least 2 applications of Binary Search Technique from the useful links/any other given below	LO4	02

Virtual Lab Links:

1. www.leetcode.com
2. www.hackerrank.com
3. www.cs.usfca.edu/~galles/visualization/Algorithms.html
4. www.codechef.com

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course “Data Structure”.
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
1UETDLL5052	Biomedical Instrumentation Lab	(1+0)

Lab Prerequisite:	Basic Electronics
Lab Objectives:	1.To discuss basic concepts of Biomedical Instrumentation 2.To Design and simulate different filter circuits. 3.To observe operation and functioning of life saving equipment
Lab Outcomes (LOs):	1. Explain the basics of biomedical instrumentation. 2. Implement different filter circuits. 3. Design the basic timer circuit 4. Observe operation of lifesaving equipment. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	Study of X-ray Tubes	LO1,LO5,LO6	02
2.	Design of active notch filter for line frequency	LO2,LO5,LO6	02
3.	Design of general purpose amplifier for Bio potential measurement.		02
4.	Design of Pacemaker using 555 timer.	LO3,LO5,LO6	02
5.	Demonstration of Blood pressure measurement.	LO4,LO5,LO6	02
6.	Demonstration of Electrocardiogram recording.		02
7.	Demonstration of Electroencephalogram recording.		02
8.	Demonstration of Electromyogram recording.		02
9.	Demonstration of Photo-Colorimeter.		02
10.	Demonstration of Spectrophotometer.		02
11.	Demonstration of Auto-analyser.		02
12.	Demonstrations of Blood Cell counter.		02
13.	Demonstration of D C Defibrillator (proto type).		02
14.	Demonstration of Baby Incubator.		02
15.	Demonstration of X Ray machine.		02
16.	Demonstration of CT scanner.		02
17.	Demonstration of MRI machine.		02
18.	Demonstration of Ultrasound machine.		02

Virtual Lab Links:

https://bmi-iitr.vlabs.ac.in/

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Biomedical Instrumentation".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Course Code	Lab Name	Credits (P+TUT)
1UETDLL5053	**Neural Network and Fuzzy Logic Lab**	**(1+0)**

Lab Prerequisite:	Knowledge of a programming language (PYTHON /C /C++/ MATLAB recommended)
Lab Objectives:	1. To study different activation functions. 2. To implement different learning algorithms. 3. To implement different memory network algorithms. 4. To demonstrate Fuzzy logic and its applications.
Lab Outcomes (LOs):	After successful completion of the course students will be able to: 1. Implement different activation functions used in ANN. 2. Implement different Neuron models. 3. Demonstrate use of Associative Memory Network to calculate weight for given pattern. 4. Implement Supervised Neural Network to classify two-dimensional input patterns. 5. Implement Unsupervised Neural Network for given specification. 6. Implement fuzzy mathematical functions and its applications.

Lab No.	Experiment Title	LO mapped	Hrs./Lab
I.	Lab Prerequisite	---	02
1.	Implement different Activation functions.	LO1	02
2.	Implement McCulloch Pitts Neuron Model.	LO2	02
3.	Implement Hebbian learning.	LO4	02
4.	Implement Single layer perceptron neural network.		02
5.	Implement Multi-layer perceptron neural network.		02
6.	Implement Error Back propagation neural network.		02
7.	Implement Kohonen Self-organizing Feature Maps.	LO5	02
8.	Implement Auto Associative memory network.		02
9.	Implement Hetero Associative memory network.	LO3	02
10.	Implementation of Fuzzy Operations.	LO6	02
11.	Implementation of Fuzzy Relations (Max-min Composition)		02
12.	Implementation of Fuzzy Controller (Washing Machine)		02

Virtual Lab Links:

1. http://vlabs.iitkgp.ernet.in/scte/index.html#
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Neural Network and Fuzzy Logic".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
IUETDLL5054	Computer Organization and Architecture Lab	(1+0)

Lab Prerequisite:	1. Digital Logic Circuits 2. Knowledge of VHDL/Verilog
Lab Objectives:	1. Demonstrate the ability to implement and verify designs of varying complexity at the register-transfer-level.
Lab Outcomes (LOs):	1. Design the basic building blocks of a computer like adders 2. To implement various algorithms for arithmetic operations 3. To design memory subsystem including cache memory. 4. To implement memory management algorithms 5. To implement the control unit of a computer 6. To complete the work as per directions and on time

Lab No.	Experiment Title	LO mapped	Hrs./Lab
The following programs may be implemented using Verilog/VHDL or remote lab. At least 6 experiments to be performed			
I.	Lab Prerequisite	---	02
1.	Implement adder	LO1	02
2.	Implement ALU		02
3.	Implement Booth's algorithm	LO2	02
4.	Implement Microprogramming	LO5	02
5.	Hardwired control unit instruction generation		02
6.	Implement Division algorithms	LO2	02
7.	Implement Single bus CPU	LO1	02
8.	Fully associative Cache memory	LO3	02
9.	Set associative cache memory		02
10.	Page replacement policy, LRU/LFU etc	LO4	02
11.	Memory allocation algorithms, best fit/first fit		02

Virtual Lab Links:

1. http://vlabs.iitkgp.ac.in/coa/index.html
2 https://personal.ntu.edu.sg/smitha/ParaCache/Paracache/dmc.html
3 http://www.ecs.umass.edu/ece/koren/architecture/Cache/default.htm
4 https://wepsim.github.io

Term work:

1. Term work should consist of a Minimum of 8 experiments.
2. Journal must include at least 2 assignments on content of theory and practical of the course "Computer Organization and Architecture".
3. The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and Minimum passing marks in term work.
4. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks.

Lab Code	Lab Name	Credits (P+TUT)
1UETL506	**Business Communication & Ethics**	(1+0)

Lab Prerequisite	Fundamental knowledge of Professional Communication Skills as acquired in semester II.
Lab Objectives:	1. To discern and develop an effective style of writing important technical /business documents 2. To investigate possible resources and plan a successful job campaign 3. To comprehend the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement 4. To develop creative and impactful presentation skills 5. To have personal traits, interests, values, aptitudes and skills. 6. To understand the importance of integrity and develop a personal code of ethics
Lab Outcomes: (LOs):	At the end of the course, the student will be able to 1. Plan and prepare effective business/ technical documents which will in turn provide a solid foundation for their future managerial roles. 2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry. 3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations. 4. Deliver persuasive and professional presentations. 5. Develop creative thinking and interpersonal skills required for effective professional communication. 6. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour

Module No. & Name	Sub Topics	LO Mapped	Hrs/ Sub topic
I.	Lab Prerequisite	-	02
1.	Advanced Technical Writing: Project/ Problem Based Learning Classification of Reports, Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.), Time Interval (Periodic, One-time, Special), Function (Informational, Analytical, etc.) Physical Factors (Memorandum, Letter, Short & Long)	LO1, LO6	01
2.	Parts of a Long Formal Report, Prefatory Parts (Front Matter), Report Proper (Main Body) Appended Parts (Back Matter)		01
3.	Language and Style of Reports, Tense, Person & Voice of Reports Numbering Style of Chapters, Sections, Figures, Tables and Equations. Proofreading through Plagiarism Checkers		01
4.	Definition, Purpose & Types of Proposals Solicited (in conformance with RFP) & Unsolicited Proposals, Types (Short and Long proposals)		01
5.	Parts of a Proposal, Elements, Scope and Limitations,		01

	Conclusion		
6.	Technical Paper Writing, Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References), Language and Formatting Referencing in IEEE Format		01
7.	Employment Skills: Cover Letter & Resume, Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resume (Chronological, Functional & Combination)	LO2, LO4	01
8.	Verbal Aptitude Test Modelled on CAT, GRE, GMAT exams		01
9.	Group Discussions, Purpose of a GD, Parameters of Evaluating a GD,		01
10.	Types of GDs (Normal, Case-based & Role Plays)		01
11.	GD Etiquettes		01
12.	Personal Interviews, Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based), Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual		01
13.	Business Meetings: Conducting Business Meetings, Types of Meetings, Meeting etiquettes	LO3, LO6	01
14.	Documentation, Notice, Agenda, Minutes		01
15.	Technical/ Business Presentations: Effective Presentation Strategies, Defining Purpose, Analyzing Audience, Location and Event, Gathering, Selecting & Arranging Material	LO2, LO4	01
16.	Structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a Presentation		01
17.	Interpersonal Skills: Emotional Intelligence	LO5, LO6	01
18.	Motivation		01
19.	Assertiveness		01
20.	Time Management		02
21	Stress Management		02
22	Start-up Skills, Financial Literacy, Risk Assessment, Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	LO2, LO5	01
23	Corporate Ethics: Intellectual Property Rights, Copyrights, Trademarks, Patents	LO6	01
	Case Studies, Cases related to Business/ Corporate Ethics	LO1 to	01

		LO6	

Books	
Text Books	1. Sanjay Kumar & PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press. 2. Bovée, C. L., & Thill, J. V. (2021). *Business communication today*. Upper Saddle River, NJ: Pearson.
Reference Books	1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill. 2. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning. 3. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). Personal development for life and work. Mason: South-Western Cengage Learning. 4. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson. 5. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press. 6. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness. Oxford University Press

Useful Links:

1. Interview techniques (How to answer tell me about yourself)
https://www.youtube.com/watch?v=m5kR7TPAkSw

2. The 4 types of team members you can hire
https://www.youtube.com/watch?v=5bYYFfpbSqc

3. Every Meeting Ever
https://www.youtube.com/watch?v=K7agjXFFQJU

Assessment:

Term Work (25 marks):

Term work of 25 marks shall consist of a Minimum 8 Assignments.
The distribution of marks for term work shall be as follows:

Assignment	: 10 Marks
Attendance	: 5 Marks
Presentation slides	: 5 Marks
Book Report (hard copy)	: 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and Minimum passing in the term work.

Oral (25 Marks):
Oral Examination will be based on a GD & the Project/Book Report presentation

1.	Group Discussion :10 marks
2.	Project Presentation :10 Marks
3.	Group Dynamics in Report Writing :05 Marks

Project Based Learning Code	Project Based Learning Name	Credits (P+TUT)
1UETPR53	Minor Project Lab-1	(1+0)

PBL Prerequisite:	1. Mini Project – 1 and 2 2. Microcontroller Applications 3. Skill Base Lab : Python Programming
PBL Objectives:	1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.
PBL Outcomes (PROs):	Learner will be able to: 1. Identify the problem statement based on societal /research needs. 2. Design algorithms/flow chart for the system 3. Develop solution using suitable programming language 4. Apply hardware/software knowledge to develop solution 5. Excel in written and oral communication. 6. Demonstrate project management principles during project work.

Module No.	Module Title	PRO Mapped	Hrs./Module
1	Problem Definition and Project Planning: 1.1 Literature Survey, Problem Definition, Objectives of the project	PRO 1	02
	1.2 List of Input and Output (sensors, Actuators), list of components, Selection of Microprocessor/Microcontroller/Selection of Boards (Arduino/ ESP8266, etc.)		02
	1.3 Preparation of Gantt/PERT/CPM chart- weekly activity of mini project		02
2	Flow Chart/Algorithms: List the steps required to solve a problem, Preparation of Flow Chart/Algorithm	PRO 2	02
3	Programming: 3.1 Comparison Details between Assembly, C, Embedded C, Python.	PRO 3	02
	3.2 Simulation using Tinkercad / Proteus		02
4	Implementation: 4.1 Design of Board- Identify, list and purchase elements of a development board, Design the board	PRO 4	02
	4.2 Solder and Interface devices like sensors, keyboards and displays to the board		02
	4.3 Integration of Hardware and Software components, Testing, Debugging using Keil/Ardiuno		02
5	Report writing and presentation preparation: Documentation of the work done in a streamlined manner, Preparation and organisation of a report according to a standard format, Use of IEEE format of bibliography	PRO 5	04
6	Project presentation & Demonstration: Project Presentation using PPT and Demonstration of working model of the system	PRO 6	04
			26

Books:	
Reference Books	**1.** Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education (India) Private Limited, New Delhi, 2015, Edition 3rd. **2.** Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, New Delhi, 2009.

Useful Links:

1. https://ieeexplore.ieee.org/
2. https://www.electronicsforu.com/
3. https://www.keil.com/
4. https://www.tinkercad.com/
5. https://www.arduino.cc/

Guidelines for Minor Project:

1. Project is a group activity and students shall form a group of 2 to 3 students. A group shall not be more than three students.
2. Students will be assigned an open-ended problem which they will finalize according to their preferences and in consultation with the faculty supervisor.
3. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
4. A collaborative logbook will be prepared by each group, which will be verified regularly by; guide/supervisor can verify and record notes/comments.
5. The solution to be validated with proper justification and report to be compiled in standard format of the college.
6. The focus of project will be on self-learning, innovation, addressing societal problems and based solutions.

Guidelines for Assessment of Minor Project:

1. The review/ progress monitoring committee shall be constituted by faculty members in-charge and/or senior faculty members.
2. The progress of the mini project to be evaluated on a continuous basis, minimum two reviews per semester. Assessment also considers peer review by students and observation of ethics.
3. Report should be prepared as per the guidelines issued by the college.
4. Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of examiners.
5. In the case of a major project, the evaluation will be based on fulfilment of goals by the end of semester.

   Students shall be motivated to participate in poster & project competition.

Internal Assessment (IA):

Internal Assessment marks should be awarded based on review/s (Quality of the problem and Clarity, Innovativeness in solutions, Cost effectiveness and Societal impact) /quiz/etc. A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments

Term work (25 Marks):

Distribution of term work marks are,

1. Marks awarded by guide/supervisor based on log book : 10
2. Marks awarded by review committee : 10
3. Quality of Project report : 05

Practical (25 Marks):

Guidelines for Assessment of Minor Project Practical Examination:

1. Report should be prepared as per the guidelines issued by the University of Mumbai.
2. Minor Projects shall be assessed through a presentation and demonstration of working model by the

student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.

3. Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Distribution of practical marks are,

1. Presentation:5
2. Project Implementation:10
3. Project Report:10

Exposure (Skill Based Learning-VII) Code	Exposure (Skill Based Learning-VII)	Credits (P+TUT)
1UETXS57	Aptitude/Logic Building and Competitive Programming skills	(1+0)

SBL Prerequisite:	1.Knowledge of elementary mathematics (HSC level) 2 Knowledge of basic English grammar 3. Knowledge of Basic programming languages
SBL Objectives:	1.To have the basic awareness about how to prepare for recruitment process 2.To introduce the students to computational skills required to appear for recruitment tests. 3. To introduce the students to coding skills required to appear for recruitment tests.
SBL Outcomes:	1. Discuss the basic concepts of QUANTITATIVE ABILITY 2. Discuss the basic concepts of LOGICAL REASONING Skills 3. Acquire satisfactory competency in use of VERBAL REASONING 4. Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning and Verbal Ability 5. Use most common algorithms for competitive programming. 6. Analyse data structures for competitive up solving.

Module No.	Module Title	SO mapped	Hrs./Module
1.	Basics of Quantitative Abilities 1.1 Problems on Number System, Problems on HCF and LCM, Problems on Average.	SO1, SO4	04
	1.2 Problems on Ratio and Proportion, Problems on Percentage.		
2.	Arithmetic Quantitative Abilities 2.1 Problems on Ages, Problems on Profit and Loss		04
	2.2 Problems on Simple and Compound Interest, Problems on Time and Distance.		
3.	Logical Reasoning 3.1 Number Series, Alpha Numerical, Letter & Symbol Series	SO2, SO4	02
	3.2 Numerical and Alphabet Puzzles, Seating Arrangement		
4.	Programming Techniques 4.1 What is Competitive Programming? Programming Contests, Language Features	SO5	05
	4.2 Recursive Algorithms, Bit Manipulation		
5.	Sorting Algorithms, Solving Problems by sorting, Binary Search	SO6	05
			20

Books:

Text Books	1.Quantitative abilities by Arun Sharma 2. Quantitative Aptitude for Competitive Examinations by R S Agrawal 3. Verbal and Non-Verbal reasoning by R S Agrawal 4. Guide to Competitive Programming Learning and Improving Algorithms Through Contests Antti Laaksonen, Department of Computer Science, University of Helsinki, Finland
Reference Books	1. Algorithms Illuminated by Tim Roughgarden 2. Algorithm Design, Jon Kleinberg and Éva Tardos 3. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein 4. Competitive Programming 4: The Lower Bound of Programming Contests in the 2020s

	by Steven Halim and Felix Halim 5.Guide to Competitive Programming: Learning and Improving Algorithms Through Contests Antti Laaksonen.
Useful Links:	

1. https://doi.org/10.1007/978-3-319-72547-5
2. Algorithms by Jeff Erickson (freely available online)
3. https://onlinecourses.nptel.ac.in/noc21_cs99/preview
4. https://unacademy.com/a/i-p-c-beginner-track

Internal Assessment (IA):

IA shall be awarded based on

1. Students active participation in skill based learning.
2. Presenting/showcasing learned skills through Social /outreach/ extension activities/Events/ Competitions/Trainings/Internships etc;
3. Submission of Report/act/demonstrations/ specific participation/Idea creation/scope/creativity/Case study etc.

Assessment Rubrics	Insufficient (1)	Poor (2)	Acceptable (3)	Good (4)	Excellent (5)
Active Participation(5)					
Presentation (5)					
Report Submission(5)					
Achievement/Recognition(5)					

Exposure (Technology Based Learning-X) Code	Exposure (Technology Based Learning-X) Name	Credits (P+TUT)
1UETXT58	1.Online Certification Courses	(1+0)
	2.NPTEL certification	
	3.IITBs Spoken Tutorial	
	4.Swayam MOOCs	
	5.Coursera certification	
	6.Internshala Trainings	

Technology Prerequisite:	Basic Engineering and Technology courses
Technology Objectives:	1. To acquire competency in emerging areas of technology. 2. To create a mindset for life-long learning required to persist technological shifts and be abreast with the market trends. 3. To facilitate learning at self-paced schedules. 4. To boost time management ability and self-discipline. 5. To provide opportunities of strengthening digital footprints by showcasing the additional proficiency acquired as well as improve connectivity and networking. 6. To enhance employment and entrepreneurial opportunities requiring specialization.
Technology Outcomes (TOs):	1. Explain concepts of the emerging technology learned through the pursued course. 2. Describe social, ethical, and legal issues surrounding the learned technology. 3. Demonstrate professionalism and skills of digital age learning and working. 4. Demonstrate knowledge in entrance exams for higher technical education, placement interviews, and other avenues. 5. Analyze real-world case studies in society/industry for applicability of sustainable technological solutions. 6. Apply the acquired knowledge in developing technology-based solutions to real-world problems or other projects at hand.

Guidelines:

1. Learners should enrol for an online course based on their area of interest concerning emerging areas of technology in consultation with Faculty Supervisor nominated by the Head of Department.
2. The course duration should be of minimum 04 weeks.
3. Students should watch all the videos of the course to learn the course in-depth and entirety.
4. Students should solve weekly assignments that are to be submitted online within the prescribed deadline.
5. Students should register and appear for the course certification exam on scheduled date and time.
6. Students should submit the certificate of course completion to the Faculty Supervisor.
7. Faculty Supervisor shall monitor students' participation and progress at every stage — from course enrolment to certification.

Useful Links:

https://swayam.gov.in

https://www.nptel.ac.in

https://www.coursera.org

Internal Assessment (IA):

Internal Assessment shall be conducted for Total 20 Marks based on the following rubrics:

Performance Level	**Not Qualifying**	**Poor**	**Acceptable**	**Good**	**Excellent**
Marks	00	08	12	16	20
Compliance Status	Not Enrolled for any Course or Not Completed Course	Completed Course, Not Attempted Certification but Completed all Assignments.	Obtained Passing Grade or 40% of Total Score in Certification Exam **OR** Completed all Assignments with Score Above 70%.	Obtained First Class Grades or 60% of Total Score	Obtained Elite Grade or 75% of Total Score