Mahatma Education Society's

Pillai College of Engineering

(Autonomous)

Affiliated to University of Mumbai

Dr. K. M. Vasudevan Pillai's Campus, Sector 16, New Panvel – 410 206.

Department of Electronics and Telecommunication Engineering
Syllabus

of

B.Tech. in Electronics and Telecommunication Engineering

for

The Admission Batch of AY 2024-25

First Year - Effective from Academic Year **2024-25**

Second Year - Effective from Academic Year **2025-26**

Third Year - Effective from Academic Year **2026-27**

Fourth Year - Effective from Academic Year **2027-28**

as per

Choice Based Credit and Grading System

Mahatma Education Society's

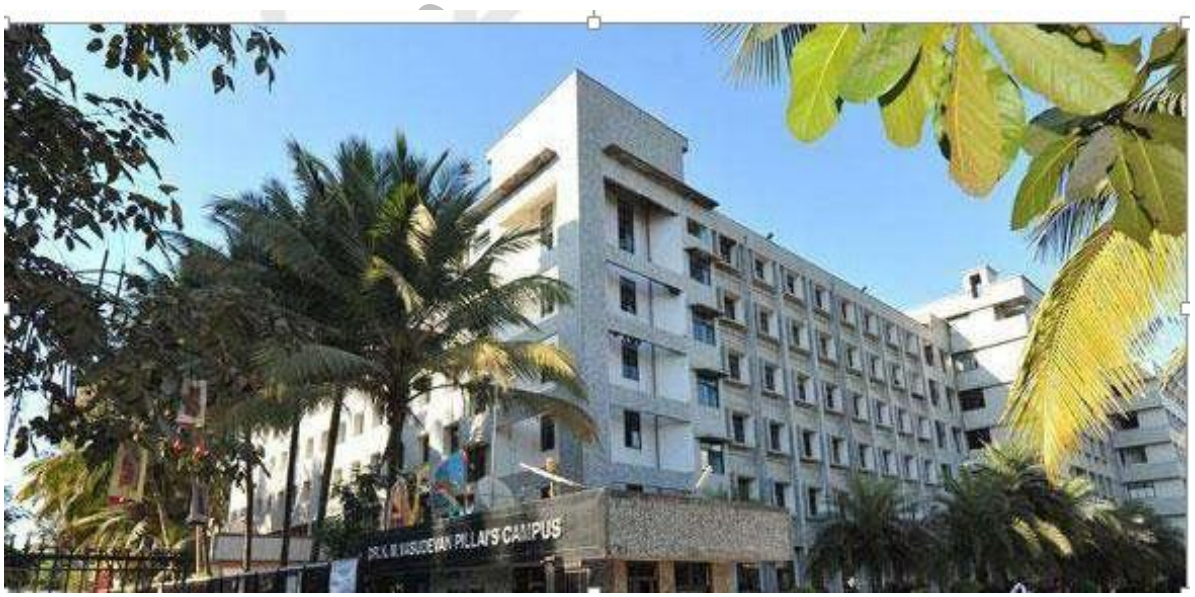
Pillai College of Engineering

Vision

Pillai College of Engineering (PCE) will admit, educate and train a diverse population of students who are academically prepared to benefit from the Institute's infrastructure and faculty experience, to become responsible professionals or entrepreneurs in a technical arena. It will further attract, develop and retain, dedicated, excellent teachers, scholars and professionals from diverse backgrounds whose work gives them knowledge beyond the classroom and who are committed to making a significant difference in the lives of their students and the community.

Mission

To develop professional engineers with respect for the environment and make them responsible citizens in technological development both from an Indian and global perspective. This objective is fulfilled through quality education, practical training and interaction with industries and social organizations.



Dr. K. M. Vasudevan Pillai's Campus, Sector - 16, New Panvel – 410 206

Department of Electronics and Telecommunication Engineering

Vision

Strive towards producing world class engineers who will continuously innovate, upgrade telecommunication technology and provide advanced, hazard-free solutions to the mankind. Inspire, educate and empower students to ensure green and sustainable society.

Mission

Benchmarking against technologically sound global telecommunication institutions with a view towards continuous improvement. Continually exposing students to scenarios that demand structuring of complex problems and proposing solutions. Educate students and promote values that can prevent further degradation of our planet. Becoming responsible citizens genuinely concerned with and capable of contributing to a just and peaceful world.

Program Educational Objectives (PEOs):

I. Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to analyze and solve challenging problems in Electronics and Telecommunication Engineering
II. Impart analytic and thinking skills to develop innovative ideas in the field of Telecommunication Engineering
III. To keep students up to date with the latest advancements in the field of Electronics and Telecommunication
IV. Inculcate qualities of leadership skills, multidisciplinary teamwork and an ability to adapt to evolving professional environment in the field of Engineering and Technology
V. To create awareness among the students towards ethical, social and environmental issues in the professional career

Program Outcomes:

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

1. Able to understand the concept of Basic Electronics, Network and Circuit Analysis, Analog and Digital circuits, Signals and System, Electromagnetics and apply them in various areas like Microwave Engineering, Wireless Communication, Digital image processing, Advance Communication systems etc.
2. Able to use techniques, skills, software, equipments and modern engineering tools necessary for Electronics and Telecommunication Engineers to identify, formulate and solve problems in industries and research work.
3. Able to work in multidisciplinary environment to provide socially acceptable technical solutions for complex communication engineering problems.

The Autonomous status of the institute has given an opportunity to design and frame the curriculum in such a way that it incorporates all the needs and requirements of recent developments in all fields within the scope of the Technical education. This curriculum will help graduates to attain excellence in their respective field. The curriculum has a blend of basic and advanced courses along with provision of imparting practical knowledge to students through minor and major projects. The syllabus has been approved and passed by the Board of Studies.

Outcome based education is implemented in the academics and every necessary step is undertaken to attain the requirements. Every course has its objectives and outcomes defined in the syllabus which are met through continuous assessment and end semester examinations. Evaluation is done on the basis of Choice Based Credit and Grading System (CBCGS). Optional courses are offered at department and institute level. Selection of electives from the same specialization makes the student eligible to attain a B. Tech. degree with respective specialization.

Every learner/student will be assessed for each course through (i) an Internal/Continuous assessment during the semester in the form of either Practical Performance, Presentation, Demonstration or written examination and (ii) End Semester Examination (ESE), in the form of either theory or viva voce or practical, as prescribed by the respective Board Studies and mentioned in the assessment scheme of the course content/syllabus. This system involves the Continuous Evaluation of students' progress Semester wise. The number of credits assigned with a course is based on the number of contact hours of instruction per week for the course. The credit allocation is available in the syllabus scheme of each semester.

The performance of a learner in a semester is indicated by a number called Semester Grade Performance Index (SGPI). The SGPI is the weighted average of the grade points obtained in all the courses by the learner during the semester. For example, if a learner passes five courses (Theory/labs./Projects/ Seminar etc.) in a semester with credits C1, C2, C3, C4 and C5 and learners grade points in these courses are G1, G2, G3, G4 and G5 respectively, then learners SGPI is equal to:

$$SGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4 + C_5G_5}{C_1 + C_2 + C_3 + C_4 + C_5}$$

The learner's up to date assessment of the overall performance from the time s/he entered for the programme is obtained by calculating a number called the Cumulative Grade Performance Index (CGPI), in a manner similar to the calculation of SGPI. The CGPI therefore considers all the courses mentioned in the scheme of instructions and examinations, towards the minimum requirement of the degree learners have enrolled for. The CGPI at the end of this semester is calculated as,

$$CGPI = \frac{C_1G_1 + C_2G_2 + C_3G_3 + \ldots + C_i * G_i + \ldots + C_nG_n}{C_1 + C_2 + C_3 + \cdots + C_i + \ldots + C_n}$$

The Department of Electronics and Telecommunication Engineering offers a B. Tech. programme in Electronics and Telecommunication Engineering. This is an eight semester course. The complete course is a 169 credit course which comprises core courses and elective courses. The elective courses

are distributed over 6 specializations. The specializations are:

Group 1: Smart Robotics and IoT driven Application Development

Group 2: Product Design

Group 3: VLSI Chip Design Technology

Group 4: Advanced Communication System

Group 5: Cloud Computing

Group 6: Data Science

The students also have a choice of opting for Institute level specializations. These are

1. IP Management and Digital Business
2. Business Management
3. Bio Engineering
4. Bio Instrumentation
5. Engineering Design
6. Sustainable Technologies
7. Contemporary Studies
8. Art and Journalism
9. Applied Science
10. Green Technologies
11. Maintenance Engineering
12. Life Skills
13. Environment and Safety

As minimum requirements for the credits to be earned during the B.Tech in Electronics and Telecommunication Engineering program, a student will have to complete a minimum of three specializations of which two are to be chosen from the department list and one has to be from the Institute level specialization list. In order to complete each specialization, a minimum of three courses under that specialization has to be completed. The credit requirement for the B.Tech. in Electronics and Telecommunication Engineering course is tabulated in Table 1.

Table 1. Credit Requirement for B.Tech in Electronics and Telecommunication Engineering

Category	Credits
Basic Sciences	26
Basic Engineering	18
Humanities and Social Sciences	10
Program Core	51
Program Electives	24
Open Electives	6
Project(s)	13
Internships/Seminars	8
Multidisciplinary	7
Co-curricular Courses,Liberal Learning	4
Indian Knowledge System	2
Total Credits	**169**

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester III

Course Code	Course Name	Category	Course Component	Teaching Scheme (Contact Hours)			Credits Assigned		
				Theory	Practical /Tutorial	Self Learning Evaluation	Theory	Practical /Tutorial	Total
MATH 201T	Engineering Mathematics III	ESC	T	3	2	1	3	1	4
EXTC 201	Electronics Devices	PCC	TL	3	2	1	3	1	4
EXTC 202	Network Theory	PCC	T	3	0	1	3	0	3
EXTC 203	Digital System Design	PCC	TL	3	2	1	3	1	4
EXTC 204	Signals and Systems	PCC	T	3	0	1	3	0	3
FIN 270	Personal Finance Management	VEC	T	2	0	1	2	0	2
HUM 270	Human Values and Social Ethics	HSSM	T	2	0	1	2	0	2
EXTC 293	Mini Project I	SKILL	LC	0	2	0	0	1	1
Total				**19**	**8**	**7**	**19**	**4**	**23**

Examination Scheme Semester III

Course Code	Course Name	Category	Theory					Term Work	Pract/ Oral	Total
			Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
			1	2	Avg					
MATH 201T	Engineering Mathematics III	ESC	40	40	40	60	2	25	-	125
EXTC 201	Electronics Devices	PCC	40	40	40	60	2	25	25	150
EXTC 202	Network Theory	PCC	40	40	40	60	2	-	-	100
EXTC 203	Digital System Design	PCC	40	40	40	60	2	25	25	150
EXTC 204	Signals and Systems	PCC	40	40	40	60	2	-	-	100
FIN 270	Personal Finance Management	VEC	20	20	20	40	2	-	-	50
HUM 270	Human Values and Social Ethics	HSSM	-	-	-	-	-	50	-	50
EXTC 293	Mini Project I	SKILL	-	-	-	-	-	25	25	50
	Total									**775**

T- Theory , L- Lab , P-Programming, C- Communication

Course Code	Course Name	Credits
MATH 201T	Engineering Mathematics III	04

Prerequisite:
Engineering Mathematics-I and Engineering Mathematics-II

Course Objectives:
1. To learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To understand the concept of Fourier series, its complex form and enhance the problem-skills.
3. To understand Matrix algebra for engineering problems
4. To understand the concept of Cauchy's integral formula and Cauchy's Residue Theorem and it's applications
5. To understand the concepts of Quadratic forms and Singular value decomposition.
6. To learn the importance of correlation and regression in analyzing data.

Course Outcomes:
The learner will be able to
1. Understand the concept of Laplace transform and its application to solve the real integrals, understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
2. Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
3. Apply the concepts of eigenvalues and eigenvectors in engineering problems.
4. Apply Cauchy's Integral formula and Cauchy's residue theorem to evaluate integrals over a given region.
5. Use the concept of Quadratic forms and Singular value decomposition which are very useful tools in various Engineering applications
6. Apply the concept of correlation and regression in analysis of data.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Laplace Transform**	Definition of Laplace transform and Laplace transform of standard functions, Properties of Laplace Transform: Linearity, First Shifting Theorem, change of scale Property, multiplication by t, Division by t, (Properties without proof). Inverse of Laplace Transform by partial fraction and convolution theorem.	07	CO1
		Self-Learning : Evaluation of integrals, Applications to solve initial and boundary value problems involving ordinary differential equations with one dependent variable.	05	

II	**Fourier Series**	Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L, Fourier series for even and odd functions, Half range sine and cosine Fourier series, Orthogonal and Ortho- normal functions, Complex form of Fourier series.	07	CO2
		Self Learning: Parseval's Identity,Fourier Integral Theorem,Fourier sine and cosine Integrals,Fourier Transforms	05	
III	**Linear Algebra Matrix Theory**	Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Functions of square matrix ,Derogatory and Non Derogatory matrices.	07	CO3
		Self Learning: Applications of Eigen values in Image processing	05	
IV	**Complex Integration**	Line Integrals,Cauchy's Integral theorem for simple connected and multiply connected regions (without proof),Cauchy's Integral formula (without proof). Taylor's and Laurent's series(without proof).Definition of singularity,zeroes,poles of f(z), Residues, Cauchy's Residue Theorem (without proof).	07	CO4
		Self Learning: Applications of Residue Theorem to evaluate real Integrals.	05	
V	**Quadratic Forms**	Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation. Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value- class of a quadratic form- Definite Semi definite and Indefinite. Reduction of Quadratic form to a canonical form using congruent transformations.	06	CO5
		Self Learning: Singular Value Decomposition.	05	
VI	**Fitting of curves, Correlation and Regression**	Fitting of first and second degree curves, Karl Pearson's coefficient of correlation, Spearman's coefficient of rank correlation, Lines of regression	05	CO6
		Self Learning: covariance, Fitting of exponential curves	04	

Tutorials

Sr. No.	Level 1.Basic 2.Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	Hours
1	**Basic**	Laplace Transform	**2**
		Self Learning: Examples based on applications of Laplace Transforms	**2**
2	**Advanced**	Inverse Laplace Transform	**2**
		Self Learning: Examples based on applications of Laplace Transforms	**2**
3	**Basic**	Fourier Series -1	**2**
		Self Learning: Problems on Parseval's Identity,Fourier Integral Theorem,	**2**
4	**Advanced**	Fourier Series -2	**2**
		Self Learning: Problems on Fourier sine and cosine Integrals,Fourier Transforms	**2**
5	**Basic**	Eigenvalues and eigen vectors;Cayley Hamilton Theorem,Diagonalisation of Matrices.	**2**
		Self Learning: verifying all the properties of Eigen values and solving problems.	**2**
6	**Advanced**	Functions of a square matrix	**2**
		Self Learning: Problems on functions of a square matrix for (3x3 matrices)& applications to Image Processing	**2**
7	**Basic**	Complex Integration-1	**2**
		Self Learning: Solving Problems based on Cauchy's Integral formulae	**2**
8	**Advanced**	Complex Integration-2	**2**
		Self Learning: Problems on applications of residue theorem to real Integrals.	**2**
9	**Basic**	Quadratic Forms-1	**2**
		Self Learning: Problems on Quadratic forms	**2**
10	**Advanced**	Quadratic Forms-2	**2**

		Self Learning: Problems on singular value decomposition	**2**
11	**Basic**	Curve Fitting	**2**
		Self Learning: Problems on Fitting of exponential curves	**2**
12	**Advanced**	Correlation	**2**
		Self Learning: Real life application problems on correlation	**2**
13	**Advanced**	Regression	**2**
		Self Learning: Real life application problems n regression	**2**

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be the average score of both the tests.

End Semester Examination: 60 Marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Term work Assessment:

The distribution of Term work marks
Assignment on entire syllabus: 10 Marks
Tutorials on entire syllabus: 10 Marks
Attendance (Theory, Tutorials): 5 Marks

Text Books and References:

1. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
2. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
3. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
4. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
5. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
6. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
7. Mathematical Statistics, J.N.Kapur and H.C.Saxena , S.Chand Publications
8. Scilab spoken tutorials videos. (https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English)

Subject Code	Subject Name	Credits
EXTC 201	Electronics Devices	04

Prerequisite:
Basic Electrical Engineering

Course Objectives:

1. To explain functionality of different electronic devices.
2. To understand characteristics, application, different Biasing Techniques of BJT,JFET and MOSFET.
3. To explain amplifiers and analyze frequency response of small signal amplifiers
4. To compare small signal and large signal amplifiers.
5. To explain the working of Feedback amplifiers and oscillators.
6. To explain the working of differential amplifiers.

Course Outcomes: The learner will be able to

1. Analyze the functionality, V-I characteristics, application of different electronic devices.
2. Understand the importance of Biasing, input and output characteristics and evaluate different parameters of BJT and MOSFET using Biasing Techniques.
3. Evaluate the different parameters of a small signal amplifier using the Hybrid pi model.
4. Evaluate frequency response to understand behavior of single and multistage BJT and MOSFET Amplifier.
5. Understand working of different power amplifier circuits, their design and use in electronics and communication circuits.
6. Understand working of differential amplifiers, Feedback amplifiers and Oscillators.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Introduction of Electronic Devices**	Study of pn junction diode characteristics and diode current equation. VI Characteristics, BJT, FET, Zener diode as voltage regulator, Schottky diode, LED, Applications of Diode : Limiter circuits, Rectifiers (Half wave and Full wave), Clamper, Clipper.	06	CO1
		Self Learning: Simulation experiments or small projects demonstrating application of diode, transistors.	04	
II	**Transistors**	Configuration of BJT, JFET,MOSFET, Operating region (BJT and MOSFET), Characteristics of BJT and MOSFET, JFET, biasing circuits of BJT and MOSFET, JFET, DC load Line, Q point and Stability factor. MODFET (i.e. HEMT), MESFET and HBT, Application of BJT and MOSFET.	07	CO2

		Self Learning: Study difference between BJT, MOSFET, HEMT, MESFET and HBT in the form of a quiz.	05	
III	**Frequency Response of Amplifiers**	Hybrid pi model, Ebers-Moll Model , CE Amplifier, CS Amplifier. Frequency response concept, Bandwidth of an amplifier, Effect of coupling capacitors, bypass capacitors and internal capacitors on frequency response. Low frequency response, High frequency response (BJT and MOSFET)	07	CO3
		Self Learning: Solving Problems on this topic.	05	
IV	**Power Amplifier (Large signal Amplifier)**	Compare small signal amplifiers and large signal amplifier, Introduction of Power Amplifiers, Classification of Power Amplifier, Class A power amplifier, Class B Power Amplifier, Class AB and Class C Power Amplifier, Types of Power Amplifier, Distortion in Amplifier, Temperature Effects, Heat Sink	08	CO4
		Self Learning: Study the characteristics of each power amplifier using simulation software.	04	
V	**Feedback and Oscillator**	Feedback Concepts , Feedback Connection Types ,Practical Feedback Circuits, Feedback Amplifier ,Oscillator Operation , Types of Transistor Oscillator (LC, Colpitts, Hartley, Phase-Shift, Wien Bridge)	05	CO5
		Self Learning: Study the working and also the application of different oscillators.	03	
VI	**Differential Amplifiers**	Basic Differential Amplifier (BJT and FET) , Common-Mode Rejection Ratio, Differential- and Common-Mode Gains, Differential and Common-Mode Input Impedances, BI CMOS CIRCUITS , BiCMOS Differential Amplifier, Multistage (Darlington Pair and Simple Emitter-Follower Output)	06	CO6
		Self Learning: Quiz or assignments on topic of BI CMOS Circuits.	04	

Lab Prerequisite:

Basic Electrical and Electronics Laboratory

Software Requirements:

LTSpice

Hardware Requirements:

Breadboard, Transistors, Resistors, Diodes, Connecting wiresLab Objectives:

The objective of this course is

1. To provide the fundamental concepts of voltage and current characteristics of Diodes.
2. To familiarize with the important applications of zener diodes.
3. To design and study the CE and CS amplifiers characteristics.
4. To familiarize with biasing circuits and characteristics of EMOSFETs and DMOSFET
5. To simulate design and analysis of Multistage and differential amplifiers.

Lab Outcomes:

1. Able to analyze the characteristics of PN junction diodes.
2. Able to Analyze and understand the zener diode as a Voltage Regulator.
3. Able to analyze and implement the different biasing circuits of BJT, MOSFET.
4. Able to analyze and simulate the characteristics of BJT , MOSFET.
5. Able to design and implement the frequency response of a single stage BJT amplifier.
6. Able to simulate the frequency response of a CS amplifier.
7. Able to simulate and design the characteristics of multi stage and also differential amplifiers.

Sr. No.	**Level** Basic Design Advanced Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	**Basic**	Demonstrate VI Characteristics of PN junction diodes on bread board and simulate one application of diode in LT Spice	2
2	**Basic**	Demonstrate VI Characteristics of Zener Diode on bread board and simulate one application of zener diode in LT Spice	2
3	**Design**	Design BJT fixed biasing and Voltage divider circuits.	2
4	**Design**	Demonstrate VI Characteristics of Mosfet using LT Spice	2
5	**Design**	Design and Implement frequency response of a single stage BJT CE amplifier.	2
6	**Design**	Design a Common Source Amplifier (N-JFET) using voltage divider bias.	2
7	**Design**	Demonstrate VI Characteristics of JFET using LT Spice	2

8	**Advanced**	Design and Implement frequency response of a multistage amplifier	2
9	**Advanced**	Implement Class A Power Amplifier using LTSpice	2
9	**Advanced**	Implement Class C Power Amplifier using LTSpice	2
10	**Advanced**	Implement Differential Amplifier using LTSpice	2

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be the average score of both the tests.

End Semester Examination: 60 Marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Lab Assessments:

1. Term work Assessment: At least 08 Experiments including 02 simulations covering the entire syllabus must be given during the ―Laboratory session batch wise". Computation/simulation-based experiments are also encouraged. The experiments should be student centric and attempts should be made to make experiments more meaningful, interesting and innovative. Application oriented one mini-project can be conducted for a maximum batch of four students. Term work assessment must be based on the overall performance of the student with every experiment/tutorials and mini-projects (if included) are graded from time to time.

2. Oral/Viva Assessment: The practical and oral examination will be based on the entire syllabus.

Text Books:

1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2ndEdition.
2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications," International Version, OXFORD International Students, 6thEdition
3. Franco, Sergio. Design with operational amplifiers and analog integrated circuits. Vol. 1988. New York: McGraw-Hill, 2002.

References:

1. Boylestad and Nashelesky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition.
2. A. K. Maini, "Electronic Devices and Circuits," Wiley.
3. T. L. Floyd, "Electronic Devices,"Prentice Hall, 9th Edition, 2012.
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition
5. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

Subject Code	Subject Name	Credits
EXTC 202	Network Theory	03

Prerequisite:

1. Basic Electrical Engineering
2. Engineering Mathematics

Course Objectives:

1. To evaluate the Circuits using network theorems.
2. To analyze the Circuits in time and frequency domain.
3. To study network Topology, network Functions and two port networks.
4. To synthesize passive network by various methods.

Course Outcomes: The learner will be able to

1. Apply their knowledge in analyzing Circuits by using network theorems.
2. Apply the knowledge of graph theory for analyzing the circuits.
3. Find transient and steady state response of a circuit using time and frequency domain analysis methods.
4. Find the network functions
5. Understand the concept of Two port networks and distinguish between various two port network parameters.
6. Synthesize the network using passive elements.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Electrical circuit analysis**	Circuit Analysis: Analysis of Circuits with and without dependent sources using generalized loop and node analysis, super mesh and super node analysis technique. Circuit Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems (Use only DC source).	08	CO1
		Self Learning: Practice problems on Thevenins, Maximum Power Transfer Theorem, Superposition Theorem	10	
II	**Graph Theory**	Objectives of graph theory, Linear Oriented Graphs, graph terminologies Matrix representation of a graph: Incidence matrix, Circuit matrix, Cut-set matrix, reduced Incident matrix, Tieset matrix, f-cutset matrix. Relationship between sub matrices A, B & Q. KVL & KCL using matrix	05	CO2

		Self Learning: Practice problems on finding Incidence, Tieset and Cutset Matrix.	07	
III	**Time and frequency domain analysis**	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equation with step signals. Frequency domain analysis of R-L-C Circuits: Forced and natural response, effect of damping factor. Solution using second order equation for step signal.	07	CO3
		Self Learning: Practice problem on finding current and voltages for transient circuits of RL, RC and RLC. Frequency domain analysis of RLC circuits	09	
IV	**Network functions**	Network functions for the one port and two port networks, driving point and transfer functions, Poles and Zeros of Network functions, necessary condition for driving point functions, necessary condition for transfer functions, testing for Hurwitz polynomial. Analysis of ladder network (Up to two nodes or loops)	06	CO4
		Self Learning: Practice problems on finding driving point impedances and hurwitz polynomial	08	
V	**Two port Networks**	Parameters: Open Circuits, short Circuit, Transmission and Hybrid parameters, relationship among parameters, conditions for reciprocity and symmetry. Interconnections of Two-Port networks T & π representation.	07	CO5
		Self Learning: Practice problems on finding parameters, parameter conversion, interrelationship and interconnections	09	
VI	**Synthesis of RLC circuits**	Positive Real Functions: Concept of positive real function, necessary and sufficient conditions for Positive real Functions. Synthesis of LC, RC Circuits: properties of LC, RC driving point functions, LC, RC network Synthesis in Cauer-I &Cauer-II , Foster-I & Foster-II forms (Up to Two Loops only).	06	CO6
		Self Learning: Practice problems on Positive Real Function,Synthesis of RC and LC circuits	08	

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be the average of score of both the tests.End Semester Examination: 60 Marks

Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Text Books:

1. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd ed. ,1966.
2. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000.

References:

1. A. Chakrabarti, "Circuit Theory", Dhanpat Rai & Co., Delhi, 6th Edition.
2. A. Sudhakar, Shyammohan S. Palli "Circuits and Networks", Tata McGraw-Hill education
3. Smarajit Ghosh "Network Theory Analysis & Synthesis", PHI learning.
4. K.S. Suresh Kumar, "Electric Circuit Analysis" Pearson, 2013.
5. D. Roy Choudhury, "Networks and Systems", New Age International, 1998.

Subject Code	Subject Name	Credits
EXTC 203	Digital System Design	04

Prerequisite: None

Course Objectives:

1. To understand number representation and conversion between different representations in digital electronic circuits.
2. To analyze logic processes and implement logical operations using combinational logic circuits.
3. To understand concepts of sequential circuits.
4. To analyze sequential systems in terms of state machines.
5. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA
6. To understand the use of VHDL for simulation of combinational and sequential circuits.

Course Outcomes: The learner will be able to

1. Develop a digital logic and apply it to solve real life problems.
2. Analyze, design and implement combinational logic circuits.
3. Analyze, design sequential logic circuits
4. Implement sequential logic circuits.
5. Analyze digital system design using PLD.
6. Simulate and implement combinational and sequential circuits using VHDL systems.

Sr.No.	Module	Detailed Content	Hours	CO Mapping
I	**Principles of combinational logic**	Review of Number System, Binary Code, Binary Coded Decimal, Octal Code, Hexadecimal Code Gray Code and their conversions, Binary Arithmetics, Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables.	05	CO1
		Self Learning: Submit a sheet with at least 10 conversion problems with solutions. NPTEL Video Link: https://www.youtube.com/watch?v=yLP0vFSbCLg Submit a scanned notebook of K-Map solutions. **K-Map Solver :**(https://www.dcode.fr/karnaugh-map-solver)	06	

II	**Analysis and design of combinational logic**	Half adder, Full adder, Half Subtractor, Full Subtractor and BCD adder. Binary Multiplier, Magnitude Comparator, Multiplexer and Demultiplexer: Multiplexer operations, cascading of Multiplexer, Boolean Function implementation using multiplexer and basic gates, demultiplexer, encoder and decoder	07	CO2
		Self Learning: Simulate the MUX using Logisim or Tinkercad Circuits. Submit the Screenshots of simulation + explanation. Logisim:(https://github.com/logisim-evolution/logisim-evolution) YouTube: "Designing Multiplexers in Logisim"	06	
III	**Sequential Logic Circuits**	Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO, Universal shift registers. Counters: Asynchronous and Synchronous, Up/Down, MOD N, BCD	07	CO3
		Self Learning: Submit a hand-drawn sheet of tables & timing diagrams. Design a 3-bit binary up counter circuit diagram.Simulate it in Logisim.submit Screenshot of counter output in simulation.	04	
IV	**Applications of Sequential Circuits**	Frequency division, Ring Counter, Johnson Counter. models, State transition diagram, Introduction to Moore and Mealy circuits-Design(Designing is not expected) .	08	CO4
		Self Learning: Prepare a short note: 1) Difference between ring counter & Johnson counter. 2) Difference between Moore and Mealy circuits-Design. Submit the scanned copy .	04	
V	**Programmable Logic Devices**	Introduction : Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic(PAL), CPLD and FPGA	05	CO5

		Self Learning: NPTEL Video : E.g. Prof. Indranil Hatai's NPTEL on FPGA Draw block diagrams,and solve examples and submit the scanned copy	04	
VI	**Introduction to VHDL Design**	Introduction to VHDL: Introduction to to Hardware Description Language, Core features of VHDL, data types, concurrent and sequential statements,data flow, behavioral, structural architectures, subprograms, Examples like Adder, subtractor, Multiplexers, De-multiplexers, decoder and FlipFlops	07	CO6
		Self Learning: Write simple codes in each style and submit the doc file : **Dataflow:**4-bit adder using with-select / when-else **Behavioral:** 4:1 MUX using process and case **Structural:** Build a full adder from half adders.	04	

Theory Assessment:
Internal Assessment: 40 marks
Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be the average of score of both the tests.

End Semester Examination: 60 Marks
Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Text Books:

1. John F. Warkerly, "Digital Design Principles and Practices", Pearson Education, Fourth Edition (2008).
2. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Education, Third Edition (2003).
3. J. Bhaskar, "VHDL Primer", PHI, Third Edition (2009).
4. Volnei A. Pedroni, "Digital Electronics and Design with VHDL" Morgan Kaufmann Publisher (2008)

References:

1. Morris Mano / Michael D. Ciletti, "Digital Design", Pearson Education, Fourth Edition (2008).
2. Thomas L. Floyd, "Digital Fundamentals", Pearson Prentice Hall, Eleventh Global Edition (2015).
3. Mandal, "Digital Electronics Principles and Applications", McGraw Hill Education, First Edition (2010).
4. Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital Logic Design with

VHDL", Second Edition, TMH (2009).
5. Ronald J. Tocci, Neal S. Widmer, "Digital Systems Principles and Applications", Eighth Edition, PHI (2003)
6. Donald P. Leach / Albert Paul Malvino/Gautam Saha, "Digital Principles and Applications", The McGraw Hill, Seventh Edition (2011).

Lab Prerequisite:
Basic Electrical and Electronics Laboratory

Software Requirements:
VHDL

Hardware Requirements:
Breadboard, Different digital IC, Resistors, Diodes, Connecting wires

Lab Objectives:
The objective of this course is

1. To provide the fundamental concepts associated with digital logic and circuit design.
2. To introduce the basic concepts and laws involved in the designing and implementation of combinational logic circuits
3. To familiarize with the combinational circuits such as Multiplexers and Demultiplexers
4. To familiarize Sequential circuits utilized in the different digital circuits and systems.
5. To simulate design and analysis of the digital circuit and system using VHDL.

Lab Outcomes:

1. Able to develop a digital logic and apply it to solve real life problems.
2. Able to Analyze, design and implement combinational logic circuits such as adders and Subtractors.
3. Able to analyze combinational circuits such as Mux & Demux Able to analyze and convert Flip-Flops
4. Able to implement sequential circuits such as counters and shift registers.
5. Able to Simulate and implement combinational and sequential circuits using VHDL systems.

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	**Basic**	To implement basic gates using universal gates.	2
2	**Design**	To design Half adder & Full adder	2
3	**Basic**	To verify the operation of Multiplexer	2
4	**Basic**	To verify the operation of Demultiplexer	2
5	**Design**	Verification of Truth table and conversion of FlipFlop	2
6	**Design**	Universal shift register	2
7	**Design**	Design an asynchronous counter	2
8	**Design**	Design a synchronous counter	2

9	**Advanced**	Modeling different types of gates: (a) 2-input NAND (b) 2-input OR gate (c) 2-input NOR gate (d) NOT gate (e) 2-input XOR gate (f) 2-input XNOR gate	2
10	**Advanced**	Modeling (a) Half-adder (b) Full-adder	2

Subject Code	Subject Name	Credits
EXTC 204	Signals and Systems	03

Prerequisite:

Engineering Mathematics III

Course Objectives:

1. To identify, classify and analyze various types of signals and systems
2. To analyze time Domain analysis of continuous and discrete time signals and systems.
3. To Analyze the continuous and discrete time signals and systems in frequency domain using Fourier Transform.
4. To analyze, formulate and solve problems on frequency domain analysis of continuous time systems using Laplace Transform.
5. To analyze, formulate and solve problems on frequency domain analysis of discrete time systems using Z- Transform.
6. To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.

Course Outcomes:

1. Classify and analyze various types of signals and systems.
2. Determine convolution integral and convolution sum.
3. Analyze the continuous and discrete time signals and systems in frequency domain using Fourier Transform.
4. Analyze, formulate and solve problems on frequency domain analysis of continuous time systems using Laplace Transform.
5. Analyze, formulate and solve problems on frequency domain analysis of discrete time systems using Z- Transform.
6. Understand the concept of FIR and IIR system

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction of Continuous and Discrete Time Signals and systems**	Introduction to Signals: Definition of Signals , Representation of continuous time signals and discrete time signals, Sampling theorem(only statement derivation not expected), sampling of continuous time signals Basic Elementary signals , Arithmetic operations on the signals- Time Shifting, Time scaling, Time Reversal of signals Classification of Continuous time signals and Discrete time signal Introduction to Systems: Definition of Systems , Classification of Continuous time systems and Discrete time systems	08	CO1
		Self Learning:- Solving problems based on the module	10	
2	**Time domain analysis of continuous time and discrete time systems**	Linear Time Invariant (LTI) systems, Convolution integral and Convolution sum for analysis of LTI systems Correlation of Signals: Auto-correlation and Cross correlation of Discrete time signal	07	CO2
		Self Learning:- Solving problems based on the module	09	
3	**Fourier Analysis of Continuous and Discrete Time Signals and Systems**	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform(Property Derivations are not expected), Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, ,Limitations of Fourier Transform	05	CO3
		Self Learning:- Solving problems based on the module	08	

4	**Frequency domain analysis of continuous time system using Laplace transform**	Definition of Laplace Transform (LT),Region of Convergence (ROC), Properties of Laplace transform(Property Derivations are not expected), Inverse Laplace transform. Analysis of continuous time LTI systems using Laplace Transform: Causality and stability of systems in s-domain, Total Response of the system, Relation between LT and FT	06	CO4
		Self Learning:- Solving problems based on the module	09	
5	**Frequency domain analysis of discrete time system using Z-transform**	Definition of unilateral and bilateral Z Transform, Region of Convergence (ROC),Properties of Z- Transform, Inverse Z-Transform (Partial fraction method only) Analysis and characterization of the LTI system using Z transform: Transfer Function and difference equation, plotting Poles and Zeros of a transfer function, causality, stability, Total response of a system. Relation between Laplace Transform and Z–Transform, Relation between Fourier Transform and Z–Transform	09	CO5
		Self Learning:- Solving problems based on the module	09	
6	**FIR and IIR systems**	Concept of finite impulse response systems and infinite impulse response systems, Linear Phase FIR systems. Realization structures of LTI Discrete time system: Direct form –I and direct form II, Linear Phase FIR structures.	04	CO6
		Self Learning:- Solving problems based on the module	06	

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be the average of score of both the tests.

End Semester Examination: 60 Marks

Weightage of each module in the end semester examination will be proportional to the number of

respective lecture hours mentioned in the curriculum.

Text Books:

1. NagoorKani, “Signals and Systems”, Tata McGraw Hill, Third Edition, 2011
2. Tarun Kumar Rawat, “Signals and Systems”, Oxford UniversityPress 2016.
3. Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley and Sons, Second Edition,2004.

References:

1. Hwei. P Hsu, “Signals and Systems”, Tata McGraw Hill, Third edition, 2010
2. Rodger E Ziemer, William H. Tranter and D. Ronald Fannin, “Signals and Systems”, Pearson Education, Fourth Edition 2009.
3. Alan V. Oppenhiem, Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”, Prentice-Hall of India, Second Edition, 2002.

Online Repository:

https://onlinecourses.nptel.ac.in/noc21_ee28/preview
https://nptel.ac.in/courses/108104100

Subject Code	Subject Name	Credits
FIN 270	Personal Finance Management	02

Course objectives: The course is aimed

1. To understand the fundamentals of budgeting and create effective personal budgets.
2. Gain knowledge of investment options, risk and returns for informed decision making.
3. Learn how to assess insurance needs
4. Implement tax - saving strategies for financial security
5. To know the various financial scams and frauds & to overcome them.

Course outcomes: On successful completion of course learner/student will be able:

1. Understand the principles of budgeting and to integrate personal financial planning concepts into real - world scenarios
2. Comprehend various investment types, risk and returns
3. Develop skills to assess insurance needs and select appropriate coverage
4. Master tax planning strategies for effective tax management
5. Identify and prevent financial scams and fraud

Theory Syllabus

Module No	Module	Detailed Contents	Hrs.
1	Budgeting	1. Understanding income & expenses: - Identifying sources of income, tracking expenses, balancing necessary Vs. discretionary spending. 2. Creating a Personal Budget: - Applying budgeting methods (e.g., 50/30/20 rule), setting financial goals and allocating for savings and debt repayment. 3. Budgeting Tools and Techniques: - Exploring budgeting apps and tools to automate savings and expense tracking.	5
		Self Learning: - 1. Preparation of personal budget 2. Exploring budgeting apps commonly used, e.g. Money View	7
2	Investment	1. Types of Investment: Equities (stocks), Fixed income (bonds), Real Estate and Mutual Funds/ ETFs. 2. Understanding investment risks: Market risk, credit risk, liquidity risk and interest rate risk. 3. Risk and return relationship: How risk affects returns, diversification and assessing personal risk tolerance. 4. Evaluating investment opportunities: Analysing potential investments and choosing based on financial goals and risk profile.	6
		Self Learning: - 1. Investment ideas w.r.t. "Intelligent Investor" Book by	7

		Benjamin Graham 2. Exploring various safe investments such as Post Office RD, Bank FD, etc.	
3	Insurance	1. Types of insurance: Health, Life, Disability, Auto and Property Insurance. 2. Key Insurance concepts: Premiums, deductibles, coverage limits and policy terms, Grace Period, Free Look period and revival of policy. 3. Evaluating insurance needs: Calculating the right coverage for personal risk and financial security 4. Choosing the right insurance products: Comparing different policies, terms and conditions based on personal needs.	5
		Self Learning: - 1. Exploring the cases on the rejection of claims by Insurance Co. 2. Exploring the IRDA regulatory concepts on Insurance	7
4	Tax Planning	1. Tax Savings Strategies: Contribution to tax-advantaged accounts and using tax-efficient investments 2. Tax deductions: Common deductions like mortgage interest, medical expenses, and charitable contributions. 3. Tax Exemptions: Exemptions for personal income, dependent exemptions and specific retirement income 4. Understanding tax planning tools: Leveraging tools and resources to maximize tax efficiency.	5
		Self Learning: 1. Exploring the cases related to Tax Evasion. 2. Exploring the heads of income under IT Act, 1961 3. Exploring the New and Old Tax Regimes	7
5	Financial Scams & Frauds	1. Common Financial Scams: Ponzi Schemes, Phishing, Identity theft and online fraud. 2. Recognizing Red Flags of Fraud: Identifying warning signs of financial scams. 3. Preventing Financial Scams: Best practices for protecting personal information and avoiding scams. 4. Reporting Scams: How to report financial fraud to relevant authorities like FTC, SEC and local consumer agencies.	5
		Self Learning: 1. Exploring cases on Scams	6

Here are five academic reference books for **Personal Financial Planning**:

1. **"Personal Financial Planning"** Lawrence J. Gitman, Michael D. Joehnk, Pearson Education
2. **"Personal Finance: A Practical Guide"**, Randy D. Brown, South-Western College Publishing
3. **"Financial Planning: A Guide to Personal Finance"**, Peter J. S. Brow, McGraw-Hill Education
4. **"Principles of Personal Financial Planning"**, Michael J. O'Hara, Cengage Learning
5. **"Financial Planning: Theory and Practice"**, E. Thomas Garman, Raymond E. Forgue, Cengage

Learning

Subject Code	Subject Name	Credits
HUM 270	Human Values and Social Ethics	02

Course Objectives: The objective of the course is four fold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes: By the end of the course, students are expected-

1. To become more aware of themselves, and their surroundings (family, society, nature);
2. To recognize the relationship between ethics and values pertinent for engineering professionals.
3. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
4. They would have better relevance of values, ethics in social work and importance of human relationship.
5. They would have a better understanding of ethics in technical writing.
6. They would have knowledge of fair practices in technology development.

SN	Details	Hours
1	**Ethics and Values** : Meaning & Concept of Ethics Difference between Ethics and Values. Ethical code of conduct for students in family, society, pear groups, social media. Development of a holistic perspective based on self-exploration.	06
	Self Learning : Self exploration by activities	07
2	**Professional Ethics** : Professional Ethics vs Personal ethics Components of professional ethics Professional values and its importance	05
	Self Learning: case studies	07
3	**Ethics and Society** : Relevance of values and ethics in social work Ethical dilemmas Values and ethical principles of social work · Service · Dignity and worth of a person · Importance of Human relationships · Integrity · Competence · Social Justice	05
	Self Learning: case studies	07
4	**Ethics in Technical writing** : Documenting sources, Presentation of Information, Ethics & Plagiarism	05
	Self Learning: Paraphrase Practice , **Plagiarism exercises**	07
5	**Ethics and Technology Development** : Risk management and Individual rights, Moral issues in development and application of technology Privacy/confidentiality of information Managing Technology to ensure fair practices	05
	Self Learning:Case studies	06

Assessment:

Term Work : 50 Marks (Continuous Evaluation)
Students will have to submit five assignments (one on each module). They will have to prepare PPTs in a group of 3 / 4 students on one case study in each module and give a presentation in a classroom.

Reference Books:

1. Martin Cohen, *101 Ethical Dilemmas* Routledge, 2nd edition, 2007.
2. M. Govindarajan, S. Natarajan & V.S. Senthilkumar, *Professional Ethics and Human Values,* Prentice Hall India Learning Private Limited, 2013.
3. Mike W. Martin, *Ethics in Engineering,* McGraw Hill Education; Fourth edition, 2017.
4. Science & Humanism Towards a Unified Worldview….. (P L Dhar & R R Gaur)
5. A foundation course on Human Values & Professional Ethics… (R R Gaur, R Sangal & G P Bagaria)

Subject Code	Subject Name	Credits
EXTC 293	Mini Project I	02

Lab Prerequisite:

Basic Electrical and Electronics Engineering (BEEE/BEE), C programming

Lab Objectives:

L1. To make students familiar with the basics of electronic devices and circuits, electrical circuits and digital systems
L2. To familiarize the students with the designing and making of GPP
L3. To make students familiar with the basics Microcontroller, Arduino board and Arduino IDE (Integrated Development Environment)
L4. To familiarize the students with the programming and interfacing of different devices with Arduino Board
L5. To acquaint with the process of identifying the needs and converting it into the problem.
L6. To familiarize the process of solving the problem in a group

Lab Outcomes:

The learner will be able to

LO1. Identify basic electronic components and to design basic electronic circuits.
LO2. Learn the technique of soldering and circuit implementation on general purpose printed circuit board (GPP).
LO3. Utilize the basic electronic tools and equipments (like DMM, CRO, DSO etc.) and also perform analysis of hardware fault (Fault detection and correction)
LO4. Write basic codes for the Arduino board using the IDE for utilizing the onboard resources.
LO5. Apply the knowledge of interfacing different devices to the Arduino board to accomplish a given task.
LO6. Identify problems based on societal /research needs , design Arduino based projects for a given problem and demonstrate capabilities of self-learning in a group, which leads to lifelong learning.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for mini projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
- A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand the problem effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate. The solution to be validated with proper justification and report to be compiled in standard format.
- With the focus on self-learning, innovation, addressing societal problems and

entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project in semester III and IV.

Software Requirements:
Eagle:https://www.autodesk.in/products/eagle/overview
Arduino IDE: https://www.arduino.cc/en/main/software

Hardware Requirements: Arduino Board and various interfacing devices as mentioned in syllabus

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	1,2	**Identification and Designing of Circuit** 1.1 Identification of a particular application with understanding of its detailed operation. Study of necessary components and devices required to implement the application. 1.2 Designing the circuit for particular application (either analog , digital, electrical , analog and digital, etc)	LO1
2	2,3	**Software simulation and Implementation on GPP** 2.1 Simulation of circuit for particular application using software's to verify the expected results 2.2 Implementation of verified circuit on general purpose printed circuit board (GPP). Now Verify the hardware results by using electronic tools and equipment like millimeter, CRO, DSO etc.	LO2,LO3
3	2,3	**Detection of Hardware faults, Result verification and understanding Troubleshooting** 3.1 Identify the hardware faults in designed circuit and subsequently rectify it 3.2 Now again verify the hardware results by using electronic tools and equipments like millimeter, CRO, DSO etc. 3.3 Understand the trouble shooting by removing some wired connections. 3.4 Understand the trouble shooting of track. Troubleshoot the faculty components or devices	LO3

4	1,2	**Introduction to Arduino Uno board and integrated development environment (IDE)** 4.1 Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software	LO4
5	2,3	**GPIO (along with Analog pin) Programming** 5.1 Introduction to programming GPIO, Analog and PWM PINS. 1 Interface any Digital Sensors to the Arduino board and display sensor values on the serial Monitor. 2 Interface any Analog sensor to the Arduino board and display sensor values on the serial Monitor. 3. Generate varying duty cycle PWM using Arduino. 5.2 Controlling output devices/Displaying Introduction to different sensor (Analog and Digital), Relays, Motors and display. 1 Interface an Analog Sensor to the Arduino board and display sensor values on LCD/TFT/Seven segment Display. 2 Interface a temperature sensor to an Arduino and switch on a relay to operate a fan if temperature exceeds a given threshold. Also display the temperature on any of the display device	LO4, LO5
6	2,3	**Interfacing Communication Devices and Cloud Networking** 6.1 Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods. 1 Interface Wi-Fi /Bluetooth/GSM/Zigbee/RF module to Arduino and program it to transfer sensor data wirelessly between two devices. Any two techniques from the above-mentioned modules needs to be interfaced 6.2 Identify problems based on societal /research needs and design Arduino based projects for a given problem	LO4, LO5,LO6
	Project	**Sample Projects** 1. Waste Management System 2. Smart City Solutions 3. Energy Monitoring Systems 4. Smart Classrooms and learning Solutions 5. Home security systems 6. Smart Agriculture solutions 7. Healthcare solutions. 8. Industrial Applications 9. IoT Applications 10. Robotics	LO1,LO2, LO3,LO4, LO5, LO6

Self Learning :
Self Learning Hours:- 30 Hrs
https://spoken-tutorial.org/media/videos/85/Arduino-Brochure-English.pdf https://spoken-

tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English

Lab Assessments:

Teamwork, Practical and Oral: The review/ progress monitoring committee shall be constituted by the heads of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, minimum two reviews in each semester. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Distribution of Term work marks for both semesters shall be as below

- Marks awarded by guide/supervisor based on log book : 10
- Marks awarded by review committee : 10
- Quality of Project report : 05

Two reviews will be conducted for continuous assessment, First shall be for finalization of problem and proposed solution Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact Innovativeness
7. Cost effectiveness and Societal impact
8. Full functioning of working model as per stated requirements
9. Effective use of skill sets
10. Effective use of standard engineering norms
11. Contribution of an individual's as member or leader
12. Clarity in written and oral communication

Guidelines for Assessment of Mini Project Practical/Oral Examination:

Report should be prepared as per the guidelines issued by the Guide. Mini Project shall be assessed through a presentation and demonstration of the 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 the head of Institution. Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms

7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Textbook:

Arduino for Dummies,by John Nussey (2013)

References:

1. R S Khandpur, "Printed circuit board", McGraw-Hill Education; 1st edition, 24 February , 2005.Arduino Projects for Dummies, by Brock Craft (2013)
2. Programming Arduino –Getting Started with Sketches, Simon Monk (2016)
3. Programming Arduino -Next Steps, by Simon Monk (2016)

Online Repository:

1. GitHub
2. NPTEL Videos on Arduino Programming
3. Spoken Tutorial Project-IIT Bombay: https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English
4. Teachers are recommended to use a free online simulation platform "Tinkercad" for the simulation of Arduino based circuits before the students implement it in the hardware: https://www.tinkercad.com/