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 2022-23

First Year - Effective from Academic Year **2022-23**

Second Year - Effective from Academic Year **2023-24**

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

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

as per

Choice Based Credit and Grading System

Mahatma Education Society's

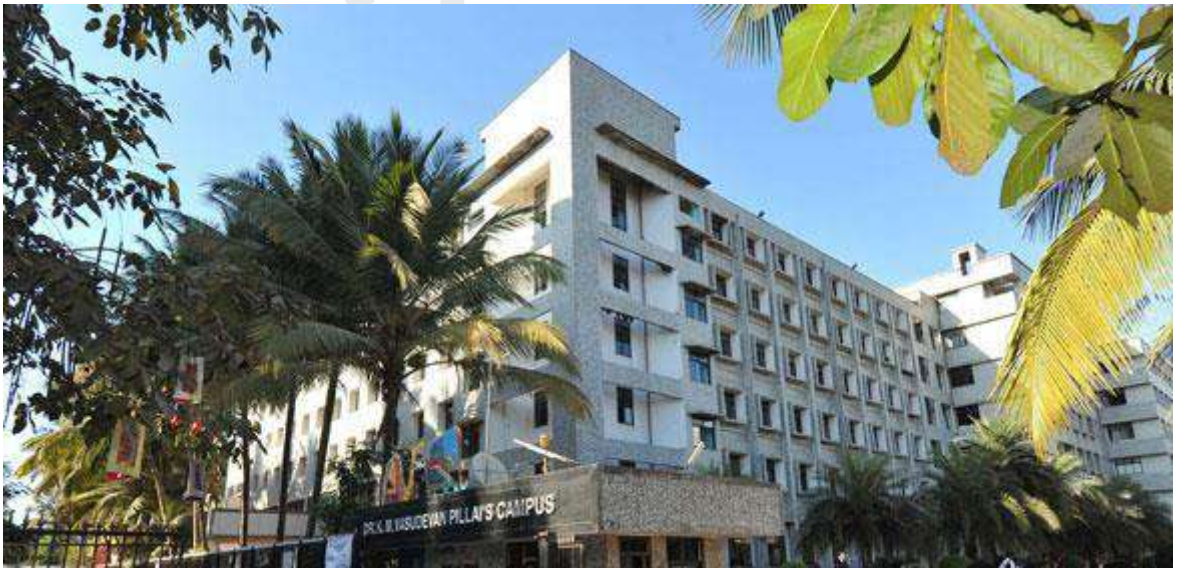
Pillai College of Engineering

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 162 credit course which comprises core courses and elective courses. The elective courses are distributed over 4 specializations. The specializations are:

1. Group 1: Internet of Things
2. Group 2: Product Design
3. Group 3: Advanced Communication System
4. Group 4: Cloud Computing

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

1. Business and Entrepreneurship
2. Bio Engineering
3. Engineering Design
4. Art and Humanities
5. Applied Science
6. Life Skills, Repair, Maintenance 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
Humanities and Social Sciences including Management courses	9
Basic Science courses	26
Engineering Science courses including workshop, drawing, basics of Electrical/ Mechanical/ Computer etc	10
Professional core courses	53
Program Specific Elective Courses	24
Institute Electives	6
Project work, seminar and internship in industry or elsewhere	24
Innovation/Skill Based Learning	11
Total Credits	**163**

Proposed Program Structure for

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester I

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
FY 101	Engineering Mathematics I	TL	3	2	3	1	4
FY 103	Engineering Physics I	TL	2	1	2	0.5	2.5
FY 105	Engineering Chemistry I	TL	2	1	2	0.5	2.5
FY 107	Basic Electrical Engineering	TL	3	2	3	1	4
FY 111	C Programming	TLP	3	2	3	1	4
FY117	Basic Workshop Practice-I	L	-	2		1	1
Total			**13**	**10**	**13**	**5**	**18**

Examination Scheme Semester I

Course Code	Course Name	Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
FY 101	Engineering Mathematics I	40	40	40	60	2	25	-	125
FY 103	Engineering Physics I	30	30	30	45	2	25	-	100
FY 105	Engineering Chemistry I	30	30	30	45	2	25	-	100
FY 107	Basic Electrical Engineering	40	40	40	60	2	25	25	150
FY 111	C Programming	40	40	40	60	2	25	25	150
FY117	Basic Workshop Practice-I	-	-	-	-	-	50	-	50
Total									**675**

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

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester II

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
FY 102	Engineering Mathematics II	TL	3	2	3	1	4
FY 104	Engineering Physics II	TL	2	1	2	0.5	2.5
FY 106	Engineering Chemistry II	TL	2	1	2	0.5	2.5
FY 108	Engineering Mechanics and Graphics	TL	2	4	2	2	4
FY 112	Python Programming	TLP	3	2	3	1	4
FY 114	Professional Communication and Ethics I	TLC	2	2	2	1	3
FY118	Basic Workshop Practice-II	L		2		1	1
Total			**14**	**14**	**14**	**7**	**21**

Examination Scheme Semester II

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
FY 102	Engineering Mathematics II	40	40	40	60	2	25	-	125
FY 104	Engineering Physics II	30	30	30	45	2	25	-	100
FY 106	Engineering Chemistry II	30	30	30	45	2	25	-	100
FY 108	Engineering Mechanics and Graphics	40	40	40	60	2	25	50	175
FY 112	Python Programming	40	40	40	60	2	25	25	150
FY 114	Professional Communication and Ethics I	20	20	20	30	1	-	25	75
FY118	Basic Workshop Practice-II	-	-			-	50		50
Total									**775**

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

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester III

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 201	Engineering Mathematics III	T	3	1	3	1	4
ET 202	Electronics Devices	TL	3	2	3	1	4
ET 203	Network Theory	T	3	-	3	-	3
ET 204	Digital System Design	TL	3	2	3	1	4
ET 205	Signals and Systems	T	3	-	3	-	3
ET 206	Python Programming II	LP	-	2	-	1	1
ET 291	Mini Project I	LC	-	2	-	2	2
Total			**15**	**10**	**15**	**6**	**21**

Examination Scheme Semester III

Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 201	Engineering Mathematics III	40	40	40	60	2	25	-	125
ET 202	Electronics Devices	40	40	40	60	2	25	25	150
ET 203	Network Theory	40	40	40	60	2	-	-	100
ET 204	Digital System Design	40	40	40	60	2	25	25	150
ET 205	Signal and Systems	40	40	40	60	2	-	-	100
ET 206	Python Programming II	-	-			-	25	25	50
ET 291	Mini Project I	-	-			-	25	25	50
Total									**725**

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

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester IV

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 207	Engineering Mathematics IV	T	3	2	3	1	4
ET 208	Electronic Communication Systems	TL	3	2	3	1	4
ET 209	Linear Integrated Circuits	TL	3	2	3	1	4
ET 210	Digital Signal Processing	T	3	2	3	1	4
ET 211	Microprocessor & Microcontroller	TL	3	2	3	1	4
ET 212	Personal Finance Management	T	2	-	2	-	2
ET 292	Mini Project II	LC	-	2	-	2	2
	Internship*	-	-	-	-	-	-
Total			**17**	**12**	**17**	**7**	**24**

Examination Scheme Semester IV

Course Code	Course Name	Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 207	Engineering Mathematics IV	40	40	40	60	2	25		125
ET 208	Electronic Communication Systems	40	40	40	60	2	25	25	150
ET 209	Linear Integrated Circuits	40	40	40	60	2	25	25	150
ET 210	Digital Signal Processing	40	40	40	60	2	25	25	150
ET 211	Microprocessor & Microcontroller	40	40	40	60	2	25	25	150
ET 212	Personal Finance Management	20	20	20	40	2	-	-	60
ET 292	Mini Project II	-	-			-	25	25	50
Total									**835**

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

* Internship is desirable but not mandatory

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester V

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 301	Digital Communication	TL	3	2	3	1	4
ET 302	Image Processing & Machine Vision	T	3	-	3	-	3
ET 303	Embedded Systems	TL	3	2	3	1	4
ET 304	Programming (Java and Scripting)	LP	-	2	-	1	1
ET 305	Professional Communication & Ethics II	TLC	2	2	-	2	2
ET 3xx	Elective I A	TL	3	2	3	1	4
ET 3xx	Elective II A	TL	3	2	3	1	4
ET 391	Mini Project III	LC	-	2	-	2	2
Total			**17**	**14**	**15**	**9**	**24**

Examination Scheme Semester V

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 301	Digital Communication	40	40	40	60	2	25	25	150
ET 302	Image Processing & Machine Vision	40	40	40	60	2	-	-	100
ET 303	Embedded Systems	40	40	40	60	2	25	25	150
ET 304	Programming (Java and Scripting)	-	-	-	-	-	25	25	50
ET 305	Professional Communication & Ethics II	-	-	-	-	-	50	-	50
ET 3xx	Elective I A	40	40	40	60	2	25	25	150
ET 3xx	Elective II A	40	40	40	60	2	25	25	150
ET 391	Mini Project III	-	-			-	25	25	50
Total									**850**

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

Department Elective is to be chosen from Group I and Group II. One Elective from each group.

<table>
<tr><th>Specialization</th><th colspan="2">Group I</th><th>Specialization</th><th colspan="2">Group II</th></tr>
<tr><th>Semester V Electives</th><th>IOT</th><th>Product Design</th><th>Semester V Electives</th><th>Advanced Communication System</th><th>Cloud Computing</th></tr>
<tr><td rowspan="4">Course Code
Course Name
DLOC I A</td><td rowspan="2">ET 307</td><td rowspan="2">ET 308</td><td rowspan="4">Course Code
Course Name
DLOC II A</td><td>ET 309</td><td>ET 311</td></tr>
<tr><td>Data Processing and Coding</td><td>Database Management</td></tr>
<tr><td rowspan="2">IOT Basics & Smart sensors</td><td rowspan="2">PCB Design and Electronics Equipment Troubleshooting</td><td>ET 310</td><td>ET 312</td></tr>
<tr><td>TV & Video Engineering</td><td>Computer Communication & Network</td></tr>
</table>

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester VI

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 309	Wireless & Mobile Communication	T	3	-	3	-	3
ET 310	Electromagnetic Wave & Radiating Systems	T	3	-	3	-	3
ET 311	WM & AT Lab	L	-	2	-	2	2
ET 312	R Programming	LP	-	2	-	1	1
ET 3xx	Elective I B	TL	3	2	3	1	4
ET 3xx	Elective II B	TL	3	2	3	1	4
IL 3xx	Institute Elective I#	T	3		3	-	3
ET 392	Final Year Project A	LC	-	2	-	2	2
	Internship*	-	-	-	-	-	-
Total			**12**	**10**	**15**	**7**	**22**

Examination Scheme Semester VI

Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 309	Wireless & Mobile Communication	40	40	40	60	2	-	-	100
ET 310	Electromagnetic Wave & Radiating Systems	40	40	40	60	2	-	-	100
ET 311	WM & AT Lab	-	-	-	-	-	50	25	75
ET 312	R Programming	-	-	-	-	-	25	25	50
ET 3xx	Elective I B	40	40	40	60	2	25	25	150
ET 3xx	Elective II B	40	40	40	60	2	25	25	150
IL 3xx	Institute Elective I#	40	40	40	60	2			100
ET 392	Final Year Project A	-	-	-	-	-	50	25	75
	Internship*	-	-	-	-	-	-	-	-
Total									**800**

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

* Internship is desirable but not mandatory

In continuation with chosen department specialization, one department Elective is to be chosen from group I.
Second department Elective is to be chosen from group II
Institute elective is to be chosen from any of the Institute level groups

<table>
<tr><th>Specialization</th><th colspan="2">Group I</th><th>Specialization</th><th colspan="2">Group II</th></tr>
<tr><th>Semester VI Electives</th><th>IOT</th><th>Product Design</th><th>Semester VI Electives</th><th>Advanced Communication System</th><th>Cloud Computing</th></tr>
<tr><td rowspan="5">Course Code
Course Name
DLOC I B</td><td rowspan="2">ET 313</td><td rowspan="2">ET 314</td><td rowspan="5">Course Code
Course Name
DLOC II B</td><td>ET 315</td><td>ET 318</td></tr>
<tr><td>Speech and Audio Processing</td><td rowspan="4">Advanced Networking Technologies</td></tr>
<tr><td rowspan="3">Robotics and Automation</td><td rowspan="3">Electronic Product Design</td><td>ET 316</td></tr>
<tr><td>Radar Engineering</td></tr>
<tr><td>ET 317</td></tr>
<tr><td></td><td></td><td></td><td>Optical Communication</td></tr>
</table>

#NOTE: Institute level Specializations and Electives will be updated soon.

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester VII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 401	Microwave & RF Design	T	3	2	3	1	4
ET 402	Human Values and Social Ethics	T	2	-	2	-	2
ET 4xx	Elective I C	TL	3	2	3	1	4
ET 4xx	Elective II C	TL	3	2	3	1	4
IL 4xx	Institute Elective II#	T	3	-	3	-	3
ET 491	Final Year Project B	LC	-	8	-	4	4
Total			**11**	**14**	**14**	**7**	**21**

Examination Scheme Semester VII

Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 401	Microwave & RF Design	40	40	40	60	2	25	25	150
ET 402	Human Values and Social Ethics	-	-	-	-	-	50	-	50
ET 4xx	Elective I C	40	40	40	60	2	25	25	150
ET 4xx	Elective II C	40	40	40	60	2	25	25	150
IL 4xx	Institute Elective II#	40	40	40	60	2	-	-	100
ET 491	Final Year Project B	-	-	-	-	-	100	50	150
Total									**750**

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

In continuation with chosen department specialization, one department Elective is to be chosen from group I.
In continuation with chosen department specialization, second department Elective is to be chosen from group II
In continuation with chosen department specialization, Institute elective is to be chosen from any of the Institute level groups

<table>
<tr><th>Specialization</th><th colspan="2">Group I</th><th>Specialization</th><th colspan="2">Group II</th></tr>
<tr><th>Semester VII Electives</th><th>IOT</th><th>Product Design</th><th>Semester VII Electives</th><th>Advanced Communication System</th><th>Cloud Computing</th></tr>
<tr><td rowspan="5">Course Code
Course Name
DLOC I C</td><td>ET 403</td><td rowspan="2">ET 405</td><td rowspan="5">Course Code
Course Name
DLOC II C</td><td>ET 406</td><td>ET 409</td></tr>
<tr><td>AI In Neural Network</td><td>Blockchain for Communication</td><td rowspan="4">Cloud Computing</td></tr>
<tr><td rowspan="2">ET 404</td><td rowspan="3">Communication System Design and Integration</td><td>ET 407</td></tr>
<tr><td>AIML in Communication Systems</td></tr>
<tr><td>Wearable Devices and Industrial IoT applications</td><td>ET 408</td></tr>
<tr><td colspan="3"></td><td>MIMO System for 5G</td></tr>
</table>

#NOTE: Institute level Specializations and Electives will be updated soon.

Bachelor of Technology in Electronics and Telecommunication

Semester VIII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 492	Final Year Project C	LC	-	8	-	4	4
ET493	Internship		-	-	-	8	8
Total			**-**	**8**	**-**	**12**	**12**

Examination Scheme Semester VIII

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 492	Final Year Project C	-	-			-	100	50	150
ET 493	Internship	-	-			-		200	200
Total									**350**

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

Course Code	Course Name	Credits
ET 201	Engineering Mathematics III	3+1

Prerequisite:
Engineering Mathematics-I and Engineering Mathematics-2

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 complex variables, C-R equations with applications.
5. To understand the concepts of Quadratic forms and Singular value decomposition.
6. To Learn Fourier Integral, Fourier Transform and Inverse fourier transform.

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. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
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 fourier transform and its inverse in engineering problems.

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.	7	1
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.	7	2

III	**Linear Algebra Matrix Theory**	Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Functions of square matrix ,Derogatory and Non Derogatory matrices.	7	3
IV	**Complex Variables and Conformal mappings**	Function f(z) of complex variable, Introduction to Analytic function: Necessary and sufficientconditions for f(z) to be analytic,Cauchy-Riemann equations in Cartesian coordinates, Milne-Thomson method: Determine analytic function f(z)when real part(u) and imaginary part (v),Conformal mapping, Linear and Bilinear mappings, cross ratios	7	4
V	**Quadratic Forms**	Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal formusing congruent transformation. Rank, Index and Signature of quadratic form, Sylvester's law of inertia, Value- class of a quadratic form- Definite Semidefinite and Indefinite. Reduction of Quadratic form to a canonical form using congruent transformations. Singular Value Decomposition.	7	5
VI	**Fourier Transform**	Fourier Integral Representation, Fourier Transform and Inverse Fourier transform of constant and exponential function.	4	6

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**
2	**Advanced**	Inverse Laplace Transform	**2**
3	**Basic**	Fourier Series -1	**2**
4	**Advanced**	Fourier Series -2	**2**
5	**Advanced**	Eigenvalues and eigenvectors;	**2**
6	**Advanced**	Cayley-Hamilton Theorem and its applications.	**2**

6	**Basic**	Complex Variables	**2**
7	**Advanced**	Conformal Mappings	**2**
8	**Basic**	Quadratic Forms-1	**2**
9	**Advanced**	Quadratic Forms-2	**2**
10	**Basic**	Fourier Transform	**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:

The distribution of term work marks -

1. Attendance - 05 marks
2. Assignments -10 marks
3. Tutorials- 10 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. Scilab spoken tutorials videos. (https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English)

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Subject Code	Subject Name	Total
ET 202	Electronic Devices	3+1

Prerequisite:
Basic Electrical Engineering

Course Objectives:

1. To explain functionality of different electronic devices.
2. To perform DC and AC analysis of small signal amplifier circuits.
3. To analyze frequency response of small signal amplifiers
4. To compare small signal and large signal amplifiers.
5. To explain working of differential amplifiers and its applications in Operational amplifiers

Course Outcomes: The learner will be able to

1. Analyze the functionality and applications of various electronic devices with the help of V-I characteristics.
2. Derive expressions for performance parameters of BJT and MOSFET based electronic circuits.
3. Evaluate frequency response to understand behavior of BJT and MOSFET based Electronics circuits.
4. Understand working of different power amplifier circuits, their design and use in electronics and communication circuits.
5. Understand working of E-MOSFET differential amplifiers and E-MOSFET current sources.
6. Select and Design electronic circuits for given specifications.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Introduction of Electronic Devices**	Study of pn junction diode characteristics & diode current equation. Application of zener diode as a voltage regulator. Construction, working and characteristics of BJT, D-MOSFET, and E-MOSFET	5	CO1
II	**Biasing Circuits of BJTs and MOSFETs**	Concept of DC load line, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias) DC load line and region of operation for MOSFETs. Analysis and design of biasing circuits for DMOSFET (self bias and voltage divider bias), E-MOSFET (Drain to Gate bias & voltage divider bias).	6	CO2

III	**Small Signal Amplifiers**	Concept of AC load line and Amplification, Small signal analysis (Zi, Zo, Av and Ai) of CE amplifiers using hybrid pi model ONLY. Small signal analysis (Zi, Zo, Av) of CS (for EMOSFET) amplifiers. Introduction to multistage amplifiers.(Concept, advantages & disadvantages)	7	CO2, CO6
IV	**Frequency response of Small signal Amplifiers**	Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance. High and low frequency analysis of BJT CE amplifiers. High and low frequency analysis of CS (E-MOSFET) amplifiers.	7	CO3,CO6
V	**Large Signal Amplifiers**	Difference between small signal & large signal amplifiers. Classification and working of Power amplifiers. Analysis of Class A power amplifier (Series fed and transformer coupled). Transformer less Amplifier: Class B power amplifier. Class AB power amplifier. Thermal considerations and heat sinks	7	CO4
VI	**Introduction to Differential Amplifiers**	E-MOSFET Differential Amplifier, DC transfer characteristics operation with common mode signal and differential mode signal Differential and common mode gain, CMRR, differential and common mode Input impedance. Two transistor (E-MOSFET) constant current source	7	CO5

Lab Prerequisite:
Basic Electrical and Electronics Laboratory
Software Requirements:
LTSpice
Hardware Requirements:
Breadboard, Transistors, Resistors, Diodes, Connecting wires

Lab 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 DMOSFETs
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 study the input and output characteristics of CE BJT
4. Able to analyze and implement the different biasing circuits of BJT
5. Able to study and analyze the frequency response.
6. Able to Simulate and understand the MOSFET characteristics.
7. Able to analyze and simulate the biasing of MOSFETs.
8. Able to simulate the frequency response of a CS amplifier.
9. Able to simulate and design the characteristics of multi stage and also differential amplifier.

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	Hours
1	**Basic**	Study of VI Characteristics of PN junction diodes.	2
2	**Basic**	To study zener diode VI Characteristics.	2
3	**Basic**	To study zener as a voltage regulator.	2
4	**Design**	To study input and output characteristics of CE BJT configuration.	2
5	**Design**	To study BJT fixed biasing and Voltage divider circuits.	2
6	**Advanced**	To study frequency response of a single stage BJT CE amplifier.	2
7	**Design**	Simulation experiment to study EMOSFET / DMOSFET biasing circuits.	2
8	**Design**	Simulation experiment to study Drain and Transfer Characteristics of MOSFET	2
9	**Design**	Simulation experiment on study frequency response of CS amplifier.	2
10	**Advanced**	Simulation experiment on study of differential amplifiers.	2
11	**Advanced**	To study frequency response of multistage amplifier	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 workAssessment: 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.

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Subject Code	Subject Name	Total
ET 203	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
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
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

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
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.	06	CO5
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).	07	CO6

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.

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Subject Code	Subject Name	Total
ET 204	Digital System Design	3+1

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
II	**Analysis and design of combinational logic**	Half adder, Full adder, Half Subtractor, Full Subtractor,Ripple Carry adder, Carry Look ahead adder 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
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	07	CO3

		registers. Counters: Asynchronous and Synchronous, Up/Down, MOD N, BCD		
IV	**Applications of Sequential Circuits**	Frequency division, Ring Counter, Johnson Counter. models, State transition diagram, Design of Moore and Mealy circuits-Design of vending Machine	08	CO4
V	**Programmable Logic Devices**	Introduction : Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic(PAL), CPLD and FPGA	05	CO5
VI	**Introduction to VHDL Design**	Introduction to VHDL Design of Combinational circuits using VHDL: Introduction 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. Design of Sequential circuits using VHDL: VHDL code for flip flop, counters.	07	CO6

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
4.Able to analyze and convert Flip-Flops
5. Able to implement sequential circuits such as counters and shift registers.
6. Able toSimulate 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

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Subject Code	Subject Name	Total
ET 205	**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	**CO 1**

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	**CO 2**
3	**Fourier Analysis of Continuous and Discrete TimeSignals 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	**CO 3**
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	**CO 4**
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	**CO 5**
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**

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.

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Subject Code	Subject Name	Total (Credits)
ET 206	Python Programming II	01

Lab Prerequisite: Python Programming I

Lab Objectives:
L1.Describe the core syntax and semantics of Python programming language.
L2. Infer the Object-oriented Programming concepts in Python
L3. Using database operations in python like mysql.
L4. Formulate GUI Programming and Image processing in Python
L5. To introduce advanced python libraries like Numpy, Pandas, Matplotlib, Seaborn, Scipy.
L6.Develop applications using a variety of libraries and functions

Lab Outcomes: The learner will be able to
LO1: Describe syntax and semantics in Python
LO2: Infer the Object-oriented Programming concepts in Python
LO3: Using database operations in python like mysql.
LO4: Design GUI Applications in Python
LO5: Express proficiency in handling Python libraries for data science LO6: Develop applications using Python

Software Requirements: Python IDE, Anaconda Environment, mysql workbench, Google Colab to run python scripts

Hardware Requirements: NA

Sr. No	Level 1. Basic 2. Design 3. Advanced 4.Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Basic	**Python Fundamentals** 1.1 Basics of Control Statements, Functions, Classes, Objects and Exceptions **OOPS and Exception handling** 1.2 Creating classes, Inheritance, polymorphism, Encapsulation, Abstraction difference between exceptions and error, exception handling with try and except, Custom exception handling, Best practice exception handling 1.4 File handlings	LO1

2	Design	**2. OOPS and Exception handling** 2.1 Creating classes, Inheritance, polymorphism, Encapsulation, Abstraction 2.2 difference between exceptions and error, exception handling with try and except, Custom exception handling, Best practice exception handling	LO2
3	Design	**3. Using Databases in Python** 3.1 Python MySQL Database Access Install the MySQLdb and other Packages 3.2 Create Database Connection CREATE, INSERT, READ Operation DML and DDL Operation with Databases	LO3
4	Advanced	**4. Graphical User Interface And Image Processing** 4.1 Graphical User Interface using Tkinter Library module, Creating simple GUI; Buttons, Labels, entry fields, widget attributes. 4.2 Database: Sqilite database connection, Create, Append, update, delete records from database using GUI. 4.3 Basic Image Processing using OpenCV library, simple image manipulation using image module	LO4
5	Advanced	**5. Numpy, Pandas, Matplotlib, Seaborn, Scipy** 5.1 Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy. 5.2 Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation. 5.3 Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn. 5.4 Introduction to Scipy, ScipySub packages Integration and Optimization.	LO5
6	Project	**6. Python Applications** 6.1 Build a project based on GUI applications 6.2 Applications in Networking, Data Analytical Tools, Introduction To Ml, Introduction To Big Data 6.3 Django Web Framework in Python Introduction to MVC and MVT architecture in Web development Django folder structure and flow of control, Web Scraping, Beautiful Soup package	LO6

Lab Assessments:

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

Text Books:

1. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
2. Zed A. Shaw, "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", Addison Wesley; 3 edition (1 October 2013).
3. YashavantKanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications; 1 edition (8 July 2019).
4. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT Publisher August 2015.
5. John Grayson, "Python and Tkinter Programming", Manning Publications (1 March 1999).

References:

1. Eric Matthes, "Python Crash Course A hands-on, Project Based Introduction to programming" No Starch Press; 1 edition (8 December 2015).
2. Paul Barry, "Head First Python" O′Reilly; 2 edition (16 December 2016)
3. Andreas C. Mueller, "Introduction to Machine Learning with Python", O′Reilly; 1 edition (7 October 2016)
4. David Beazley, Brian K. Jones, "Python Cookbook: Recipes for Mastering Python 3", O'Reilly Media; 3 edition (10 May 2013).
5. Bhaskar Chaudhary, "Tkinter GUI Application Development Blueprints: Master GUI programming in Tkinter as you design, implement, and deliver 10 real world application", Packt Publishing (November 30, 2015)

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Subject Code	Subject Name	Total (Credits)
ET 291	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	LO4

		Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software	
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

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
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. 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.

2. Arduino Projects for Dummies, by Brock Craft (2013)
3. Programming Arduino –Getting Started with Sketches, Simon Monk (2016)
4. 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/

Back to Scheme

Course Code	Course Name	Credits
ET 207	**Engineering Mathematics IV**	3+1

Prerequisite:
Engineering Mathematics-I , Engineering Mathematics-II and Engineering Mathematics -III

Course Objectives:

1. To understand the basic techniques of statistics like correlation, regression, and curve fitting for data analysis, Machine learning, and AI.
2. To Acquaint with the concepts of probability, random variables with their distributions and expectations.
3. To Understand the concepts of vector spaces used in the field of machine learning and engineering problems
4. To understand the concepts of Calculus of Variations.
5. To understand the concepts of complex integration
6. To Use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: The learner will be able to

1. Apply the concept of Correlation and Regression to the engineering problems in data science, machine learning, and AI.
2. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
3. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
4. Find the extremals of the functional using the concept of Calculus of variation.
5. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals
6. Apply the concepts of vector calculus in real life problems.

Sr. No.	Module	Detailed Content	Hrs.	CO Mapping
I	**Correlation, Regression and Curve Fitting,**	Karl Pearson's Coefficient of correlation (r),Spearman's Rank correlation coefficient (R) ,Lines of regression ,Fitting of first and second degree curves.	6	1
II	**Probability, Probability Distributions,**	Conditional probability, Total Probability and Baye's Theorem, Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expectation, Variance, Binomial distribution, Poisson distribution, Normal distribution	7	2
III	**Linear Algebra: Vector Spaces**	Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality, Unit vector ; Linear combinations, linear Dependence and Independence, QR decomposition ; Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors ; Vector spaces over real field, subspaces.	7	3

IV	**Calculus of Variations**	Euler- Lagrange equation (Without Proof), When F does not contain y, When F does not contain x, When F contains x, y, y'.Isoperimetric problems- Lagrange Method. Functions involving higher order derivatives: Rayleigh-Ritz Method.	6	4
V	**Complex Integration**	Line Integral, 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)	7	5
VI	**Vector Integration**	Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation. Gauss' divergence	6	6

List of tutorials

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	**Basic**	Correlation and Regression	**2**
2	**Advanced**	Regression and Curve fitting	**2**
3	**Basic**	Probability	**2**
4	**Advanced**	Probability Distribution	**2**
5	**Advanced**	Calculus of variation	**2**
6	**Basic**	Linear algebra : Vector space -11	**2**
6	**Advanced**	Linear algebra : Vector space -2	**2**
7	**Basic**	Complex Integration -2	**2**
8	**Advanced**	Complex Integration -2	**2**
9	**Basic**	Vector Integration-1	**2**

10	**Advanced**	Vector Integration-2	**2**

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be 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.

Term work:

The distribution of term work marks -

Attendance - 05 marks
Assignments -10 marks
Tutorials- 10 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. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
7. Beginning Linear Algebra Seymour LipschutzSchaum's outline series, Mc-Graw Hill Publication.

Back to Scheme

Course Code	Course Name	Credits
ET 208	**Electronic Communication Systems**	3+1

Prerequisite:
Electronic Devices and Circuits

Course Objectives:
The course is introduced to
1. Illustrate the Elements in Analog Communication Systems
2. Understand the concepts of Amplitude Modulation Demodulation
3. Learn Frequency Modulation Demodulation
4. Evaluate the performance of Radio Receivers
5. Identify pulse analog modulation techniques
6. Introduce digital communication systems and multiplexing techniques

Course Outcomes:
The learner will be able to
1. Understand the basic components and types of noises in communication system
2. Describe amplitude modulation; compare the types and uses of AM system
3. Explain the Frequency modulator demodulator circuits and analyse noise in FM system
4. Distinguish AM and FM receivers in circuit requirements and their performance
5. Sketch the output waveforms for pulse modulation techniques.
6. Demonstrate the principles of multiplexing and demultiplexing techniques.

Sr. No.	Module	Detailed Content	Hrs.	CO Mapping
I	**Introduction to Communication Systems**	Elements of Analog and Digital Communication Systems, electromagnetic spectrum, signal bandwidth and power, types of communication channels, Introduction to time and frequency domain. Basic concepts of wave propagation. Noise in communication systems ,parameters of noise, Noise Analysis-Friss Formula	05	CO1
II	**Amplitude Modulation and Demodulation**	Basic concepts, need for modulation, waveforms (time domain and frequency domain), modulation index, bandwidth, voltage distribution and power calculations. DSBFC: Principles, low-level and high-level transmitters, DSB suppressed carrier, Balanced modulators with diode (Ring modulator and FET) and SSB systems. Amplitude demodulation: Diode detector, practical diode detector, Comparison of different AM techniques, Applications of AM and use of VSB in broadcast television.	10	CO2

III	**Frequency Modulation and Demodulation**	Frequency and Phase modulation (FM and PM): Basic concepts, mathematical analysis, FM wave (time and frequency domain), sensitivity, phase and frequency deviation, modulation index, deviation ratio, bandwidth requirement of angle modulated waves, narrow band FM and wideband FM. Varactor diode modulator, FET reactance modulator, Direct FM transmitter, indirect FM Transmitter, noise triangle, pre- emphasis and de-emphasis FM demodulation: Balanced slope detector, Foster-Seely discriminator, Ratio detector, FM demodulator using Phase lock loop, Compare FM and PM.	8	CO3
IV	**AM and FM Receivers**	Characteristics of radio receivers,AM Radio Receiver: TRF, Super - heterodyne receiver block diagram, tracking and choice of IF, AGC and its types and Double Conversion Radio Receiver, FM receiver block diagram,	4	CO4
V	**Pulse Modulation Techniques**	Sampling theorem for low pass signal, proof with spectrum, Nyquist criteria, Sampling techniques, aliasing error and aperture effect. Analog Pulse Techniques : PAM, PWM, PPM generation, detection and applications. Digital Techniques : Basics of PCM system, Delta modulation (DM) and Adaptive Delta Modulation (ADM). Comparison of Digital techniques	6	CO5
VI	**Multiplexing and Demultiplexing Techniques**	Frequency Division Multiplexing transmitter & receiver block diagram and applications. Time Division Multiplexing transmitter & receiver block diagram and applications. T1 System, PAM TDM system	5	CO6

Electronics and Communication Laboratory :

Lab Prerequisite:

Electronic Devices and Circuits

Software Requirements: Matlab

Hardware Requirements: Kits for AM, DSB-SC, DSB-FC, SSB, FM, PAM, PWM, PPM, Superheterodyne receiver, TDM, FDM

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hrs.**
1	1, 2	Generation and detection of AM (DSB-FC, DSB-SC,SSB) signals.	2
2	1, 2	Generation and detection of FM signals.	2
3	3	Study of AM broadcast receiver (Super heterodyne).	2
4	1	Generation of PAM signal and verify the sampling theorem.	2
5	1	Generation of PPM, PWM signal.	2

6	3	Study of TDM and FDM multiplexing techniques.	2
7	2, 3	Implement Pre-emphasis and De-emphasis using Spice /Matlab Simulation	2
8	2, 3	Generate AM & FM using Matlab Simulation	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:

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.

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

Text Books:

1. Kennedy and Davis, "Electronics Communication System", Tata McGraw Hill, Fourth edition.
2. B.P. Lathi, Zhi Ding "Modern Digital and Analog Communication system", Oxford
3. University Press, Fourth edition.
4. Wayne Tomasi, "Electronics Communication Systems", Pearson education, Fifth edition.

References:

1. Taub, Schilling and Saha, "Taub's Principles of Communication systems", Tata McGraw Hill, Third edition.
2. P. Sing and S.D. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hill, Third edition.
3. Simon Haykin, Michel Moher, "Introduction to Analog and Digital Communication", Wiley, Second edition.
4. Dennis Roddy and John Coolen, Electronic Communication, Pearson, 4/e, 2011.

Back to Scheme

Course Code	Course Name	Credits
ET 209	**Linear Integrated Circuits**	3+1

Prerequisite:

1. Basic Electrical & Electronics Engineering
2. Electronic Devices and Circuits

Course Objectives:

1. To understand basic concepts of operational amplifiers.
2. To understand various linear and non-linear applications of operational amplifier.
3. To understand specifications of A/D and D/A converter and their types.
4. To understand the fundamentals of IC555 and its applications.
5. To understand PLL IC 565 and VCO IC 566 and its applications.
6. To understand various voltage regulator integrated circuits.

Course Outcomes:

Having successfully completed this course, the student will be able to

1. Understand the basic building blocks and fundamentals of operational amplifiers.
2. Develop skills to design linear and nonlinear applications of op-amp.
3. Analyze various ADC and DAC techniques.
4. Explain and compare the working of multivibrators using timer IC 555 and its applications.
5. Gain knowledge about PLL IC 565 and VCO IC 566 and its applications.
6. Illustrate the functions of various voltage regulator integrated circuits.

Sr. No.	Module	Detailed Content	Hrs.	CO Mapping
I	**Basics of Operational Amplifier**	Block diagram of Op-Amp, Ideal and practical characteristics of op-amp, Configurations of Op-Amp: Operational amplifier open loop and closed loop configurations.	4	CO1
II	**Linear Applications of OP-AMP**	Inverting and non-inverting amplifier, voltage follower, summing and difference amplifier, current amplifier, voltage to current converter and current to voltage converter, Integrator & differentiator (ideal & practical), Instrumentation amplifier and applications,Active Filters: First and Second order active low pass, high pass, band pass, band reject and Notch filters.Positive feedback, Barkhausen's criteria, Sine Wave Oscillators: RCphase shift oscillator, Wien bridge oscillator.	9	CO2
III	**Non-linear Applications of OP-AMP**	Comparators: Inverting comparator and non-inverting comparator, zero crossing detectors, window detector, Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger,Waveform Generators: square wave	7	CO2

		generator and triangular wave generator, Basics of Precision Rectifiers: Half wave and full wave precision rectifiers, peak detector, sample and hold circuit.		
IV	**Analog to Digital and Digital to Analog Convertors**	Specifications of D/A converter,DAC techniques: weighted resistor DAC and R-2R ladder DAC, Specifications of A/D converter, ADC techniques:flash ADC, dual slope ADC, successive approximation ADC.	5	CO3
V	**Special Purpose Integrated Circuits**	Functional block diagram and working of IC 555, Design of Astable and Monostable multivibrator using IC 555, Applications of Astable and Monostable multivibrator as Pulse width modulator and Pulse Position Modulator, Functional block diagram and working of VCO IC 566 and application as frequency modulator, Functional block diagram and working of PLL IC 565 and application as FSK Demodulator.	8	CO4, CO5
VI	**Voltage Regulators**	Functional block diagram, working and design of three terminal fixed (78XX, 79XX series) and three terminal adjustable (LM317, LM337) voltage regulators, Functional block diagram, working and design of general purpose IC 723 (HVLC and HVHC). Introduction and block diagram of switching regulator.	6	CO6

Lab Prerequisite:
Basic Electrical & Electronics Engineering
Electronic Devices & Circuits
Software Requirements: Tina, LTspice and Proteus
Hardware Requirements: Function Generator, CRO, multimeter along with basic components required for designing the circuit.

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4.Project/Case Study/Seminar	**Detailed Lab Description**	**Hrs.**
1	1,2	Design inverting and non-inverting amplifier using IC 741.	2
2	1,2	Design summing amplifier using op-amp IC 741	2
3	1,2	Design difference amplifier using op-amp IC 741	2
4	2,3	Design and analyze Integrator using op-amp IC 741	2
5	2,3	Design and analyze Differentiator using op-amp IC 741	2
6	1,2	Design Wein bridge and RC phase shift Oscillator using op-amp IC 741	2
7	2,3	Design and analyze second order High pass and Low pass filter using op-amp IC 741	2
8	2,3	Design Instrumentation amplifier using 3 Op-Amp.	2

9	1,2	Design Precision rectifier using op-amp IC 741	2
10	2,3	Design Square & Triangular wave generator using op-amp IC 741	2
11	1,2	Design Schmitt trigger using op-amp IC 741	2
12	2,3	Design and implement 2bit R-2R ladder DAC.	2
13	2,3	Design and implement flash ADC	2
14	2,3	Design Astablemultivibrator using IC 555 for fixed frequency and variable duty cycle.	2
15	2,3	Design Monostable Multivibrator using IC 555.	2
16	2,3	Design Low Voltage Low Current voltage regulator using IC 723.	2
17	2,3	Design High Voltage High Current voltage regulator using IC 723.	2
18	2,3	Design Frequency Modulator using IC 566	2

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be 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.

Lab Assessments:

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

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

Text Books:

1. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education
2. Salivahanan and Kanchanabhaskaran, "Linear Integrated Circuits", TMH
3. D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 4th Edition.

Back to Scheme

Course Code	Course Name	Credits
ET 210	**Digital Signal Processing**	3+1

Prerequisite:
Signals and systems

Course Objectives:

1. To introduce students with Discrete fourier transform and Fast fourier transforms for analysis of Discrete time signals and systems.
2. To use and design techniques for implementation of IIR digital filters.
3. To use and design techniques for implementation of FIR digital filters.
4. To introduce Finite Word Length effects in Digital Filters.
5. To introduce the students to digital signal processors and its applications.
6. To use and understand multirate digital signal processing.

Course Outcomes: The learner will be able to

1. Analyze the discrete time signals and system using different transform domain techniques
2. Apply the knowledge of design of IIR digital filters to meet arbitrary specifications.
3. Apply the knowledge of design of FIR digital filters to meet arbitrary specifications
4. Understand the effect of hardware limitations on performance of digital filters.
5. Develop different signal processing applications using DSP processors
6. Analyze discrete-time filter banks and multi-rate signal processing

Module	Detailed Content	Hrs.	CO Mapping
I	Discrete Fourier Transform and Fast Fourier Transform: Definition and Properties of DFT, IDFT, Circular convolution, Computation of linear convolution using circular convolution, Filtering of long data sequences: Overlap-Save and Overlap-Add Method FFT: Fast Fourier Transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT	8	CO1
II	IIR Digital Filters: Analog filter design -Butterworth filters, Chebyshev Type I filters, Mapping of S-plane to Z-plane, IIR filter design by impulse invariance method and Bilinear transformation method, Design of IIR digital Butterworth filters and Chebyshev Type I filters. Analog and Digital frequency transformations	8	CO2
III	FIR Digital Filters- Introduction of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and linear phase FIR filters, location of the zeros of linear phase FIR filters, Gibbs phenomenon, Design of FIR filters using Window techniques (Rectangular, Hamming, Hanning, Blackmann), Design of FIR filters using Frequency Sampling technique, Comparison of FIR & IIR	7	CO3
IV	Finite Word Length effects in Digital Filters- Quantization, truncation and rounding, Input quantization error,	6	CO4

	Product quantization error, Coefficient quantization error, Zero-input limit cycle oscillations, Overflow limit cycle oscillations, Scaling. Quantization in Floating Point realization of IIR digital filters, Finite word length effects in FIR digital filters		
V	DSP Processors- Introduction to General Purpose and Special Purpose DSP processors, fixed point and floating point DSP processor, digital signal processor architecture, Pipelining, multiplier and accumulator (MAC), Very long instruction word Architecture (VLIW) Architecture of TMS320C6X fixed and floating DSP processors. Applications of digital signal processing-Speech processing, Radar Signal Processing, Biomedical Applications in DSP	6	CO5
VI	Multirate DSP and Filter Bank: Introduction and concept of Multirate Processing, Decimator and Interpolator, Decimation and Interpolation by Integer numbers Sample rate conversion using Polyphase filter structure, Filter Banks	4	CO6

List of Practicals

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	Hours
1	**Basic**	To perform DFT and IDFT of the discrete time sequence and sketch the magnitude and phase spectrum.	2
2	**Basic**	To perform circular convolution of discrete time sequences using DFT and IDFT method and compute linear convolution using circular convolution.	2
3	**Design**	To Design a analog low pass Butterworth and Chebyshev filter	2
4	**Design**	To Design an IIR butterworth low pass filter using impulse in-variance method .	2
5	**Design**	To Design an IIR butterworth low pass filter using bilinear transformation method .	2
6	**Design**	To Design an IIR Chebyshev low pass filter using bilinear transformation method .	2
7	**Design**	To Design a FIR low pass, high pass filter using various windowing methods and plot their frequency response.	2
8	**Design**	To plot magnitude and phase response of low pass ,high pass & all Pass filter	2
9	**Design**	To plot magnitude and phase response of comb filter & notch filter	2
10	**Advanced**	To perform interpolation and decimation on a given discrete signal.	2

11	**Advanced**	To perform the Circular Convolution of two given discrete sequences using TMS320C6745 Kit.	2
12	**Advanced**	To perform the Linear Convolution of two given discrete sequences using TMS320C6745 Kit.	2
13	**Case Study**	One case study	2

Theory Assessment:

Internal Assessment: 40 marks

Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be 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.

Lab Assessments:

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

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

Text Books:

1. Tarun Kumar Rawat, "Digital Signal Processing", Oxford University Press, 2015
2. Nagoor Kani, "Digital Signal Processing", Tata McGraw Hill Education Private Limited.
3. Emmanuel C. Ifeachor, Barrie W. Jervis, "Digital Signal Processing", A Practical Approach by, Pearson Education
4. S. Salivahanan, C. Gnanpriya, ― Digital Signal processing‖, McGraw Hill
5. Ramesh Babu, "Digital Signal Processing", Scientech Publication (India) Private Limited

References:

1. Proakis J., Manolakis D., "Digital Signal Processing", 4th Edition, Pearson Education.
2. B. Venkata Ramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, 2004.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete Time Signal Processing", Pearson, 8th Indian Reprint, 2004.

Back to Scheme

Course Code	Course Name	Credits
ET 211	**Microprocessor & Microcontroller**	3+1

Prerequisite:
Digital System Design

Course Objectives:
1. To understand the basic concepts of microcomputer systems.
2. To understand the architecture of the 16-bit Microprocessor 8086.
3. To understand architecture and programming of 8-bit Microcontroller 8051.
4. To develop knowledge of peripheral devices and their interfacing for designing 8051 based applications in Assembly Language.
5. To understand the architecture of PIC and AVR microcontrollers.
6. To understand the basics of the ARM Architecture.

Course Outcomes:
The learner will be able to
1. Understand The Basic Concepts Of Micro Computer Systems.
2. Understand The architectural aspects of 8086 microprocessor.
3. Program 8051 microcontroller by understanding its architectural aspects.
4. Interface variousperipheraldevicesto8051 microcontrollers.
5. Design applications using microcontrollers
6. Develop basic knowledge about the ARM architecture.

Module No.	Unit No.	Details	Hrs.	CO Mapping
1.	**Introduction to Microcomputer Systems.**		04	CO1
	1.1	Block diagram of microprocessor-based system: CPU, I/O Devices, Clock, Memory, Concept ofAddress,Data and Control Bus and Tristate logic.		
	1.2	Concepts of Program counter register,Reset, Stack and stack pointer, Subroutine, Interrupts and Direct Memory Access		
	1.3	Concept of RISC CISC Architecture		
	1.4	Concept of Harvard Von Neumann Architecture		
2.	**Architectural features of 8086 Microprocessor**		10	CO2
	2.1	Major Features Of 8086 Microprocessor.		
	2.2	8086 CPU Architecture, instruction set and programming, pipelined operation,		
	2.3	Programmer's Model & Memory Segmentation.		
	2.4	8086 pin description in detail.		
	2.5	Minimum And Maximum mode pins of 8086.		
	2.6	Read and Write bus cycle of 8086		

3.	**8051 Microcontroller Architecture and assembly language programming**		06	CO3
	3.1	Comparison between Microprocessor and Microcontroller		
	3.2	Features,architecture and pin configurations, Memory organization, Addressing modes of 8051		
	3.3	Assembler directives of 8051. Instruction Set:Data transfer,Arithmetic, Logical,Branching.		
	3.4	Programs related to: arithmetic, logical, delay, input, output, timer, counters, port, serial communication and interrupts.		
4.	**Internal Hardware of 8051 Microcontroller & Interfacing Applications**		08	CO4
	4.1	I/O Port structures, Interrupts, Timers/Counters, Serial Ports And their programming.		
	4.1	Display Interfacing:7-segment LED display, 16x2 generic alphanumeric LCD display.		
	4.2	Analog Devices Interfacing: 8-bitADC/DAC		
	4.4	Motor Interfacing:dc motor,stepper motor and servomotor.		
5.	**PIC and AVR Microcontrollers**		06	CO5
	5.1	PIC family Categories and importance (10F/12F/16F/18F), PIC18 Architecture and Features, Assembly Language Programming: Branch, Arithmetic and Logic Instructions. Peripheral Interfacing		
	5.2	AVR Microcontroller: Architecture and Features, Standard I/O interrupts		
	5.3	Comparison of PIC and AVR microcontrollers.		
6.	**The ARM Architecture**		05	CO6
	6.1	ARM Introduction, Concept of Cortex-A, Cortex-R and Cortex-M, Architectural Inheritance, Introduction and features of ARM7,		
	6.2	Programmer's Model and Pipelining, Exceptions, Interrupts and Vector Table,		
	6.3	Instruction set: Data processing and transfer, control flow. Thumb Instruction Set Support		

Lab Prerequisite:
Basic Electrical and Electronics Engineering, Engineering Physics I & II
Software Requirements: Experiments can be conducted on Assembler, Emulator
Hardware Requirements: Hardware kits

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	Hrs.
1	1	To perform the basic arithmetic and logical operations using the 8086 Microprocessor	2
2	2	To write an assembly language program to search a character in a string using 8086	2
3	3	To write an assembly language program for password checking using 8086.	2
4	1	To write an assembly language program to perform Arithmetic and Logical Operations using 8051 microcontroller.	2
5	1	To write an assembly language program To transfer of data bytes between Internal and External Memory using 8051 microcontroller.	2
6	2	To write an assembly language program to perform experiments based on General Purpose Input-Output & Timers.	2
7	3	Programs for Interfacing of SSD/LCD with 8051 microcontroller.	2
8	3	Program for Serial communication of 8051 using UART.	2
9	3	Programs for Interfacing of Stepper Motor with 8051 microcontroller.	2
10	3	Programs for Interfacing of DC Motor with 8051 microcontroller.	2
11	1	Perform DC motor speed control using PWM with PIC microcontroller	2
12	2	Interface ADC with PIC microcontroller	2
13	3	Interface Different Sensors and LCD with PIC microcontroller	2
14	4	Mini project based on any application related to (8051/ PIC) microcontroller.	2

Theory Assessment:
Internal Assessment: 40 marks
Consisting of Two compulsory internal assessments 40 Marks each. The final marks will be 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.

Lab Assessments:

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

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

Text Books:

1. Microprocessor and Interfacing: By Douglas Hall (TMH Publication)
2. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
3. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010.

Reference Books:

1. 8086 Microprocessor Programming and Interfacing the PC: By Kenneth Ayala (West Publication)
2. Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI Publication).
3. Satish Shah, "The 8051 Microcontrollers", Oxford publication first edition 2010.
4. "MCS@51 Microcontroller, Family users Manual" Intel

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Course Code	Course Name	Credits
ET 212	**Personal Finance Management**	02

Course objectives: The course is aimed

1. To introduce the basic concepts of finance and their practical application.
2. To demonstrate the process of drafting a financial budget.
3. To explain investment avenues and planning of personal finance.
4. To develop portfolio strategies for individual and institutional investor
5. To discuss various components of insurance and tax management.
6. To introduce financial frauds, measures to avoid frauds and resources of frauds.

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

1. To know the basic concepts of finance and interpret current business positions by reading books of accounts.
2. To analyze investment avenues and plan personal finance to develop portfolio strategies for individuals.
3. To develop skills to interpret current market position.
4. To create analytical approach for financial decisions.
5. To learn and understand Tax and Insurance management.
6. To identify financial frauds and understand the level of financial aspects.

Module No	Module	Detailed Contents	Hrs.
1	Introduction to Personal Financial Planning	Financial Planning Process: Goal, Vision and mission , Components of Personal Financial Plan, Advantages and developing personal financial plan	3
2	Financial Budget	Meaning and Process of Drafting Financial Budget , Components of Financial Budget, DraftingFinancial Budget	3
3	Investment Management	Meaning of Investment, Concept of Risk and Return and Time Value of Money, Investment Avenues, Portfolio Creation and Management	6
4	Insurance and Spending Management	Components of Insurance: Life Insurance, Health Insurance ,Property Insurance ,Spending Management	3
5	Tax Management	Introduction to Tax Regime and Tax Returns, Introduction to Income Tax and its impact on Incomes ,Tax on property: Revenue and Capital Incomes, Tax Management, Tax Saving, Tax Avoidance	3
6	Financial Frauds	Meaning and Types of Fraud,Investment Frauds, Online Payment Frauds, Identity Theft, Mass Marketing Fraud ,Measures to avoid frauds,Recourse from frauds,Cases of Frauds	6

Theory Assessment:

Internal Assessment: 20 marks
Consisting of Two compulsory internal assessments 20 Marks each. The final marks will be the average score of both the assessments.

End Semester Examination: 40 Marks
Weightage of each module in the end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

Books and References:
1. Financial Management: I M Pandey, Vikas Publishing House.
2. Financial Management: M.Y. Khan, P.K. Jain, Tata McGraw Hill.
3. Financial Management: Prassana Chandra, Prentice Hall.
4. Investment Analysis & Portfolio Management- Prasanna Chand a, Ta McGrawH
5. Wealth Management- Dun & Bradstreet, Tata McGrawHill
6. Wealth Management- S.K .Bagachi, Jaico publishing house

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Course Code	Course Name	Credits
ET 292	**Mini Project II**	02

Lab Prerequisite: ET 291 Project

Lab Objectives:

1. To improve the knowledge of electronics hardware among students
2. To familiarize the students with the programming and interfacing of different devices with Arduino and Raspberry Pi Board.
3. To increase students' critical thinking ability and provide solutions to some real time problems.
4. To acquaint with the process of identifying the needs and converting it into the problem.
5. To familiarize the process of solving the problem in a group
6. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems
7. To inculcate the process of self-learning and research.

Lab Outcomes: The learner will be able to

1. Write code using python language using IDE for utilizing the onboard resources.
2. Apply the knowledge of interfacing different devices to the Raspberry Pi board to accomplish a given task.
3. Identify problems based on societal /research needs.
4. Design Raspberry Pi based projects for a given problem.
5. Draw the proper inferences from available results through theoretical/ experimental/simulations
6. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning

Software Requirements:

1. Raspbian OS: https://www.raspberrypi.org/downloads/
2. Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
3. SD Card Formatter: https://www.sdcard.org/downloads/formatter/

Online Repository:

1. GitHub
2. NPTEL Videos on Raspberry Pi and Arduino Programming
3. https://www.electronicsforu.com/raspberry-pi-projects
4. https://circuitdigest.com/simple-raspberry-pi-projects-for-beginners
5. https://www.electronicshub.org/raspberry-pi-projects/

Hardware Requirements:

Raspberry Pi Boards, Sensors and Peripherals

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4.Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**LO Mapping**
1	1, 2	**Introduction to Raspberry Pi:** 1.1 What is Raspberry Pi? Downloading and Installation of NOOBS, First PowerUp& Having a Look around, Introduction to the Shell and Staying updated. 1.2 Familiarization with Raspberry PI and perform necessary software installation. Apparatus Requirement: Hardware: Raspberry PI Board, Memory of 16GB, Power adapter, Memory Writer. Software: NOOBS, Raspbian OS, Win32 disk Imager, SD-Formatter software.	LO1, LO2
2	1, 2	**Interfacing with Input / Output Devices using Python** 2.1 Introduction to Python, Connecting to the outside World with GPIO. 1 To Interface LED/Buzzer with Raspberry PI and write a program to turn ON LED for 1 sec after every 2 sec. Apparatus Requirement: Raspberry PI with inbuilt Python Package, LED, Buzzer. 2.2 To interface Push Button / Digital Sensor (IR/LDR) with Raspberry PI and write a program to turn ON LED when Push button is pressed or at sensor detection. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Push Button Switch, Digital Sensor (IR/LDR). 2.3. To interface analog sensor using MCP 3008 analog to digital converter chip. Apparatus Requirement: Raspberry PI with inbuilt Python Package, analog sensor, MCP 3008 chip.	LO2, LO4, LO5
3	1, 2	**Interfacing Temperature Sensor, Motors, Display Devices.** 3.1 Introduction to Temperature sensor (Analog and Digital), Relays, Motors (DC, Stepper) and Driver circuits. 3.2 To interface DHT11 sensor with Raspberry PI and write a program to print temperature and humidity readings. Apparatus Requirement: Raspberry PI with inbuilt Python Package, DTH11 Sensor. 3.3 To interface motor using relay with Raspberry PI and write a program to turn ON motor when push button is pressed. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Relays, Motor Driver, Motors. 3.4 To interface OLED with Raspberry PI and write a program to print temperature and humidity readings on it. Apparatus Requirement: Raspberry PI with inbuilt Python Package, OLED display	LO2, LO4, LO5

4	2, 3	**Interfacing Communication Devices and Cloud Networking** 4.1 Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods. 4.2 To interface Bluetooth/Zigbee/RFID/WiFI with Raspberry PI and write a program to send sensor data to smartphones using Bluetooth/Zigbee/RFID/WIFI. (Any -one can be used for performing) Apparatus Requirement: Raspberry PI with inbuilt Python Package, Bluetooth/Zigbee/RFID/WIFI. 4.3 Introduction to Cloud computing, different types cloud networks and interconnection using Raspberry Pi 4.4 Write a program on Raspberry PI to upload temperature and humidity data from thingspeak cloud. Apparatus Requirement: Raspberry PI with inbuilt Python Package, Cloud networks such as thingspeak(open source), AWS, Azure, etc. anyone can be used for understanding purpose and building projects.	LO2, LO3, LO4, LO5
5	2, 3	**Understanding of Communication Protocols** 5.1 Introduction to MQTT, IFTTT protocols and configuration steps. 1 Write a program on Raspberry Pi to publish temperature data to MQTT broker 5.2 Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it. 5.3 Configuration of Web Server using Raspberry Pi.	LO2, LO3, LO4, LO5
6	4	**Sample Projects** 1. MQTT Based Raspberry Pi Home Automation: Controlling Raspberry Pi GPIO using MQTT Cloud 2. License Plate Recognition using Raspberry Pi and OpenCV 3. Real Time Face Recognition with Raspberry Pi and OpenCV 4. Smart Garage Door Opener using Raspberry Pi 5. Remote Controlled Car Using Raspberry Pi and Bluetooth 6. Fingerprint Sensor based door locking system using Raspberry Pi 7. Raspberry Pi Ball Tracking Robot using Processing 8. Web Controlled Home Automation using Raspberry Pi 9. Line Follower Robot using Raspberry Pi 10. Raspberry Pi based Smart Phone Controlled Home Automation 11. Web Controlled Raspberry Pi Surveillance Robotic Car 12. Raspberry Pi Based Weight Sensing Automatic Gate 13. Raspberry Pi Emergency Light with Darkness and AC Power Line Off Detector 14. Detecting Colors using Raspberry Pi and Color Sensor TCS3200 15. Measure Distance using Raspberry Pi and HCSR04 Ultrasonic Sensor	LO3, LO6

		16. Call and Text using Raspberry Pi and GSM Module 17. Raspberry Pi Home Security System with Email Alert 18. Raspberry Pi Based Obstacle Avoiding Robot using Ultrasonic Sensor 19. Web Controlled Notice Board using Raspberry Pi 20. RF Remote Controlled LEDs Using Raspberry Pi 21. RFID and Raspberry Pi Based Attendance System 22. Raspberry Pi Interactive Led-Mirror 23. Garage Door monitor using Raspberry Pi 24. Raspberry Pi Digital Code Lock on Breadboard 25. Electronic Voting Machine using Raspberry Pi	

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 supervisors 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.

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 1 in semester III and IV.

However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis.

Lab Assessments:

Termwork,Practical and Oral:

Term Work The review/ progress monitoring committee shall be constituted by the head 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

Review/progress monitoring committee may consider the following points for assessment based on following general guidelines.
A students' group shall complete project in all aspects including,

- Identification of need/problem
- Proposed final solution
- Procurement of components/systems
- Building prototype and testing

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

Oral/Viva Assessment:
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
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individuals as member or leader
13. Clarity in written and oral communication

All criteria in generic may be considered for evaluation of performance of students in mini projects.
Guidelines for Assessment of Mini Project Practical/Oral Examination:
Report should be prepared as per the guidelines issued.

Lab Prerequisite: ECP1 Project
Mini Project 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 organisations 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 as member or leader
8. Clarity in written and oral communication

Text Books:

1. Raspberry Pi Documentation: https://www.raspberrypi.org/documentation/
2. The Official Raspberry Pi Beginner's Book by **raspberrypi.org/magpi**: https://www.raspberrypi.org/magpi-issues/Beginners_Book_v1.pdf

3. The Official Raspberry Pi Projects Book by **raspberrypi.org/magpi**: https://www.raspberrypi.org/magpi-issues/Projects_Book_v1.pdf

References:

1. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017)
2. Simon Monk, "Raspberry PI Cookbook Software and Hardware Problems and Solutions" O'Reilly 2nd Edition
3. Simon Monk, Programming the Raspberry Pi, 2nd Edition: Getting Started with Python" The McGraw Hill
4. "DK Workbooks: Raspberry Pi Project Workbook", DK Children; Workbook edition (March 7, 2017)
5. Donald Norris, "Raspberry Pi Electronic Projects for Evil Geniuses", McGraw-Hill Education TAB; 1 edition (May 20, 2016)

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