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

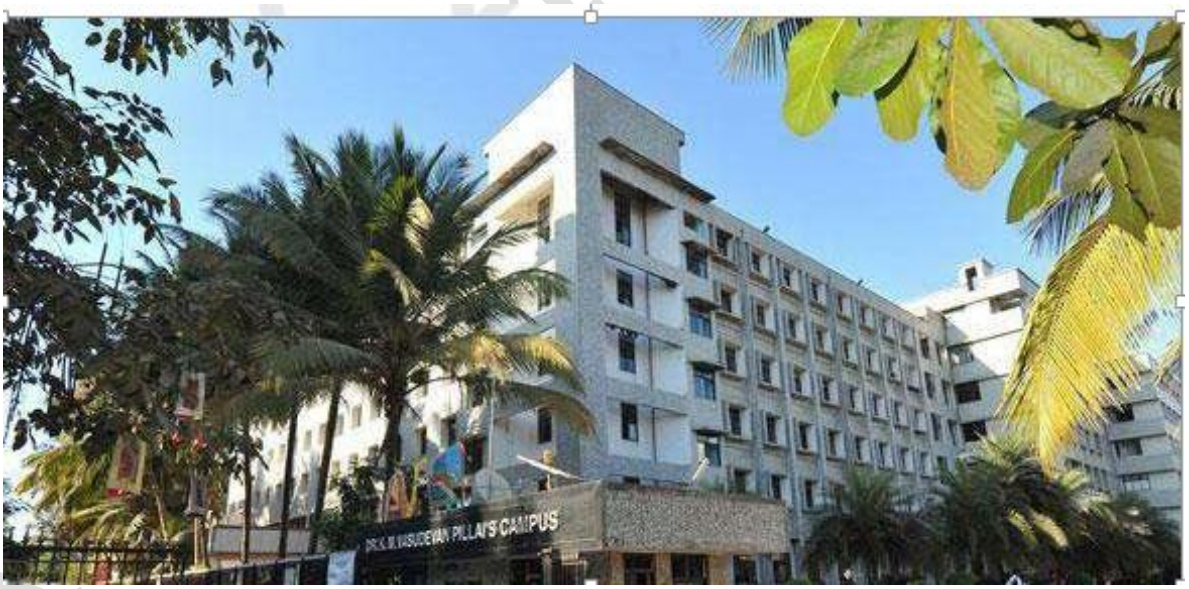
Pillai College of Engineering

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:

Group 1: Smart Robotics and IoT driven Application Development
Group 2: Product Design
Group 3: VLSI Chip Design Technology
Group 4: Advanced Communication System
Group 5: Cloud Computing
Group 6: Data Science

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

1. 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**

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**

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**	**09**	**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**

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**

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><td>Specialization</td><td colspan="3">Group I</td><td>Specialization</td><td colspan="3">Group II</td></tr>
<tr><td>Semester V Electives</td><td>Smart Robotics and IoT driven Application Development</td><td>Product Design</td><td>VLSI Chip Design Technology</td><td>Semester V Electives</td><td>Advanced Communication System</td><td>Cloud Computing</td><td>Data Science</td></tr>
<tr><td rowspan="2">Course Code
Course Name
Elective I A</td><td rowspan="2">ET 306</td><td rowspan="2">ET 307</td><td rowspan="2">ET 308</td><td rowspan="2">Course Code
Course Name
Elective II A</td><td>ET 309</td><td rowspan="2">ET311</td><td rowspan="2">ET312</td></tr>
<tr><td>Data Processing and Coding</td></tr>
<tr><td rowspan="2">IOT Basics & Smart sensors</td><td rowspan="2">PCB Design and Electronics Equipment Trouble shooting</td><td rowspan="2">Basics of VLSI Design</td><td>ET 310</td><td rowspan="2">Computer Communication & Network</td><td rowspan="2">Database Management System</td></tr>
<tr><td>TV & Video Engineering</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 313	Wireless & Mobile Communication	T	3	-	3	-	3
ET 314	Electromagnetic Wave & Radiating Systems	T	3	-	3	-	3
ET 315	WM & AT Lab	L	-	2	-	2	2
ET 316	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			**15**	**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 313	Wireless & Mobile Communication	40	40	40	60	2	-	-	100
ET 314	Electromagnetic Wave & Radiating Systems	40	40	40	60	2	-	-	100
ET 315	WM & AT Lab	-	-	-	-	-	50	25	75
ET 316	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><td>Specialization</td><td colspan="3">Group I</td><td>Specialization</td><td colspan="3">Group II</td></tr>
<tr><td>Semester VI Electives</td><td>Smart Robotics and IoT driven Application Development</td><td>Product Design</td><td>VLSI Chip Design Technology</td><td>Semester VI Electives</td><td>Advanced Communication System</td><td>Cloud Computing</td><td>Data Science</td></tr>
<tr><td rowspan="5">Course Code
Course Name
Elective I B</td><td rowspan="2">ET 317</td><td rowspan="2">ET 318</td><td rowspan="2">ET 319</td><td rowspan="5">Course Code
Course Name
Elective II B</td><td>ET 320</td><td rowspan="2">ET323</td><td rowspan="2">ET324</td></tr>
<tr><td>Speech and Audio Processing</td></tr>
<tr><td rowspan="3">Robotics and Automation</td><td rowspan="3">Electronic Product Design</td><td rowspan="3">Integrated Circuit Technology</td><td>ET 321</td><td rowspan="3">Advanced Networking Technologies</td><td rowspan="3">Big Data Analytics</td></tr>
<tr><td>Radar Engineering</td></tr>
<tr><td>ET 322</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Optical Communication</td><td></td><td></td></tr>
</table>

Institute level specializations are (to be finalized)

1. Business and Entrepreneurship
2. Bio Engineering
3. Engineering Design
4. Art and Humanities
5. Applied Science
6. Life Skills, Repair, Maintenance and Safety

Course Code	Course Name	Credits
ET201	Engineering Mathematics III	04

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 aquadratic 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)

Back to scheme

Subject Code	Subject Name	Total
ET 202	Electronics Devices	04

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

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

Text Books:

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

References:

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

Back to Scheme

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.

Back to scheme

Subject Code	Subject Name	Total
ET 204	**Digital System Design**	**04**

Prerequisite: None

Course Objectives:

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

Course Outcomes: The learner will be able to

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

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Principles of combinational logic**	Review of Number System, Binary Code, Binary Coded Decimal, Octal Code, Hexadecimal Code Gray Code and their conversions, Binary Arithmetics, Digital logic gates, Realization using NAND, NOR gates, Boolean Algebra, De Morgan's Theorem, SOP and POS representation, K Map up to four variables.	05	CO1
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

Back to scheme

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.

Back to Scheme

Subject Code	Subject Name	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)

Back to Scheme

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:
Termwork, 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**	04

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**	04

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**	04

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**	04

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**	04

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

Back to Scheme

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 Chandra, Tata McGrawHill
5. Wealth Management- Dun & Bradstreet, Tata McGrawHill
6. Wealth Management- S.K .Bagachi, Jaico publishing house

Back to Scheme

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 Genius", McGraw-Hill Education TAB; 1 edition (May 20, 2016)

Back to Scheme

Course Code	Course Name	Credits
ET 301	**Digital Communication**	04

Prerequisite:
Electronic Communication System, Signals and systems

Course Objectives:

1. To understand the basics of probability theory and Digital Communication
2. To Understand the basics of information theory, source coding techniques.
3. To evaluate performance of different error control coding schemes.
4. To compare the performance of line c distinguish various digital modulations techniques.
5. To understand impulse response of a matched filter for optimum detection

Course Outcomes:
After successful completion of the course learner will be able to

1. Understand the basics of probability theory and Digital Communication.
2. Identify various source coding schemes
3. Design and implement different error correction codes
4. Describe and determine the performance of line codes and methods to mitigate inter symbol interference
5. Describe various digital modulations techniques.
6. Illustrate the impulse response of a matched filter for optimum detection

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	Introduction to Probability Theory and Digital Communication	Information, Probability, Conditional Probability of independent events, Relation between probability and probability Density , Rayleigh Probability Density , CDF, PDF. Introduction to Digital Communication System, Advantages of the digital representation of the signal, Comparative study of analog and digital Communication System	05	01
2	Information Theory and Source Coding	Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and its properties Shannon‘s Source Coding Theorem, Shannon- Fano Source Coding, Huffman Source Coding Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem	06	02

3	Error Control Systems	Types of error control, error control codes, linear block codes, systematic linear block codes, generator matrix, parity check matrix, syndrome testing, error correction, and decoder implementation Systematic and Non-systematic Cyclic codes: encoding with shift register and error detection and correction Convolution Codes: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods	09	03
4	Baseband Modulation and Demodulation	4.1 Discrete PAM signals and it's power spectra Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern	05	04
5	Bandpass Modulation & Demodulation	Band-pass digital transmitter and receiver model, digital modulation schemes Generation, detection, signal space diagram, spectrum, bandwidth efficiency, and probability of error analysis of: Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK)Modulations, Binary Phase Shift Keying (BPSK) Modulation, Quaternary Phase Shift Keying QPSK), M- ary PSK Modulations, Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK)	10	05
6	Optimum Reception of Digital Signal	1 Baseband receiver, Optimum Receiver and Filter Matched Filter and its probability of error, Coherent Reception.	04	06

Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study /Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	Study and analyze Line codes	02
2	Advance	Error detection and correction using Hamming code virtuallab http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/comp_networ ks_sm/labs/exp1/index.php	02
3	Basic	To Study Generation & reception of ASK & its spectral analysis.	02
4	Basic	To Study Generation & reception of FSK & its spectral analysis.	02
5	Basic	To Study Generation & reception of PSK & its spectral analysis.	02
6	Advance	To observe the effect of signal Distortion using EYE-Diagram	02
7	Design	To Study and perform Linear Block codes	02
8.	Design	To Study and perform Cyclic Codes	02
9.	Design	To Study and perform Convolutional Codes	02
10.	Advance	Matched filter impulse response for a given input	02

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:
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. Digital Communication, Sanjay Sharma, S. K. Kataria and sons
2. H. Taub, D. Schilling, and G. Saha, ―Principles of Communication Systems,Tata Mc- Graw Hill, New Delhi, Third Edition, 2012.
3. Lathi B P, and Ding Z., ―Modern Digital and Analog Communication Systems, Oxford University Press, Fourth Edition, 2009.
4. Haykin Simon, ―Digital Communication Systems, John Wiley and Sons, New Delhi, Fourth Edition, 2014

References:

1. Sklar B, and Ray P. K., ―Digital Communication: Fundamentals and applications, Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.
2. T L Singal, ―Analog and Digital Communication, Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
3. P Ramakrishna Rao, ―Digital Communication,Tata Mc-Graw Hill, New Delhi, First Edition, 2011.
4. M F Mesiya, ―Contemporary Communication systems, Mc-Graw Hill, Singapore, First Edition, 2013

Back to Scheme

Course Code	Course Name	Credits
ET 302	**Image Processing & Machine Vision**	03

Prerequisite:
Signals and Systems, Digital Signal Processing, Python Programming Skill Lab

Course Objectives:

1. To cover the fundamentals and mathematical models in digital image processing and Machine Vision
2. To teach quality enhancement of image through filtering operations.
3. To teach the students image morphology and restoration techniques.
4. To expose the students to segmentation techniques in image processing and Machine Vision.
5. To teach the techniques of extracting image attributes like regions and shapes.
6. To learn classification and recognition algorithms for machine vision

Course Outcomes:
After successful completion of the course student will be able to

1. Understand fundamentals of image processing and machine vision.
2. Enhance the quality of image using spatial and frequency domain techniques for image enhancement.
3. Learn image morphology and restoration techniques.
4. Learn image segmentation techniques based on the principle of discontinuity and similarity using various algorithms.
5. Represent boundaries and shapes using standard techniques.
6. Classify the object using different classification methods.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Digital Image Fundamentals and Point processing techniques	1.1 Introduction –Steps in Digital Image Processing, concept of spatial and intensity resolution, Relationships between pixels. 1.2 Point Processing : Image Negative, Log Transform, Power Law transform, Bit plane slicing, Contrast stretching , Histogram equalization and Histogram Specification	4	CO1
II	Image Enhancement	1 Spatial Domain filtering : The Mechanics of Spatial Filtering, Smoothing Spatial Filters-Linear Filters-Averaging filter, Order-Statistic Filters- Median filter, Application of Median filtering for Noise removal Sharpening Spatial Filters- The Laplacian, Unsharp Masking and Highboost Filtering, Using First-Order Derivatives —The Gradient- Sobel, Prewitt and Roberts 2 Frequency Domain Filtering: Introduction to 2-D DFT and its application in frequency domain filtering, Wavelet transform, Haar transform 3 Frequency Domain Filtering Fundamentals, Fourier Spectrum and Phase angle ,Steps for Filtering in the Frequency Domain, Correspondence Between Filtering in the Spatial	8	CO2

		and Frequency Domains, Frequency domain Image Smoothing and sharpening filter - Ideal, Butterworth , Gaussian		
III	Image morphology and restoration	.1Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Boundary extraction , Hole filling, Thinning and thickening .2Restoration : A Model of the Image Degradation/Restoration Process, Noise models, Removal periodic noise, Principle of Inverse filtering	6	CO3
IV	Image Segmentation	Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, Canny's edge detection algorithm , Edge linking : Local processing and boundary detection using regional processing (polygonal fitting) Thresholding : Foundation, Role of illumination and reflectance, Basic global thresholding Region Based segmentation: Region Growing, Region Splitting and merging	8	CO3,CO4
V	Introduction to machine vision and descriptors	Principle of machine vision , real world applications, chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences Introduction to Texture, co-occurence matrix	6	CO3,CO5
VI	Machine Vision Algorithms	Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Confusion Matrix K-means clustering algorithm, Introduction, bays decision theory continuous case, two category classification, Bayesian classifier ,Support vector machine setting, Classifier Learning, Support vector machine, cluster analysis	6	CO5,CO6

Theory Assessment:

Internal Assessment for 40 marks:

Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Cengage Engineering, 3rd Edition, 2013
2. Gonzalez and Woods, "Digital Image Processing", Pearson Education, India, Third Edition.
3. R. O. Duda and P. E. hart, Pattern classification and scene analysis, Wiley Interscience publication
4. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

References:

1. Anil K.Jain, “Fundamentals of Image Processing”, Prentice Hall of India, First Edition,

W Pratt, “Digital Image Processing”, Wiley Publication, 3rd Edition, 2002

Back to Scheme

Course Code	Course Name	Credits
ET 303	**Embedded Systems**	04

Prerequisite:
Microcontroller and microprocessors, C programming

Course Objectives:
1. Understand the basics of an embedded system.
2. To study concepts involved in Embedded Hardware.
3. To study concepts involved in Embedded Software for System realization.
4. To learn Real-time programming to design time-constrained embedded systems
5. To learn the development of Embedded system
6. To study various Embedded System applications

Course Outcomes:
1. Students will be able to define and explain embedded systems and the different embedded system design technologies explain the various metrics or challenges in designing an embedded system.
2. Student will be able to cultivate ability to understand the internal architecture and interfacing of different peripheral devices and Devices and Communication Buses
3. Students will be able to use Embedded C programming language to Implement embedded systems**.**
4. Student will be able to know Program Modeling Concepts with Real Time Operating Systems
5. Students will able to design embedded system based on Cortex series
6. Students will be able to foster the ability to understand the role of embedded systems application as well as select the relevant microcontrollers for various industrial applications.

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction**	Definition, Characteristics, Classification, Applications Design metrics of Embedded system and Challenges in optimization of metrics.	03	CO1
2	**Embedded Hardware**	**2.1** Features of Embedded cores- Microcontroller, ASIC, ASSP, SoC, FPGA, RISC and CISC cores. **2.2** Types of memories: SRAM, DRAM, PROM,EEPROM,FLASH, NVRAM. **2.3** ARM Cortex-M3 Features, Architecture, Programmer's model, Special Registers, Operating Modes and States, MPU, Memory map and NVIC. **2.4** Low power - Need and techniques. Case study of Low Power modes in Cortex-M3. **2.5** Communication Interfaces: Comparative	13	CO2

		study of Serial communication Interfaces -RS-232, RS-485, SPI, I2C, CAN, USB (v2.0), Bluetooth, Zig-Bee. (Frame formats of above protocols are not expected) **2.6** Selection Criteria of Sensors and Actuators		
3	**Embedded Software**	Program Modeling concepts: DFG, CDFG, FSM. Embedded firmware design approaches: super loop based approach, operating system based approach; embedded firmware development languages-assembly language based development, high level language based development.	03	CO3
4	**Real-time Operating system**	**4.1** Real-time Operating system: Need of RTOS in Embedded system software and comparison with GPOS. **4.2** Task Management: Task, Task states, Multi-tasking, Task scheduling, and algorithms- Preemptive SJF, Round-Robin, Priority, Rate Monotonic Scheduling, Earliest Deadline First **4.3** Inter-process communication: Message queues, Mailbox, Event timers. **4.4** Task synchronization: Need, Issues- Deadlock, Race condition, live Lock, Solutions using Mutex, Semaphores. **4.5** Shared Data problem, Priority inversion.	10	CO4
5	**Testing and Debugging Methodology**	Testing & Debugging: Hardware testing tools, Boundary-scan/JTAG interface concepts, Emulator. Software Testing tools, Simulator, Debugger. White-Box and Black-Box testing.	03	CO5
6	**System Integration (Case Studies)**	**6.1** Embedded Product Design Life-Cycle (EDLC)- Waterfall Model **6.2** Hardware-Software Co-design Case studies for Automatic Chocolate Vending Machine, Washing Machine, Smart Card, highlighting i) Specification requirements (choice of components) ii) Hardware architecture iii) Software architecture	07	CO6

Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advance 4. Project/ Case Study /Seminar	**Detailed Lab/Tutorial Description**	**Hours**

1	Basic	Interfacing of LEDs /switches with any embedded core.(ARM/STM32,MSP430 etc)	02
2	Basic	Interfacing of a relay with any embedded core. (ARM/STM32,MSP430 etc)	02
3	Basic	Interfacing of LCD/ Seven segment display with any embedded core.(ARM/STM32,MSP430 etc)	02
4	Basic	Interfacing of Ultrasonic/Humidity sensor with any embedded core. (ARM/STM32,MSP430 etc)	02
5	Basic	Interfacing of Temperature sensor with any embedded core. (ARM/STM32,MSP430 etc)	02
6	Design	Interfacing of a DC motor (speed and direction control) with any embedded core. (ARM/STM32,MSP430 etc)	02
7	Design	Interfacing of a stepper motor (to move by a particular angle) with any embedded core.(ARM/STM32,MSP430 etc)	02
8	Design	Implement the I2C communication (ARM/STM32, MSP430 etc)	02
9	Advance	Write a Program to Create Multiple Tasks and understand the Multitasking capabilities of RTOS (FreeRTOS).	02
10	Advance	Write a Program to illustrate the Queue Management Features of FreeRTOS.	02
11	Advance	Write a Program to illustrate the Event Management Features of FreeRTOS.	02
12	Design	Write a Program to illustrate the use of Binary and Counting Semaphore for Task Synchronization using FreeRTOS	02

Software Requirements: Respective IDE platform
Hardware Requirements: Development board of 8051/ARM/STM32, etc

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of 40 Marks each on 40% syllabus for each test. The final marks will be the average of the 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. **Termwork Assessment:** Term work should consist of 8 experiments [Four Experiments should be considered from Experiment 1 to Experiment 8 and four should be from remaining from the proposed list given in above table] and one case study based on hardware/Simulation. Journal must include at

least 3 assignments on theory and practicals of "Embedded C Programming". The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks).

2. **Oral/Viva Assessment:** Viva exam to be conducted by Internal & External examiners.

Text Books:

1. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, New Delhi, 2009.
2. Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education (India) Private Limited, New Delhi, 2015, Edition 3rd.
3. Sriramlyer, Pankaj Gupta," Embedded Real Time Systems Programming", Tata McGraw Hill Publishing Company ltd., 2003.
4. Joseph Yiu,"The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 2014, 3rd Edition.
5. Dr. K.V. K. K. Prasad, "Embedded Real Time System: Concepts, Design and Programming", Dreamtech, New Delhi, Edition 2014.

Reference Books/sites:

1. David Simon, "An Embedded Software Primer", Pearson, 2009.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems - Real Time Interfacing", Publisher - Cengage Learning, 2012 Edition 3rd.
3. Andrew Sloss, Domnic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimising System Software", Elsevier, 2004
4. Frank Vahid, Tony Givargis, "Embedded System Design - A Unified Hardware/Software Introduction", John Wiley & Sons Inc., 2002. www.freertos.org

Back to Scheme

Course Code	Course Name	Credits
ET 304	**Programming (Java and scripting)**	01

Lab Objectives: Three to Four
L1. To understand the functions and expression used in java coding
L2. To learn how to implement object - oriented design with Java
L3. To understand how to use Java API's for program development
L4. To understand how to design applications with threads in Java
L5. To learn how to design Graphical User Interface (GUI) with Java Swing
L6. To learn how to handle and manage files in Java.

Lab Outcomes: Six Course Outcomes
LO1: Learn to write, compile, run and test simple Java programs
LO2. Learn to implement object - oriented programming concepts using Java Programming.
LO3. Learn to use and access packages and Applet's .
LO4. Understanding multithreading in Java and designing simple applications.
LO5. Learn to design GUI applications using Java Swing.
LO6. Managing Files and I/O Handling in Java.

Hardware Requirements: PC with windows OS, 64bit
Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ CaseStudy/ Seminar	**Detailed Lab/Tutorial Description**	**LO Mapping**
1	1	Java Program to find GCD of two number	LO1
2	1	Java program to convert binary number to Decimal and vise-versa	LO1
3	1	Java program to multiply two matrix using multi-dimensional array	LO1
4	2	Write a program to implement default and parameterized constructors.	LO2
5	2	Java program of painting in Applet	LO3
6	3	Write a program to implement multithreaded	LO4
7	3	To develop a program to display a table using swings.	LO5
8	3	Write a program to demonstrate Exception handling	LO6
9	1	Create a text file using Java file writer.	LO6
10	4	Mini Project using concept of Principles of Programming	LO6

Lab Assessments:

1. **Termwork Assessment:** Term work should consist of 10 experiments. Journal must include at least 2 assignments on content of theory and practical of "Java Programming".The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks).
2. **Oral/Viva Assessment**: Practical & oral exam to be conducted by Internal & External examiners. Practical execution (10 marks) & Oral (15 marks).

Text Books:

1. E Balagurusamy ,"Programming with Java – A Primer" , Forth Edition, Tata – Mcgraw-Hill Publication, 2010, ISBN: 978-0-07-014169
2. Khalid A. Mughal, Rolf W. Rasmussen, A Programmer's Guide to Java™ SCJP Certification Third Edition , Addison -Wesley
3. Joyce Farrell. Programming Logic and Design, Comprehensive, 6th edition

References:

1. H.M. Deitel, P.J. Deitel , "Java - How to Program" ,Fifth Edition, PHI Publication , 2003, ISBN:81-203-2371-8
2. Bruce Eckel " Thinking in Java", PHI Publication
3. Patric Naughton ,Michael Morrsison , "The Java Handbook " McGraw Hill Publication

Steven Holzner etal . Java 2 Programming, Black Book , Dreamtech Press, 2009

Back to Scheme

Course Code	Course Name	Credits
ET 305	**Professional Communication & Ethics II**	02

Course Objectives:

1. To enable learners to formulate professional documents in a structured manner that meets the corporate requirements.
2. To provide an appropriate environment, opportunity and scope to the learners to acquire skills such as collaboration, leadership qualities, assertiveness etc. necessary for group discussion and team building.
3. To promote the importance of having an impressive personality that will enhance self-esteem, build self-confidence and sensitize the learners in appropriate behavior.
4. To prepare the learners for campus placement, employability and competitive examination required for lifelong learning.
5. To inculcate the ethical code of conduct and corporate etiquettes.
6. To develop effective presentation, research and organizational and creative skills necessary for global and industrial set up.

Course Outcomes:

1. Learners will be able to acquire the writing skills necessary for professional documents to meet the corporate requirement.
2. Learners will be able to demonstrate the skills required for self-improvement and effective communication.
3. Develop self-confidence and behave professionally.
4. Learners will be able to perform successfully in competitive exams like GRE, CET and TOEFL
5. Able to determine the importance of ethics and etiquettes in social and professional situations.
6. Able to illustrate effective presentation, research organizational and creative skills necessary for lifelong learning.

Prerequisite: Basic language skills

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Structure, Style and Language of Report Writing	1.1 Introducing the purpose , aim, objective and format of report 1.2 Literature review-ability to gather and analyse information from different sources and summarize. Specific emphasis on plagiarism, use of quotation marks appropriately. 1.3 Research Methodology 1.4 Presenting data-figures, diagrams and labelling 1.5 How and why to write discussion 1.6 Citing and referencing- IEEE format 1.7 Writing an abstract	6	CO1

II	Writing Technical Proposals	1.1 Format 1.2 Executive summary 1.3 Defining the problem and presenting the solution 1.4 Summarizing a technical proposal	4	CO1
III	Oral Skills For Employability	1.1 Group Discussion- with special reference to leadership qualities, assertiveness, analyzing the topic, developing different perspectives, introducing and concluding the discussion. 1.2 Interview-with special reference to introducing oneself and answering questions with confidence. 1.3 Presentation Skills-with special reference to preparing slides, dress code, non-verbal communication including paralinguistic features, introduction and conclusion.	4	CO2, CO4, CO6
IV	Personality Development and Social Etiquettes	3.1. Personality Development ● Improving self-awareness-analyzing our own experiences,looking at ourselves through the eyes of others ● Knowing and Building your own identity ● Discovering and Developing your talents ● Teamwork/collaboration 3.2. Social Etiquettes ● Formal Dining Etiquettes ● Cubicle Etiquettes ● Responsibility in Using Social Media ● Showing Empathy and Respect ● Learning Accountability and Accepting Criticism ● Demonstrating Flexibility and Cooperation ● Selecting Effective Communication Channels	5	CO3, CO5
V	Ethics and Ethical codes of conduct	5.1 Writing Resume and statement of purpose 5.2 Business and corporate activities(special emphasis on business meetings) 5.3 Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions.	3	CO4, CO5
VI	Content writing	6.1 Research Skills 6.2 Organizational skills 6.3 Creative Writing- Blog posts, Web pages etc.	4	CO6

Sr. No.	Details of Assignments	Details of Activities	Hours	CO Mapping
I	Written assignment on Literature Review 20 page report on technical topic (to be included as part of term work)	Sample IEEE papers to be shared with students and train them to identify contributions of each author. These contributions can then be written in the format required in journals.	5	CO1, CO5
II	Written assignment on summarising a technical proposal 4 page technical proposal (to be included as part of term work)	Example of summarising techniques to be demonstrated.	4	CO1, CO5
III	Oral Skills for Employability- to be included in term work.	Role play and mock interviews Mock group discussion Mock presentation	2 4 4	CO2, CO3, CO4
IV	Written Assignment on Documentation of Business Meeting	Mock meetings	2	CO1, CO4
V	Written Assignment on Resume writing/ Statement of Purpose.	NA	2	CO3
VI	Written Assignment on Blog Posts	NA	2	CO6

Assessment:

Term work will consist of-

1. Assignments - 10 marks
2. Group Discussion - 10 marks
3. Interviews - 5 marks
4. Report - 5 marks
5. Technical Proposal - 5 marks
6. Attendance - 5 marks
7. Presentation - 10 marks

References:

1. Raman Meenakshi & Sharma Sangeeta, *Communication Skills*, Oxford University Press
2. Kumar Sanjay & Lata Pushp, *Communication Skills*, Oxford University Press
3. Virendra Singh Nirban, Krishna Mohan, RC Sharma, *Business Correspondence and Report Writing*

Back to Scheme

Course Code	Course Name	Credits
ET 306	IOT Basics & Smart Sensors	04

Prerequisite:
Microprocessor & Microcontroller

Course Objectives: Introduce evolution of internet technology and need for IoT.

1. Discuss on IoT reference layers and various protocols and software.
2. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized, and analyzed.
3. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of the basic laws and phenomena on which operation of sensor transformation of energy is based, measurement and theory of instruments and sensors.
4. Train the students to build IoT systems using sensors, single board computers and open source IoT platforms.
5. Make the students apply IoT data for business solutions in various domains in a secure manner.

Course Outcomes:

1. Identify the IoT networking components with respect to the OSI layer.
2. Build schematic for IoT solutions .
3. Design and develop IoT based sensor systems.
4. Select IoT protocols and software.
5. Evaluate the wireless technologies for IoT.
6. Appreciate the need for IoT Trust and variants of IoT and compete in the design, construction, and execution of systems for measuring physical quantities

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Internet of Things	Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Trends in the Adoption of IoT, Societal Benefits of IoT, Risks, Privacy, and Security. Exemplary Device Boards, Arduino, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases	5	1

II	Sensing and Actuation	Sensor fundamentals and characteristics, Optical Sources and Detectors, Intensity Polarization and Interferometric Sensors, Strain, Force, Torque and Pressure sensors, Position, Direction, Displacement and Level sensors, Velocity and Acceleration sensors, Flow, Temperature and Acoustic sensors, Actuators and its types: Hydraulic, Pneumatic, Electrical, Thermal, Magnetic	7	2
III	Networking and the Internet of Things	IoT and Machine to Machine Communications, IoT protocols, Network configurations, Network Operator Requirements, SNMP, NETCONF, YANG, Interoperability in IoT. SDN	6	3
IV	Sensor Networks and IoT	Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. Sensor Network Architecture: Data Dissemination, Flooding and Gossiping-Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs- Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling, Amplifiers and Sensor Noise, Importance and Adoption of Smart Sensors, Architecture of Smart Sensors	9	4
V	Cloud Computing	Interfacing and data logging with cloud, Evolution of Cloud Computation, Commercial clouds and their features, open source IoT platforms, cloud dashboards, Fog Computing, Introduction to big data analytics and Hadoop.	7	5
VI	Developing Internet of Things Data Analytics and Tools for IoT	IoT security, Need for encryption, standard encryption protocol, lightweight cryptography, Quadruple Trust Model for IoT-A – Threat Analysis and model for IoT-A, Cloud security	5	6

Lab Syllabus

Sr. No	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	IoT systems Working with Raspberry pi using Python. Arduino platform Working with open source clouds	02
2	Design	Python Programming for IoT Systems: Basic operations, String manipulation, Dictionary, Signal plotting, processing and graphics on cloud	02

3	Basic	Develop a displacement measurement system with the following sensors: i. Inductive transducer (LVDT) ii. Hall effect sensor	02
4	Design	After studying the characteristics of temperature sensors listed below, develop a temperature measurement system for a particular application using the suitable sensor. i. Thermocouple principles ii. Thermistor and linearization of NTC Thermistor iii. Resistance Temperature Detector iv. Semiconductor Temperature sensor OA79 v. Current output absolute temperature sensor Based on sensing experiments carried out suggest a noncontact method and try to complete its proof of concept.	02
5	Basic	Embedded Programming and IoT: C programming, Declarations and Expressions, Arrays, Pointers, Constructs, Data structures and Linked list, Embedded C (Keil).	02
6	Design	Working with ARM (Keil and energia) Sub Task 1: Peripheral programming of ARM7 board Sub Task 2: PWM generation Sub Task 3:Configuring CC3200, wifi configuration ,HTTP and MQTT Protocol	02
7	Basic	Working with MSP430 (CCStudio) Sub Task 1: Port programming of MSP430 microcontrollers Sub Task 2: Analog to Digital Conversion using MSP430 microcontroller Sub Task 3: LCD display of characters and numbers. Sub Task 4: Timer	02
8	Design	Low power wireless transmission using Zigbee Sub Task 1 : Interfacing Zigbee controller with MSP 430 microcontroller using SPI/UART. Sub Task 2: Programming sleep and wake up mode of MSP 430.	02
9	Advanced	Design a method to analyze liquid flow velocity using a non-contact measurement technique(Laser/Ultrasonic sensor). Record the dynamic flow velocity using LabVIEW	02
10	Advanced	Consider a real time data available in college campus and develop a data analytic system to determine the average, trend and prediction	02
11	Project	Mini Project	04

Software Requirements:
Arduino IDE, Noobs, Keil and energia, CCStudio

Hardware Requirements:
Arduino, Raspberry Pi, ARM7 Board, MSP430, Inductive transducer, Hall Effect sensor, Thermocouple, Thermistor, Temperature sensor, LCD Display, Zigbee Chip, Motors, LabVIEW and Peripherals, Miscellaneous

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:

Term work for 25 marks:

At least 10 Experiments from the above mentioned list must be performed during the "Laboratory session batch wise". A mini project based on the entire syllabus must be performed by every student individually (can be hardware or Computation/simulation based project must be encouraged). Term work assessment must be based on the overall performance of the student with experiments and assignments graded from time to time.

End Semester Practical/Oral Examination: 25 Marks

Pair of Internal and External Examiner should conduct practical/viva based on contents. Distribution of marks for practical/viva examination shall be as follows:

Practical Examination: 15 Marks Oral Examination: 10 Mark

Text Books:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk"
2. Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2016
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David

Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.

4. Jacob Fraden, "HandBook of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
5. Jon. S. Wilson, "Sensor Technology Hand Book", 2011, 1st edition, Elsevier, Netherland.

References:

1. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014
2. LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning, The Internet of Things: From RFID to the Next-Generation Pervasive Network, Aurbach publications, March,2008.
3. RonaldL. Krutz, Russell Dean Vines,Cloud Security: A Comprehensive Guide to Secure Cloud Computing,Wiley-India, 2010.
4. John G Webster, "Measurement, Instrumentation and sensor Handbook", 2017, 2nd edition, CRC Press, Florida.
5. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition, John Wiley, New York.

Text Books:(For Laboratory)

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David

Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.

2. Jacob Fraden, "HandBook of Modern Sensors: physics, Designs and Applications", 2015, 3rd edition, Springer, New York.
3. John H. Davies, "MSP430 Microcontroller Basics", 2011, 2nd edNewnes publishing, New York.
4. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks"

2011, 1st ed., John Wiley & Sons, New Jersey

References:(For Laboratory)

1. Vijay Madisetti , Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally "Internet of Things: A Hands-on-Approach" Arshdeep Bahga & Vijay Madisetti, 2014.
2. Bahaa E. A. Saleh and Malvin Carl Teich, "Fundamentals of photonics", 2012, 1st edition,

John Wiley, New York.
3. Sergey Y. Yurish,"Digital Sensors and Sensor Systems: Practical Design", 2011, 1st ed., IFSA publishing, New York.

4. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", 2009, 1 st ed., John Wiley & Sons, New Jersey.

Back to Scheme

Course Code	Course Name	Credits
ET 307	PCB Design and Electronics Equipment Troubleshooting	04

Prerequisite:
Basic Circuit theory, Electromagnetics

Course Objectives:

1. Understanding of PCB design fundamentals
2. Ability to select the circuit, components and prepare layout
3. Ability to design PCB and perform drilling, component mounting, soldering, tinning, masking and testing.
4. Ability to design a PCB with SMD Components
5. Inculcate PCB design rules at high frequencies and to be aware of SMD components and packages.
6. To develop a skill set to work on real life projects and design

Course Outcomes:

1. Explain types of PCBs and basic procedure to design a PCB
2. Identify various tools and to become familiar with electronic components and their packages/footprints
3. Illustrate the use of PCB CAD tools and their features for practical designs and schematic preparation.
4. Fabricate PCB and become familiar with drilling, tinning, masking and soldering of components.
5. To compare PCB design at high frequency with low frequency
6. Fabricate PCBs for simple and advanced circuits and perform hardware testing to validate the design.

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of PCB Design	Types of PCBs: General purpose, Single sided, Double Sided, Multi-layered PCBs. PCB materials, Introduction to layout Design, Rules for track (track length, width, size, joint and angle etc) PCB Design rules at radio frequency, Photolithography, Introduction to softwares like Eagle, Express-PCB, OrCAD, Ki-CAD, Altium, Proteus. Files and their extensions, Schematic/Layout editor, library editor, Text editor, preparation of Gerber/dxf/dwg/step/iges files, Short-cut keys and special commands, Forward and backward annotation, Electrical components and packages, Component libraries, footprint,	6	CO1, CO2

		symbol, Plug ins, Routing, Assembling, Multi-layered PCB Design, Making of Schematic Symbol, Export, import and modify library components, Making of component footprints, Portability/compatibility of project files		
II	PCB fabrication processes	**Pre-PCB fabrication processes:** Selection of circuit and components, Selection of PCB type, track printing, legend printing, Schematic preparation, Electronic rule checking (ERC) **Post-PCB fabrication processes: Implementation of PCB:** Etching, tinning, Masking (Green, Red, White, Black, Blue and Pink), Drilling, pads, vias, Component mounting, soldering, EMI-EMC issues, Hardware testing, Packaging / Enclosure Design	8	CO3, CO4
III	Advanced PCB Design	High frequency PCB design technology, Selection of SMD (Surface mounted devices) components packages / libraries and its mounting, Design Rules, Plated through hole technology	7	CO3, CO4
IV	Introduction to Troubleshooting	Troubleshooting Basics, Safety measures and Precaution during Troubleshooting, Common Troubleshooting Techniques, Test and Measuring instruments for troubleshooting, Measurement of A.C. voltage and D.C. voltage using multimeter for the given circuit, Continuity test of PCB track, wiring, switch etc., Inspection of solder joints, defects of soldered joints in given circuits.	5	CO5
V	Device Troubleshooting	Testing of Active and passive components separately or Mounted on PCB like: Resistor, Capacitors, Inductors, Switches, Relays, Transformers, Fuses, Connectors, Single/three phase MCBs, single phase ELCBs, RJ45 connector, Diodes, Transistors, FETs, MOSFET, SCR, DIAC,TRIAC, Displays (LCD or LED), Opto electronics components, Crystal oscillator, Fault diagnosis in op-amp circuits. Testing Various parameters of electronic active/passive components using a data book.	7	CO6
VI	Troubleshooting Digital Circuits	Logic IC families, Packages in Digital ICs, IC identification, IC pin-outs, Handling ICs, Digital troubleshooting methods – typical faults, testing digital ICs with pulse generators, Special consideration for fault diagnosis in digital circuits, Handling	6	CO6

		precautions for ICs sensitive to static electricity, Testing flip-flops, counters, registers, multiplexers and demultiplexers, encoders and decoders; Tri-state logic. Testing Various parameters of digital IC using data book.		

Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Design	Design of a General Purpose PCB for Basic Circuit	02
2	Design	Implementation of Single sided Glass epoxy PCB for an Electronic Circuit.	02
3	Design	Implementation of both sided Glass epoxy PCB for an Electronic Circuit.	02
4	Design	Implementation of multi-layered PCBs for an Electronic Circuit.	02
5	Advanced	Implementation of PCB with SMD Components	02
6	Advanced	Implementation of Both sided PCB Using PTH (Design of SIW)	02
7	Basic Design	Mini-Project -1	02
8	Advanced Design	Mini-Project -2	02

Software Requirements: EAGL/Ki-CAD/ ORCAD/Express-PCB/Altium/Proetis/ Hardware Requirements: PCB Board, PCB Lab setup, SMD and PTH Setup.

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:
Termwork Assessment: Term work should consist of 10 experiments. Journal must include at least 2 assignments on content of theory and practical of "Java Programming".The final certification and acceptance of term work ensures that satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks)
Oral/Viva Assessment: Practical & oral exam to be conducted by Internal & External examiners. Practical execution (10 marks) & Oral (15 marks).

Text Books:

1. Simon Monk, Make your own PCBs with EAGLE: From Schematic Designs to Finished Boards, 1st Edition, McGraw Hill Education.
2. P. Horowitz and W. Hill, The Art of Electronics, 3rd Edition, Cambridge University Press.
3. Henry W. Ott, "Electromagnetic Compatibility Engineering", A John Wiley and Sons, Inc. Publication.
4. Matthew Scarpino, Designing Circuit Boards with EAGLE: Make High Quality PCBs at Low Cost, 1st Edition, Prentice Hall.Archambeault and Drewniak James, PCB Design for Real World EMI Control, Springer Publication

Back to Scheme

Course Code	Course Name	Credits
ET 308	Basics of VLSI Design	04

Course Objectives:

1. To teach fundamental principles of VLSI circuit design and layout techniques.
2. To highlight the circuit design issues in the context of VLSI technology
3. To explain different scaling effects.
4. To study CMOS gates and effect of W/L ratio.
5. To study dynamic gates and circuit realization using pass transistors.
6. To design semiconductor memories and its importance.

Course Outcomes: Upon successful completion of the course students will be able to

1. Apply the knowledge to demonstrate a clear understanding of choice of technology and technology scaling.
2. Explain the design of MOSFET Inverters.
3. Analyze and design MOS based circuits design styles.
4. Understand CMOS gates and effect of W/L ratio.
5. Understand dynamic gates and circuit realization using pass transistors.
6. Understand the design of Semiconductor Memories.

Prerequisite: Analog Electronics Circuits, Digital Circuits and System Design (DCSD)

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hrs
1	**Technology Comparison MOSFET Scaling**	Comparison of BJT, NMOS and CMOS technology Types of scaling, MOSFET Models, MOSFET capacitances	5
2	**MOSFET Inverters**	**Circuit Analysis:** Static and dynamic analysis (Noise, propagation delay and power dissipation) of resistive load, E mode MOSFET load, D mode MOSFET load inverter and CMOS inverter, comparison of all types of MOS inverters, design of CMOS inverters	7
3	**Universal gates, Complex circuits using MOSFETs**	**Logic Circuit Design**: Analysis and design of 2-I/P NAND and NOR using equivalent CMOS inverter, W/L ratio, Complex circuits	7
4	**MOS Circuit Design Styles**	**Design Styles:** Static CMOS, pass transistor logic, transmissiongate, Pseudo NMOS, Domino, NORA, Zipper, C2MOS, sizing using logical effort	8
5	**Circuit Realization using MOSFETs**	**Circuit Realization:** SR Latch, JK FF, D FF, 1 Bit ShiftRegister, MUX, decoder using above design styles	6

6	**Semiconductor Memories**	**SRAM:** ROM Array, SRAM (operation, design strategy, leakage currents, read/write circuits), DRAM (Operation, leakage currents, refresh operation), Flash memory-NOR Flash, NAND flash.	**6**

DETAILED LAB SYLLABUS:

Software Requirements: TINA**,** NGSpice, Microwind

Sr. No.	**Detailed Lab Description**
1	Effect of parasitic capacitance and threshold voltage on output of NMOS inverter with resistive load.
2	Circuit characteristics and performance estimation of NMOS inverter with resistiveload. 1) Verification of V_{OH} level for different values of load resistance. 2) Find rise time for different values of load resistance.
3	Circuit characteristics and performance estimation of NMOS inverter with Enhancement mode MOSFET load.
4	Circuit characteristics and performance estimation of NMOS inverter with Depletion mode N channel MOSFET as a load.
5	Circuit characteristics and performance estimation of CMOS inverter. 1) Verification of V_{OH} and V_{OL} levels. 2) Comparison of rise and fall times for different values of W/L ratio of pull up and pulldown devices.
6	Circuit characteristics and performance estimation of CMOS Dynamic 2 Input NANDGate. 1) Verification of V_{OH} and V_{OL} levels for various input possibilities. 2) Verification of precharge and evaluate condition for different inputs. 3) Verification of charge leakage problem.
7	Design of 4:1 MUX using pass transistor logic and transmission gates.
8	Design of 6T SRAM using Microwind dsch3.1.

Theory Assessments:

1. Internal Assessment: Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. End Sem Theory Examination:

- Question paper will consist of 4 questions, each carrying 20 marks.
- Total 3 questions need to be solved.
- Q.1 will be compulsory, based on the entire syllabus.
- Remaining questions will be randomly selected from all the modules.
- Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

- Term work should consist of 8 experiments.
- Journal must include at least 3 assignments.

1. **Term work Assessment:**

Total 25 Marks (Experiments: 10-marks, Assignments: 10-marks, Attendance Theory & Practical: 05-marks)

2. **Oral/Viva Assessment**:

Based on the above contents and entire syllabus.

Text Books:

1. Sung-Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits Analysis and Design", Tata McGraw Hill, 3rd Edition.
2. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition.

References:

1. Etienne Sicard and Sonia Delmas Bendhia, "Basics of CMOS Cell Design", Tata McGraw Hill, First Edition. 2. Neil H. E. Weste, David Harris and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 3rd Edition.
2. Debaprasad Das, "VLSI Design", Oxford, 1st Edition. 6. Kaushik Roy and Sharat C. Prasnad, "Low-Power CMOS VLSI Circuit Design", Wiley, Student Edition

Back to Scheme

Course Code	Course Name	Credits
ET 309	**Data Processing and Coding**	04

Prerequisite:
Electronics Communication System Digital Communication
Course Objectives:

To teach the students

1. Lossy & Lossless compression techniques for Text.
2. Compression techniques for Audio signals.
3. Lossy & Lossless compression techniques for Image & Video.
4. Goals and design principles for cryptography and common structures of secret key primitives such as block and stream ciphers and message authentication codes.
5. Basic key management techniques in both secret key and public key cryptography.
6. Network and Web Security.

Course Outcomes:
After successful completion of the course student will be able to

1. Define compression; understand compression as an example of representation
2. Implement text, audio and video compression techniques.
3. Translate the most common file formats for image, sound and video.
4. Understand basic principles of cryptography and general cryptanalysis & be acquainted with the concepts of symmetric encryption and authentication.
5. Compare & Contrast Symmetric and Asymmetric Key Cryptography schemes.
6. Compose, build and analyze simple cryptographic solutions

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Text Compression	1. Introduction to Information theory: Entropy, Information Value, Data Redundancy. 2. Statistical Methods: Shannon-Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding. 3. Statistical Methods: Arithmetic Coding (Encoding, Decoding, Adaptive Coding). 4. Dictionary Methods: LZ77, LZ78, LZW Algorithms.	8	CO1,CO2
II	Audio Compression	Sound, Digital Audio, μ-Law and A-Law Companding, MPEG – ½ Audio Layer (MP3 Audio Format)	5	CO2,CO3
III	Image & Video Compression	1. Image Compression: Discrete Cosine 2. Transform, JPEG. Differential Lossless Compression, DPCM 3. Wavelet Methods: Discrete Wavelet Transform, JPEG 2000.	5	CO2,CO3

		4. Video Compression: Analog Video, Digital Video, Motion Compensation, Temporal and Spatial Prediction. MPEG and H.264.		
IV	Data Security	1. Security Goals, Cryptographic Attacks, Techniques 2. Symmetric Key: Substitution Cipher, Transposition Cipher , Stream and Block Cipher 3. DES, AES	8	CO4
V	Number Theory and Asymmetric Key Cryptography	1. Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm 2. RSA, attacks on RSA, Diffie Hellman key exchange, key management, and basics of elliptical curve cryptography 3. Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm.	8	CO5
VI	System Security	Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.	5	CO6

Lab Syllabus

Lab Prerequisite: Knowledge of MATLAB/SCILAB

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	2	To implement Huffman Coding	02
2	2	To implement Arithmetic coding	02
3	2	To implement LZ77/78 Coding	02
4	2	To implement LZW Coding	02
5	3	To implement one dimension & two-dimensional DCT	02
6	2	To implement Chinese Remainder Theorem	02
7	2	To implement Caesar Cipher Algorithm	02
8	2	To implement Transposition cipher	02
9	3	To implement Diffie Hellman key exchange Algorithm	02
10	3	To implement RSA algorithm	02

Software Requirements: MATLAB/SCILAB

Hardware Requirements:NIL

Theory Assessment:

Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:
Term Work: **25 Marks**
End Semester Practical/Oral Examination 25 marks:

Text Books:

1. Mark Nelson, Jean-Loup Gailly,The Data Compression Book,2nd edition, BPB Publications
2. Khalid Sayood, Introduction to Data Compression, 2nd Edition Morgan Kaufmann.
3. William Stallings, ―Cryptography and Network Security Principles and Practices 5th
4. Edition, Pearson Education.
5. Behrouz A. Forouzan, ―Cryptography and Network Security, Tata McGraw-Hill.

References:

1. David Salomon, ―Data Compression: The Complete Reference, Springer.
2. Matt Bishop, ―Computer Security Art and Science, Addison-Wesley.

Back to Scheme

Course Code	Course Name	Credits
ET 310	**TV & Video Engineering**	04

Prerequisite:
Electronic Communication System

Course Objectives:

1. To understand basic concepts of TV system
2. To learn the importance of the digitization in Television Engineering
3. To become well conversant with new development in video engineering.
4. To understand compression techniques
5. To introduce to advanced systems and dvb standards
6. Describe the modern display devices like.

Course Outcomes:

1. Understand overview of TV system.
2. Able to understand NTSC and PAL Television system and concept of Colour theory in Colour TV.
3. Able to recollect digitization in television and compression technique.
4. Understand details of Know about different dvb standards.
5. Understand advanced digital systems
6. Understand various display device

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of TV system	1.1 Elements of TV system, Transmitter and receiver- block diagram approach, interlaced scanning, composite video signal, VSB transmission and reception 1.2 Camera Tubes: Vidicon, Image Orthicon	8	CO1
II	Colour TV Standards	2.1 Colour fundamentals, mixing of colors , color perception, chromaticity diagram, Color TV systems 2.2 NTSC, PAL systems, colour TV transmitter, colour TV receivers.	8	CO2
III	Fundamental Concept of Digital Video	3.1 Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameters (Digitization, pixel array, scanning notation, viewing distance and angle, aspect ratio, frame rate and refresh rate.) 3.2 Chroma subsampling: 4:4:4,4:2:2,4:2:0,4:1:1 digital video formats	10	CO3

		3.3 Video compression standards: MPEG2:DCT coding, codec structure. Introduction to H.264/MPEG-4 AVC, Introduction to H.265 Direct-to-home TV(DTH)		
IV	Digital Video Broadcasting	4.1 Introduction to DVB-T,DVB-T2,DVB-H,DVB-S,DVB- C	6	CO4
V	Advanced Digital TV Systems	5.1 MAC signal, D2-MAC/packet signal, MAC decoding and interfacing, advantages of MAC signal, HDTV, MUSE, Smart TV and its functions IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G mobile System, Digital	10	CO5
VI	Displays Device	6.1 LCD,LED 6.2 Chromecast	4	CO6

Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4.Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	To acquire the knowledge of the RF section and IF section of the TV trainer kit and test faults in both sections.	02
2	Basic	To test various faults in the Horizontal & Vertical Oscillator section of the TV trainer kit.	02
3	Basic	To understand and test faults in the Video and Chroma section of TV trainer kits.	02
4	Basic	Study block diagram and functioning of different sections of wi-fi/ Smart LED Television	02
5	Design	Develop an algorithm to compress the image/video using morden compression methods.	02
6	Advanced	To Study the function of front panel control keys and remote control keys of smart LED TV.	02
7	Advanced	Study and measure voltage of the power supply section.	02
8	Advanced	To understand the LED interface section.	02
9	Advanced	To acquire the knowledge of direct to home television system	02
10	Advanced	To study various waveform and important voltages level in DTH system	02

Theory Assessment:

Internal Assessment for 40 marks:

Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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. **Termwork 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 attempt 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/tutorial 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. Television and video Engineering, A. M. Dhake, Tata McGraw Hill Publication
2. Monochrome and colour Television by R.R.Gulati
3. R.G.Gupta , "Television and Video Engineering", Tata Mc Graw Hill publication.
4. Dhake A.M, "Television and Video Engineering", Tata McGraw Hill publication.
5. Keith Jack, "Video Demystified", 4e, Elsevier

References:

1. Charles Poynton, "San Francisco, Digital video and HDTV, Algorithms And Interfaces," Morgan Kaufmann publishers, 2003.
2. Digital Television (Practical guide for Engineers) by Fischer

Back to Scheme

Course Code	Course Name	Credits
ET 311	**Computer Communication & Network**	04

Course Objectives:

1. To develop an understanding of computer networking basics.
2. Describe how computer networks are organized with the concept of layered approach.
3. Analyze the contents in a given data link layer packet, based on the layer concept.
4. Describe what a classless addressing scheme is? Design logical sub-address blocks with a given address block.
5. Describe how routing protocols , transport layer and application layer protocols work.

Course Outcomes: Six (Based on Bloom's Taxonomy)

1. Demonstrate the concepts of data communication at the physical layer and compare ISO - OSI model with TCP/IP model.
2. Demonstrate the knowledge of networking protocols at the data link layer.
3. Design the network using IP addressing and subnetting / supernetting schemes.
4. Analyze various routing algorithms and protocols at the network layer.
5. Analyze transport layer protocols and application layer protocols.
6. Develop knowledge and skills necessary to gain employment as computer network engineer and network administrator.

Prerequisite: Basic knowledge of Computer Theory

Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Computer Network and Physical Layer Specifications	Overview of OSI Model, of TCP/IP Protocol Suite, Applications of Computer Networks, Software Primitives, Transmission Media, Network devices, Switching, Physical Layer Coding	6	CO1
II	Framing and Channel Allocation, Error Control	Bits stuffing, Byte Stuffing, Character Coding, HDLC, PPP, CRC, Checksum, Hamming Code, Overview ARQ, Dynamic Channel Allocation(CSMA/CD, CSMA/CA)	7	CO2
III	IP addressing (IP v4, IPv6)	Classful, classless addressing, Subnetting, IPV4, IPV6, Migration from IPv4 to IPV6	6	CO3,CO6
IV	Routing(interdomain, Intradomain),	Types of Routing, Routing Algorithm: Distances Vector Routing, Link state Routing Path vector Routing,	5	CO4,C06
V	TCP and UDP services, Socket Programming	TCP header, 3-way connection Establishment, TCP services: Error Control, Flow control , Congestion Control, TCP state transition diagram, TCP timers, UDP header, Socket Programing,Client Server programing	8	CO5,CO6

VI	HTTP, FTP, Mailing Protocols, DNS, DHCP,	Application Layer Services, HTTP, FTP , TFTP, SNMP, POP3 , IMAP4,DNS, DHCP	7	CO5,CO6

Laboratory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	To perform crimping and set up a LAN connection.	02
2	Design	To configure a network using Distance Vector Routing Protocol-RIP using Cisco Packet Tracer.	02
3	Design	Configure a network using Path Vector Routing Protocol- BGP using Cisco Packet Tracer	02
4	Advanced	To perform subnetting using Cisco Packet Tracer	02
5	Advanced	To configure the DHCP server.	02
6	Basic	To study about the NS2 simulator in detail.	02
7	Advanced	To Simulate and to study stop and Wait protocol using NS 2.1	02
8	Advanced	To Simulate Sliding Window protocol using NS 2.1	02
9	Project	Mini Project	02

Software Requirements: Cisco Packet Tracer, NS2

Hardware Requirements: Network Devices: Routers, Switches, Crimping Tool

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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. Termwork Assessment: At least 08 Experiments including 02 simulations covering the entire syllabus must be given during the ―Laboratory session batch wise". 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. Based on the above scheme grading and term work assessment should be done.
2. Oral/Viva Assessment: The practical and oral examination will be based on the entire syllabus.

Textbooks:

1. Computer Networks, Fifth Edition, Andrew S. Tanenbaum.
2. TCP/IP Protocol Suite, Tata McGraw Hill, Behrouz A. Forouzan

References:

1. DATA AND COMPUTER COMMUNICATIONS Eighth Edition William Stallings
2. Computer Networking: A Top-Down Approach, 6th Edition. James Kurose. Keith W. Ross

Back to Scheme

Course Code	Course Name	Credits
ET 312	**Database Management System**	04

Prerequisite: C Programming, Python Programming

Course Objectives:
1. Understand the requirement of Database Management System
2. Develop entity relationship data model and its mapping to relational model
3. Learn relational algebra and Formulate basic SQL queries
4. Formulate Advance complex SQL queries
5. Apply normalization techniques to normalize the database
6. Understand the concept of transaction, concurrency control and recovery techniques.

Course Outcomes:
1. Recognize the need of database management system and understanding Data Models
2. Design ER and EER diagrams for real life applications and Construct relational models for the same.
3. Formulate SQL queries and design Database.
4. Analyze Database using complex SQL queries
5. Apply the concept of normalization to relational database design.
6. Describe the concept of transaction, concurrency and recovery.

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to DBMS	Characteristics of database, Database users, Advantages of DBMS , Data Models , Schemas and Instances, DBMS system Architecture, Three schema Architecture and Data Independence, Data abstraction	4	CO1
II	Entity–Relationship Data Model and Relational Model	The Entity-Relationship (ER) Model: Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Relationship constraints: Cardinality and Participation, Design of an E-R database schema; Extended E- R features; Introduction to the Relational Model, relational schema and concept of keys. Reduction of an E-R schema to EER schema; Reduction of an E-R schema to tables.	6	CO2
III	Structured Query Language (SQL)	Overview of SQL, Data Definition Commands, Basic SELECT Queries,SELECT Statement Options,FROM Clause Options,Integrity constraints: key constraints, Domain Constraints, Referential integrity , check constraints, Data Manipulation commands, Data Control commands	7	CO3

IV	Advanced SQL	Nested and Complex Query, SQL with SET operations: Union, Intersect, Except, etc, Aggregate Functions,Group By, Having, SQL with Logical operations, Join Queries, Virtual Tables: Creating a View, Sequences,Procedural SQL, Embedded SQL Database Design:The Information System,The Systems Development Life Cycle, The Database Life Cycle, Conceptual Design, DBMS Software Selection, Logical Design, Physical Design, Database Design Strategies, Centralized versus Decentralized Design.	10	CO4
V	Relational-Database Design	Pitfalls in relational-database design, Concept of normalization, Function Dependencies, First Normal Form, 2NF, 3NF, BCNF, 4NF	6	CO5
VI	Transactions Management and Concurrency and Recovery	Transaction concept, Transaction states, ACID properties, Transaction Control Commands, Concurrent Executions, Serializability-Conflict and View, Concurrency Control: Lock-based, Timestamp-based protocols, Recovery System: Log based recovery, Deadlock handling	6	CO6

Laboratory Syllabus:

Lab Prerequisite: C Programming, Python Programming

Sr. No.	Level 1.Basic 2.Design 3.Advance 4.Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	Hours
1	1	Identify the case study and detailed statement of the problem.	02
2	2	Design an Entity-Relationship(ER)/ Extended Entity-Relationship (EER) Model.	02
3	2	Mapping of ER Diagram to Relational Schema Model	02
4	3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System.	02
5	3	Apply DML commands for the specified system.	02
6	3	Perform Merge Operation	02
7	3	Perform Aggregation Function and Clauses in SQL	02
8	3	Perform Join Operation	02
9	3	Perform Trigger Function and view in Postgresql	02

10	4	Analysis of any Database / case study	02
11	4	Application of the knowledge on mini project	02

Software Requirements: SQL server (Oracle/MySQL/PostGreSQL)

Hardware Requirements: 2GB RA

Theory Assessment:

Internal Assessment for 40 marks:
1. Consisting of One Compulsory Internal assessment of 40 Marks
2. Continuous evaluation : Test/Assignments /Quiz/Case studies/project/Seminar presentation of 40 Marks

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. Teamwork Assessment: Term work should consist of 10 experiments. Journal must include at least 2 assignments on content theory and practical of "Database Management System". The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments:05-marks).

2. Oral/Viva Assessment: Practical & oral exam to be conducted by Internal & External examiners. Practical execution (10 marks) & Oral (15 marks).

Text Books:

1. Elmasri & Navathe, "Fundamentals of Database System", 7 th Edition, Addison Wesley Publication.(2015).
2. Abraham Silberschatz, Henry Korth, Sudarshan , "Database System Concepts", 6th Edition, (2010)
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rdEdition, McGraw-Hill, (2002)

References:

1. Michael Mannino, "Database design, Application Development and Administration", 4th Edn(2008)
Peter Rob and Coronel, "Database systems, Design, Implementation and Management", 5th Edition, Thomson Learning,2001
3. C. J. Date, "Introduction To Database Systems", Seventh Edition, Addison Wesley

Text Books (For Laboratory)

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6thEdition, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of Database Systems, 5thEdition, Pearson Education.
3. Dr. P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press.

References (For Laboratory)

1. Microsoft SQL Server Black Book By Patrick Dalton
2. https://www.w3schools.com/sql/
https://www.postgresqltutorial.com

Back to Scheme

Course Code	Course Name	Credits
ET 391	**Mini Project III**	02

Course Objectives:

1. To develop background knowledge Embedded Systems.
2. To understand the design of embedded systems.
3. To choose proper microcontroller for Embedded systems
4. To understand use of wireless sensors/communications with Embedded systems
5. To understand communication techniques.
6. To write programs for embedded systems and real time operating systems /IoT

Course Outcomes: After successful completion of the course, the student will be able to

1. Understand the embedded systems with design metrics.
2. Understand microcontrollers and programming in Embedded C.
3. Implementation of Embedded systems with different sensors.
4. Implementation of Embedded systems with different communication protocols.
5. Anayze concepts of Real time operating systems.
6. Design embedded system applications using sensors, peripherals and RTOS

Course Contents :

Guidelines for mini project

Mini Project should be completely microcontroller based.

a) Take specifications, using these specifications design projects.

b) Select proper microcontroller board considering features and requirements of the project.

c) Program it using Embedded C and perform verification of each module

d) Test Functional Simulation and verify it using a simulation tool.

e) Make hardware connection of peripherals with microcontroller board and execute the program.

f) Troubleshoot if not get expected result

A: Execution of Project:

Project group shall consist of not more than 4 students per group. Project Work should be carried out in the Design / Projects Laboratory.

Project designs ideas can be necessarily adapted from recent issues of electronic design Use of Hardware devices/components is mandatory.

Layout versus schematic verification is mandatory Assembly of components and enclosure design is mandatory.

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

B: Selection of Project :

The Project may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on Learning additional skills.

C: Weekly Interaction of project team and project guide :

Week 1 & 2: Formation of groups, Finalization of Mini project & Distribution of work. Week 3 & 4: PCB artwork design using an appropriate EDA tool, Simulation.

Week 5 to 8: PCB manufacturing through vendor/at lab, Hardware assembly, programming (if required) Testing, Enclosure Design, Fabrication etc

Week 9 & 10: Testing of final product, Preparation, Checking & Correcting of the Draft Copy of Report Week 11 & 12: Demonstration and Group presentations.

Log book for all these activities shall be maintained and shall be produced at the time of examination.

D. Report writing : A project report with following contents shall be prepared:

Title Specifications Block diagram Circuit diagram Selection of components Calculations

Simulation results

PCB artwork Layout versus schematic verification report Testing procedures Enclosure design Test results Conclusion

Module No	Module	Detailed Content	CO Mapping
I	Introduction	Definition of Embedded System, Embedded Systems Vs General Computing Systems, Classification, Major Application Areas. Characteristics and Design Metric of an embedded system. Identification of Project Title	CO1
II	Controller boards and Programming – Embedded C	ARM LPC 21XX (2148)/8051, STM32 boards and Texas MSP 430 lunchbox/ Tiva C board and PIC/PSoc* Comparison of C and embedded C, Data Types, Variable, Storage Classes, Bit operation , Arrays, Strings, Structure and unions, Classifier	CO2
III	Interfacing Sensors and Peripherals	Sensors and Signal Conditioning Circuits amplifiers /attenuators /filters /comparators/ADC and DAC) , Interfacing with GLCD/TFT display , Relays and Drivers for interfacing Motors (DC and stepper) Interfacing with BLDC motors and drivers, USB/HDMI camera interfacing	CO3
IV	Communication in Embedded C	Serial communication, CAN bus, I2C, MOD bus, SPI Interfacing with Wi-Fi, Bluetooth ,ZigBee, LoRa, RFID and putting data on IoT Interfacing with GSM module , GPS module, SD card	CO4
V	Real Time Operating Systems	Operating system basics , Types of OS , Tasks, process, Threads Multiprocessing and ,Multitasking , Task scheduling ,	CO5
VI	Cloud/Web server	Implementation on web server , Thingspeak, AWS cloud platform for IoT based programming and modeling	CO6

Guidelines for Assessment of Mini Project:

Term Work (25 Marks) :- On demonstration in front of an internal and external examiner. In the examination each individual student should be assessed for his/her contribution, understanding and knowledge gained about the task completed. The review/ progress monitoring committee shall be constituted by the head of departments of each.

Back to Scheme

Course Code	Course Name	Credits
ET 313	**Wireless & Mobile communication**	03

Prerequisite:
Computer Communication and Network

Course Objectives:

1. To get familiar with the basics of wireless systems.
2. To understand various aspects of Mobile radio propagation.
3. To study various emerging technologies like Bluetooth, Zigbee, Wi- fi, WiMax etc.
4. To explore details of UWB.
5. To study advanced technologies used in Wireless communication.
6. To discuss the introduction of 5G technology.

Course Outcomes:
Students will be able to:

1. Get familiar with the basics of wireless systems.
2. Understand various aspects of Mobile radio propagation.
3. Study various emerging technologies like Bluetooth, Zigbee, Wi- fi, WiMax etc..
4. Explore details of UWB.
5. Study advanced technologies used in Wireless communication.
6. Discuss introduction of 5G technology

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Wireless Networks	Infrastructure of Wireless Networks , Wireless communication systems, Applications of wireless communication systems, Types of wireless communication systems, trends in mobile communication systems.	06	CO1
II	Mobile Radio Propagation	Large scale fading: Free space propagation model, the three basic propagation mechanisms, reflection, ground reflection (two-ray) model, diffraction, scattering, practical Link budget design using path loss models Small scale fading: Small scale multipath propagation, parameters of mobile multipath channels, types of small-scale fading, Rayleigh and Ricean distributions.	08	CO2
III	Emerging wireless technologies	Bluetooth, ZigBee, WiMax, Wi-fi, Ad-hoc wireless networks, Wireless sensor networks, UWB	08	CO3

IV	Wireless Local Area Networks	Introduction, WLAN equipment, topologies and technologies, WLAN applications and existing basic service set, WLAN security and power management, WLAN main features of IEEE 802.11a,b,I and n.	06	CO4
V	Advanced technologies in Wireless Communication	Mobile Machine to Machine communication, Mobile traffic management, cooperative communication	06	CO5
VI	Introduction to 5G	Salient features of 5G , 5G technology, 5G Architecture, Advantages and disadvantages, Applications, 5G Advancements, 5G Challenges, 5G future scope	06	CO6

Theory Assessment:

Internal Assessment for 40 marks:

Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Textbooks:

1. Vijay K. Garg, "Wireless Communication and Networking", Morgan – Kaufmann Series in Networking—Elsevier
2. KE- LIN DU & M. N. S. Swamy, ―Wireless Communication Systems, Cambridge University Press India Pvt. Ltd
3. Dr. Sunilkumar S. Manvi, Mahabaleshwar S. Kakkasageri, ―Wireless & Mobile Networks: Concepts and Protocols Wiley India
4. Theodore S. Rappaport "wireless communications - principles and practice", PEARSON Second edition.

References:

1. T L Singal "wireless communications", Mc Graw Hill Education
2. Fundamentals of 5G Mobile Networks: Jonathan Rodriguez (Ist Edition), Wiley Publication
3. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, ―AD HOC & Sensor Networks – Theory & Applications , Cambridge University Press India Pvt. Ltd

Back to Scheme

Course Code	Course Name	Credits
ET 314	**Electromagnetic wave & Radiating Systems**	03

Syllabus under preparation

Back to Scheme

Course Code	Course Name	Credits
ET 315	**WM & ATD Lab**	01

Lab Prerequisite:

1. Electromagnetics and wave theory.
2. Transmission line

Lab Objectives: Six Course Objectives

L1. Ability to design and analyze the performance of wire antennas and its applications.
L2. Ability to design and analyze the performance of microstrip antennas and its applications.
L3. Ability to measure the performance parameters of reflector/ array/ Yagi-Uda/ Log-periodic antenna
L4. Ability to design and analyze the performance of various wireless systems like GSM CDMA and WCDMA in Matlab or Scilab
L5. Ability to study and analyze various Systems like Zigbee and WSN in NS2 L6. Ability to study Path loss models

Lab Outcomes: At the end of the course the student should be able to:

1. Estimate the impact of various parameters of wire antennas like wire diameter and its length on the radiation characteristics of the antenna.
2. Design microstrip antenna using simulation tools and estimate the effect of change in antenna dimensions on the radiation characteristics of the antenna.
3. Determine beamwidth, directivity and radiation pattern of a reflector/array Yagi-Uda/ Log-periodic antenna
4. Design and analyze the performance of various wireless systems like GSM CDMA and WCDMA in Matlab or Scilab.
5. Analyze various Systems like Zigbee and WSN in NS2
6. Determine various losses from Path loss models.

Laboratory Syllabus: (Minimum 8 experiment)

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Basic	To determine radiation pattern, beamwidth and F/B ratio of Dipole antenna	LO1
2	Basic	To determine radiation pattern, beamwidth, and F/B ratio of monopole antenna	LO1
3	Basic	To determine radiation pattern, beamwidth, and F/B ratio of array of two dipole antenna	LO1
4	Basic	To determine radiation pattern, beamwidth, and F/B ratio of yagi-uda antenna	LO1
5	Basic	To determine radiation pattern, beamwidth, and F/B ratio of Log-periodic antenna	LO1

6	Basic	To determine radiation pattern, beamwidth, and F/B ratio of reflector antenna	LO1
7	Design	To design a dipole antenna and study the effect of variation of wire diameter and length of wire on its performance (using software simulation tool)	LO2
8.	Design	To design a Rectangular microstrip antenna and study the effect of variation in length and width of the patch on its performance.	LO2
9.	Design	To design a 2-element microstrip MIMO antenna system and study the effect of spacing between antenna elements on the radiation characteristics of antennas.	LO2
10	Project	To design and fabricate a patch antenna and test its parameters.	LO2
11	Basic	Study, discussion and installation of different network simulation tools such as NS2/NS3, Net stumbler , Wireshark etc.	LO2
12	Design	Analysis of Zigbee Network to compute the energy efficiency of the network.	LO3
13	Design	Simulation of a simple wireless network (IEEE802.11)using NS2 or any other simulator.	LO4
14	Design	Simulation of path loss model.	LO3
15	Basic	Configuration of WLAN.	LO4
16	Basic	Analysis of WiFi network to compute average end to end delay and packet delivery ratio.	LO5
17	Design	Link budget analysis of a GSM Network using Scilab / Matlab.	LO4
18	Design	Simulation of Wireless Sensor Network (IEEE802.15.4)in NS2 or any other simulator.	LO5
19	Design	Link budget analysis of a WCDMA Network using Scilab / Matlab.	LO6

Software Requirements: CST Microwave studio(any simulation software)
Hardware Requirements:Antenna trainer kit, SCILAB/MATLAB software, NS2

Lab Assessments:

1. **Teamwork Assessment:** 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. The grades will be converted to marks as per ―Choice Based Credit and Grading System" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.
2. **Oral/Viva Assessment**: The practical and oral examination will be based on entire syllabus.

Text Books:

1. C. A. Balanis, Antenna Theory: Analysis and Design (3rd eds.), John Wiley & Sons, Hoboken, NJ, 2005.
2. J. D. Kraus, R. J. Marhefka, A.S. Khan ―Antennas & Wave Propagation‖, McGraw Hill Publications, 4th Edition, 2011
3. G. Kumar, K. P. Ray, Broadband Microstrip Antenna, Artech House, 2002.
4. Theodore S. Rappaport "wireless communications - principles and practice", PEARSON Second edition.

References:

1. Printed MIMO antenna by Mohammed Sharawi
2. Stutzman, Theile, ― Antenna Theory and Design, John Wiley and Sons , 3rd Edition
3. R. E. Collin, ―Antennas and Radio Wave Propagation, International Student Edition, McGraw Hill
4. T L Singal "Wireless Communications", McGraw Hill Education
5. Fundamentals of 5G Mobile Networks: Jonathan Rodriguez (Ist Edition), Wiley Publication
6. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, ―AD HOC & Sensor Networks – Theory & Applications , Cambridge University Press India Ltd

Back to Scheme

Course Code	Course Name	Credits
ET 316	**R Programming**	01

Lab Prerequisite:
Basic statistics.

Lab Objectives:
L1. To provide an overview of a new language R used for data science.
L2. To introduce students to the R programming environment and related ecosystem and thus provide them with an in-demand skill-set, in both the research and business environments.
L3. To introduce the extended R ecosystem of libraries and packages L4. To demonstrate usage of as standard Programming Language.
L5. To familiarize students with how various statistics like mean median etc. can be collected for data exploration in R
L6. To enable students to use R to conduct analytics on large real life datasets.

Lab Outcomes:
LO 1: Install and use R for simple programming tasks.
LO 2. Extend the functionality of R by using add-on packages
LO 3. Extract data from files and other sources and perform various data manipulation tasks on them.
LO 4. Code statistical functions in R.
LO 5. Use R Graphics and Tables to visualize results of various statistical operations on data .
LO 6. Apply the knowledge of R gained to data Analytics for real life applications.

Laboratory Syllabus

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Basic	**Introduction:** Installing R on personal machines. installing R and RStudio. The basic functionality of R will be demonstrated , Variable types in R. Numeric variables, strings and factors.,Accessing the help system. Retrieving R packages.,Basic data types and operations: numbers, characters and composites.Data entry and exporting data	LO1 LO2 LO3
2	Basic	**Data structures**: vectors, matrices, lists and data frames.	LO1 LO3
3	Basic/Design	**R as a programming language**:Grouping, loops and conditional execution, Functions **Exploratory data analysis**Range, summary, mean, variance, median, standard deviation, histogram, box plot, scatterplot	LO1 LO 4
4	Design	**Graphics in R** Graphics and tables Working with larger datasets Introduction to ggplot2 graphics	LO3

5	Design/ Advanced	**Regression and correlation** Simple regression and correlation,Multiple regression ,Tabular data and analysis of Categorical data	LO4
6	Project	**R for Data Science (Mini Project)** Implementing a mini project using any data mining or big data analytics algorithm in R Extracting data from a large Dataset,Exploratory analysis,Visualizations and interpretation of results	LO5, LO6

Laboratory Assessment:

Term Work:

Term Work shall consist of experiment on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5Marks (Attendance)

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical/viva based on contents. Distribution of marks for practical/viva examination shall be as follows:

Practical Examination: 15 Marks Oral Examination: 10 Marks

Text Books:

1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf (Online Resources)
2. R Cookbook Paperback – 2011 by Teetor Paul O Reilly Publications
3. Beginning R: The Statistical Programming Language by Dr. Mark Gardener, Wiley Publications
4. R Programming For Dummies by Joris Meys Andrie de Vries, Wiley Publications

References:

1. Hands-On Programming with R by Grolemund, O Reilly Publications
2. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.

R for Data Science Learning Dan Toomey December 2014 Packt

Back to Scheme

Course Code	Course Name	Credits
ET 317	**Robotics and Automation**	04

Prerequisite:
IoT Basics & Smart Sensors, Applied Mathematics.

Course Objectives: Students will try:

1. To introduce the students to different types of Robots and understand the fundamentals of robotics.
2. To provide in depth knowledge of Direct Kinematics & Inverse Kinematics.
3. To impart skills for analysis of Velocity Kinematics and Dynamics.
4. To familiarize students with Trajectory planning of robots and robot vision.
5. To familiarize students with task planning of robots and industrial automation.
6. To train the students to analyze industrial automation and build automated systems.

Course Outcomes: Students will be able to:

1. Understand the basic concepts of robotics.
2. Perform the kinematic analysis of robots.
3. Analyze Velocity Kinematics and Dynamics.
4. Perform trajectory planning of robots & describe importance of visionary system in robotic manipulators
5. Perform task planning of robots and design industrial automation systems.
6. Analyze and build industrial automation systems

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of Robotics	Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Languages, Applications.	06	CO 1
II	Kinematics of Robots	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation Denavit-Hartenberg representation of forward kinematics, Forward and inverse kinematic solutions of three and four axis robot	08	CO2
III	Velocity Kinematics & Dynamics	Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. Dynamic Analysis of Forces : Lagrangian mechanics, Newton Euler formulation, Dynamic equations of two axis robot	08	CO3
IV	Trajectory planning &	Basics of Trajectory planning , Joint-space trajectory planning, Cartesian-space trajectories,	06	CO4

	Robot Vision	Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform, Camera Calibration		
V	Task Planning & Fundamental concepts of Industrial Automation	Task level programming, Uncertainty, Configuration Space, Gross motion Planning; Grasp planning, Fine-motion Planning, Simulation of Planer motion, Source and goal scenes, Task planner simulation. Concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production automation strategies, levels of automation.	06	CO5
VI	Transfer lines and automated assembly	General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, Flow line balancing.	06	CO6

List of Experiment:

- Suggested List of experiments
- Forward kinematics
- Inverse kinematic
- Dynamic analysis
- Joint-space trajectory
- Cartesian-space trajectory
- Template matching
- Iterative processing Segmentation

Software Requirements:
MATLAB/Scilab

Theory Assessment:
Internal Assessment for 40 marks: Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:
Term work for 25 marks:

1. At least eight experiments covering the whole syllabus, duly recorded and graded. The experiments should be students' centric and attempts should be made to make experiments more meaningful, interesting and innovative.

2. Two assignments to be included covering at least 60% of the syllabus.
3. The final certification and acceptance of term work ensures satisfactory performance of Laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme.

End Semester Practical/Oral Examination:

Pair of Internal and External Examiner should conduct practical/viva based on contents. Distribution of marks for practical/viva examination shall be as follows:
Practical Examination: 15 Marks
Oral Examination: 10 Marks

Text Books:

1. Robert Shilling, "Fundamentals of Robotics - Analysis and control", Prentice Hall of India, 2009
2. Saeed Benjamin Niku, "Introduction to Robotics–Analysis,Control, Applications", Wiley India Pvt. Ltd., Second Edition, 2011

References:

1. John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India, 2009
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, "Robot Modeling & Control ", Wiley India Pvt. Ltd., 2006
3. Mikell P. Groover et.al, "Industrial Robots-Technology, Programming & applications", McGraw Hill , New York, 2008

Back to Scheme

Course Code	Course Name	Credits
ET 318	**Electronic Product Design**	04

Prerequisite:
Electromagnetics Engineering, Antenna, Microwave Engineering, Transmission lines, Electronic Devices and Systems, Knowledge of basic electronic components

Course Objectives: Six

1. Understand the fundamentals of Product Design
2. Understand market needs and generate innovative ideas for product development
3. Understand the sources of EMI that may affect the performance of the product
4. Understand various techniques of making the product compatible to the electromagnetic environment
5. Understand basic rules of PCB design and system integration for prototyping
6. Understand the debugging techniques and testing of the prototype

Course Outcomes:

1. Describe the fundamentals of Product design
2. Identify the innovative ideas for product development
3. Identify various sources of EMI affecting system performance
4. Identify and describe the techniques of electromagnetic compatibility
5. Describe design considerations of printed circuit board
6. Describe the procedure of debugging and testing of the prototype

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Product Design	Introduction, Product Requirements and Specifications, Product Architecture, packaging, case studies of products in markets, Disassembling existing Product(s) and understanding relationship of components with each other, Case studies of product failures	09	CO1
II	Ideation	Generation of ideas, Funnelling of ideas, Short-listing of ideas for product(s) as an individual or a group of individuals, Sketching of products, Market research for need, competitions, scale and cost, Initial specifications of products, Selection of circuit and components, Identification of suitable simulation software, Prototype Design in simulation software	10	CO2

III	Electromagnetic Interference (EMI)	Introduction. Natural and Nuclear Sources of EMI, Intrinsic sources of noise, EMI from Apparatus and Circuits. Quantification Of Communication System EMI, Electrostatic Discharge (ESD), Elements of Interference, Including Antennas, Transmitters, Receivers and Propagation. Electronic Equipment And System EMI Concepts. Examples Of EMI Coupling Modes. Equipment Emissions And Susceptibilities- Types of coupling: Common-Mode Coupling, Differential-Mode Coupling, and Coupling Reduction Techniques. Other Coupling mechanisms: Power Supplies And Victim Amplifiers	10	CO3
IV	Electromagnetic Compatibility	Grounding, Shielding, Filtering, Bonding, EMC Specifications, EMC Regulations / Standards and Measurements	08	CO4
V	PCB Layout Considerations and Prototyping	Introduction to PCB layout making software's, General PCB Layout Considerations: Partitioning, Keep Out Zones, Critical Signals, System Clocks, PCB-to-Chassis Ground Connection, Return Path Discontinuities PCB Layer Stackup: One- and Two-Layer Boards, Multilayer Boards, General PCB Design Procedure, component mounting and System integration	09	CO5
VI	Prototype Debugging, Testing and Report writing	Steps of debugging, troubleshooting techniques, Inspection and testing of components, EMI-EMC testing, Enclosure design consideration, Product safety and liability issues, Product Documentation and report writing	08	CO6

Laboratory Syllabus

Sr. No.	**Level** 1. Basic 2. Design 3. Advance 4. Project/ Case Study /Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Study	Case study of product failures	**02**
2	Design	Ideation and prototype design in simulation software	**02**
3	Advanced	Measurement of conducted and radiated Electromagnetic Interference	**02**
4	Design	To study electromagnetic compatibility techniques.	**02**
5	Advanced	Implementation of PCB prototype considering EMI-EMC issues.	**02**
6	Advanced	Enclosure design for the prototype	**02**
7	Advanced	Troubleshooting of the prototype.	**02**
8	Basic	Preparation of product manual and launching of product.	**02**

Theory Assessment:

Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Laboratory Assessment:

Term work Assessment:
At least 08 experiments covering the entire syllabus should be set to have well predefined inference and conclusion. The experiments should be students' centric and an attempt should be made, to frame experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work

Oral/Viva Assessment:
Practical and Oral exams will be based on the entire syllabus.

Hardware Requirements:

1. CRO (Analog/ DSO),
2. Spectrum Analyzer (SA)
3. Vector network analyzer (VNA)
4. Basic electronic and electrical components and tools
5. SMD and PTH Setup.
6. PCB Lab setup
7.

Software Requirements:

- EAGLE
- Ki-CAD
- ORCAD
- Express-PCB
  - Altium
  - Proetis
  - CST Microwave studio
- Other open source

Text Books

1. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiely and Sons, 2005
2. W. Prasad Kodali, "Engineering Electromagnetic Compatibility: Principles, Measurements, Technologies, and Computer Models", 2nd Edition, ISBN: 978- 0-7803-4743-4, January 2001, Wiley-IEEE Press
3. David. A. Weston, "Electromagnetic Compatibility-principles and applications", Second Edition, Publisher: Marcel Dekker, Inc. 2001, ISBN 0-8247-8889-3
4. J. A. S. Angus, "Electronic Product Design", Chapman and Hall, 1996.
5. Eppinger, S., & Ulrich, K. "Product design and development", McGraw - Hill Higher Education

References:

1. Clayton R. Paul, "Electromagnetic Compatibility", John Wiley & Sons, 2nd Edition.
2. Roozenburg, N. F. and Eekels, J. "Product design: fundamentals and methods" Vol. 2, John Wiley & Sons Inc. 1995.

Back to Scheme

Subject Code	Subject Name	Total
ET 319	**Integrated Circuit Technology**	**04**

Course Objectives:

1. To provide knowledge of Wafer preparation and fabrication for VLSI Technology
2. To provide knowledge of IC fabrication processes and advanced IC technologies.
3. To provide knowledge of IC fabrication processes and design rules.
4. To disseminate knowledge about novel semiconductor measurement.
5. To provide knowledge about different VLSI Technology.
6. To disseminate knowledge about novel VLSI devices and materials.

Course Outcomes: Upon successful completion of the course students will be able to

1. Analyze and demonstrate a clear understanding of various MOS fabrication processes & CMOS fabrication flow.
2. Analyze and design layout of MOS based Circuits.
3. Demonstrate a clear understanding of Semiconductor Measurements & Testing.
4. Analyze SOI and GaAs technology.
5. Develop different fabrication process.
6. Understand advanced technologies, Novel Devices and materials in Modern VLSI Technology

Prerequisite: Electronic Devices and Circuits I, Digital Circuit Design, VLSI Design

DETAILED THEORY SYLLABUS:

Sr. No.	Module	Detailed Content	Hours
1	**Semiconductor manufacturing requirements and Crystal growth techniques**	**Semiconductor Manufacturing:** Semiconductor technology trend, Clean rooms, Wafer cleaning and Gettering. Semiconductor Substrate: Crystal structure, Crystal defects, Czochralski growth, Float Zone growth, Bridgman growth of GaAs, Wafer Preparation and specifications	**08**
2	**Semiconductor Device Fabrication Processes-1**	Epitaxy: Classification, Molecular Beam Epitaxy Silicon Oxidation: Thermal oxidation process, Kinetics of growth, Properties of Silicon Dioxide, Oxide Quality. Device Isolation: LOCOS, Shallow Trench Isolation (STI). Deposition: Physical Vapor Deposition-Evaporation and Sputtering, Chemical Vapor Deposition: APCVD, LPCVD,PECVD Diffusion: Nature of diffusion, Diffusion in a concentration gradient, diffusion Equation, diffusion systems, problems in diffusion. Ion Implantation: Penetration range-Nuclear& Electronic stopping and Range, implantation damage, Annealing-Rapid thermal annealing, ion implantation systems.	**07**

3	**Semiconductor Device Fabrication Processes-2**	Etching & Lithography: Etching: Basic concepts and Classification Lithography: Introduction to Lithography process, Types of Photoresist, Types of Lithography: Electron beam, Ion beam and X-ray lithography. Metallization and Contacts: Introduction to Metallization, Schottky contacts and Ohmic contacts. CMOS Process Flow: N well, P-well and Twin tub, CMOS Latch Up Design rules, Layout of MOS based circuits (gates and Combinational logic), Buried and Butting Contact.	**07**
4	**Measurement and Testing**	Semiconductor Measurements: Conductivity type, Resistivity, Hall Effect Measurements, Drift Mobility. Testing: Technology trends affecting testing, VLSI testing process and test equipment, test economics and product quality	**06**
5	**VLSI Technologies**	SOI Technology: SOI fabrication using SIMOX, Bonded SOI and Smart Cut ,PD ,SOI and FD SOI Device structure and their features. Advanced Technologies: low κ and high κ, BiCMOS, HκMG Stack, Strained Silicon. GaAs Technologies: MESFET Technology, MMIC technologies, MODFET	**06**
6	**Novel Devices and Materials**	Multigate Devices:Various multigate device configurations-double gate, triple gate (FinFET) and Gate All Around (Nanowire). Nanowire: Concept, VLS method of fabrication, Nanowire FET, Types: Horizontal and Vertical Nanowires, III-V compound Materials in Nanowires. 2-D Materials and FET:Graphene& CNT FET, MOS2 and Black Phosphorous	**05**

DETAILED LAB SYLLABUS:
Software Requirements: NANOHUB, MICROWIND

Sr. No.	**Detailed Lab Description**
1	To study the CZ process for Silicon Crystallization.
2	Implement NMOS inverter with resistive load using NANOHUB and study its Characteristics.
3	Various effects of Temperature on Thermal Oxidation using NANOHUB.
4	Design of CMOS Inverter using Microwind.
5	Design of CMOS NAND using Microwind.
6	Design of CMOS NOR using Microwind.
7	Design of CMOS EXOR using Microwind.
8	To implement the given function Y=A+BC using Microwind.
9	Design of 6T SRAM using Microwind.
10	Case Study IEEE paper.

Theory Assessments:

1. **Internal Assessment:** Two Internal assessments will be conducted for 40 marks each with average marks of both assessments as final score.

2. **End Sem Theory Examination:**
   - Question paper will consist of 4 questions, each carrying 20 marks.
   - Total 3 questions need to be solved.
   - Q.1 will be compulsory, based on the entire syllabus.
   - Remaining questions will be randomly selected from all the modules.
   - Weightage of marks should be proportional to number of hours assigned to each module.

Lab Assessments:

1. **Term work Assessment:**
   - Term work should consist of 10 experiments.
   - Journal must include at least 2 assignments
   - Mini Project to be performed

   Total 25 Marks (Experiments: 10-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks, Mini Project: 5-marks)

2. **Oral/Viva Assessment**:

   Based on the above contents and entire syllabus.

Text Books:

1. James D. Plummer, Michael D. Deal and Peter B. Griffin, "Silicon VLSI Technology",Pearson, Indian Edition.
2. Stephen A. Campbell, "The Science and Engineering of Microelectronic Fabrication",Oxford University Press, 2nd Edition.
3. Sorab K. Gandhi, "VLSI Fabrication Principles", Wiley, Student Edition.
4. G. S. May and S. M. Sze, "Fundamentals of Semiconductor Fabrication", Wiley, First Edition.
5. Kerry Bernstein and N. J. Rohrer, "SOI Circuit Design Concepts", Kluwer AcademicPublishers, 1st edition.

References:

1. Jean-Pierre Colinge, "FinFETs and Other Multigate Transistors", Springer, 1st edition
2. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley and Sons,1st edition.
3. James E. Morris and KrzysztolIniewski, "Nanoelectronic Device ApplicationsHandbook", CRC Press.
4. Glenn R. Blackwell, "The electronic packaging", CRC Press.
5. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for digital, memory and mixed-signal VLSI circuits", Springer.
6. G.S.May and S. M. Sze, "Fundamentals of Semiconductor Fabrication", Wiley, First Edition

Back to Scheme

Subject Code	Subject Name	Total
ET 320	Speech and Audio Processing	04

Prerequisite: Signals and Systems, **Digital Time Signal Processing Course**
Objectives: Six

1. To understand basic concepts and methodologies for the analysis and modeling of speech signals.
2. To characterize the speech signal as generated by a speech production model.
3. To understand the digital representation of the speech waveform.
4. To perform the analysis of speech signals using STFT.
5. To extract the information of the speech or audio signals.
6. To provide a foundation for developing applications in this field.

Course Outcomes: Six (Based on Bloom's Taxonomy)

After successful completion of the course student will be able to

1. Demonstrate advanced Knowledge in Digital model representation of speech signals.
2. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
3. Analyze speech signals to extract the characteristics of vocal tract (formants) and vocal cords (pitch).
4. Formulate and design a system for speech recognition and speaker recognition.
5. Acquired knowledge about audio and speech signal estimation and detection.

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of Human speech production system	1.1 Review of digital signal and systems, Transforms representations of signal and systems, 1.2 Speech production and acoustic tube modelling, anatomy, and physiology of the vocal tract and ear, hearing and perception.	6	1

II	Digital Models for Speech signals	2.1 Articulatory phonetics, acoustic phonetics, discrete time model for speech production	4	2
III	Time domain analysis of speech processing,	3.1 Time energy, average magnitude, and zero-crossing rate, speech vs silence discrimination 3.2 Short-time autocorrelation, pitch period estimation using short-time autocorrelation, median smoothing	8	3
III	Frequency domain representations ,	4.1 Time dependent Fourier representation for voiced and unvoiced speech signals, linear filtering interpretation, spectrographic displays 4.2 Pitch period estimation based on FFT and harmonic peak detection method, estimation of formants using log spectrum	8	4
IV	Homomorphic Speech Processing	5.1 Cepstral analysis of speech, mel frequency cepstral coefficients (MFCC), perceptual linear prediction (PLP) 5.2 Pitch period estimation in cepstral domain, evaluation of formants using cepstrum	7	5
VI	Speech and Audio Processing	6.1 Vocoder- Voice excited channel vocoder, Voice excited and error signal excited LPC vocoders. Adaptive predictive coding of speech, Auditory Modeling. Audio signal processing for Music applications. Speech recognition pattern comparison techniques.	6	6

Lab Syllabus

Lab Prerequisite: Knowledge of MATLAB/SCILAB

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**

1	1	To implement a program to generate basic signals	02
2	2	To implement a program to read and play Audio file	02
3	2	To implement a program to concatenate speech signals	02
4	2	To implement a program to concatenate into a stereo file	02
5	3	To implement a program to find resonating frequency of a tuning fork using Autocorrelation method	02
6	2	Program to find effect of length of window on Short Time Autocorrelation Function.	02
7	2	To implement a program, to compute short time energy of audio file using various windows.	02
8	2	To implement a program to compare spectrum of Voiced and Unvoiced Speech segments using Hamming window.	02
9	3	To implement stereo to mono conversion	02
10	3	To implement an application of Speech processing	02

Software Requirements: MATLAB/SCILAB

Theory Assessment:

Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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 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 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. L R Rabiner and S W Schafer, ―Digital processing of speech signals, Pearson Education,2009.
2. Shaila D. Apte, ―Speech and Audio Processing Wiley India, New Delhi, 2012.

Reference Books

1. Thomas F Quateri, ― Discrete Time Speech Signal Processing ―Pearson Edition,2006.
2. Ben Gold and Nelson Morgan, ―Speech & Audio Signal Processing, wiley, 2007.

Douglas O Shaughnessy, ―Speech Communications, 2nd Edition, Oxford university press, 2000

Back to Scheme

Subject Code	Subject Name	Credits
ET 321	**Radar Engineering**	04

Prerequisite:

Electronic Communication Systems
Antenna and Wave Propagation **Course**
Objectives:

1. Learn the basic terminology and concept of Radar
2. Interprete Radar equation , in presence of noise
3. Understand Different types of Radar
4. Analyze Tracking Radar
5. Requirements for Radar transmitter and Receivers
6. Design Consideration of Advance Radar Systems

Course Outcomes:

1. Define terms used in Radar and Tabulate Radar Frequencies
2. Interpret the equation of Radar Range in varying Conditions
3. Describe and compare various types of Radar
4. Analyze working of Tracking Radar
5. Evaluate the performance of Radar Transmitters and Receivers
6. Explain the advance applications of Radar

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Basics of RADAR	RADAR- definition, Terms in RADAR , Frequencies used, Block Diagram, Applications of Radar	4	CO1
II	Mathematical Modelling of Radar	Detection of signal in noise, Receiver Noise and Signal-to-noise Ratio, Probability of detection and false alarm: Simple , complex	6	CO2

		Targets , Pulse Repetition Frequency,Integration of Pulses ,		
III	MTI and Pulse Doppler Radar	Introduction to Doppler and MTI radar, Doppler frequency shift , Simple CW Doppler radar, MTI radar block diagram , Delay line canceler ,Moving-target-detection Pulse Doppler radar	8	CO3
IV	Tracking Radar	Monopulse tracking , Conical scan and sequential lobbing , Limitation of tracking accuracy , Low angle tracking	6	CO4
V	Radar Transmitters and Receivers	Radar RF power sources: Klystron, Travelling wave tube,Magnetron,CFA , low power transmitter, high power transmitter, Radar Receivers : Receiver noise figure , Superheterodyne Receiver , Types of displays,Antennas used in Radar	10	CO5
VI	Advance Radar Systems	LORAN,DECCA, Instrumentation Landing System,Synthetic Aperture Radar-SAR	5	CO6

Lab Syllabus

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/ Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	To demonstrate the elements in the RADAR system	02
2	Basic	Use Doppler RADAR to detect the maximum range.	02
3	Basic	Determine the velocity of the moving objects with the help of RADAR range.	02
4	Basic	Use RADAR system to measure the distance traveled by any object.	02
5	Design	Simulation experiment on Matlab/Scilab	02
6.	Design	Simulation experiment on Matlab/Scilab	02
7	Project/Case Study/Seminar	Design a RADAR system(PBL)	02
8	Project/Case Study/**Seminar**	Seminar on Recent Advancements in RADAR	02

Theory Assessment:

Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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 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) MerillSkolnik,―"IntroductiontoRADARSystems",Tata McGrawHill, Third Edition
2) MerillSkolnik,―Radar Handbook, Tata Mcgraw Hill, Second Edition

References:

1. Mark A.Richards,JamesA.Scheer, William A.Holm, ―Principles of Modern Radar Basic Principals, ScitechPublishing.
2. SimonKingsley,ShaunQuegon,―UnderstandingRadarSystems‖,ScientechPublishing Inc.
3. G.S. N.Raju, ―Radar Engineering and Fundamentals Of Navigational Aids, I. K International publishing House Pvt.Ltd

Back to Scheme

Subject Code	Subject Name	Credits
ET322	**Optical Communication**	04

Prerequisite:

Analog and Digital Communication, Physics, Electromagnetic Engineering

Course Objectives:

1. List, write and explain fundamentals and transmission characteristics of optical fiberCommunication.
2. List, write and explain the design of Optical Fiber(OF) Component Material, it's fabrication, connectors, splicers to vary length of OF.
3. List, write and explain fundamentals and transmission characteristics of optical fiber communication.
4. List, write and explain principles and characteristics of various sources, detectors and various fiber optic components.
5. List, write and explain principles and characteristics of various sources, detectors and various fiber optic components
6. Calculate parameters for optical link budgeting and analyze the link.

Course Outcomes:

1. Analyze the fundamental principle of optical fiber communication.
2. Apply the fundamental principles of optics and light waves to design optical fiber communication.
3. Design optical fiber communication links using appropriate components like optical fiber, light source, detectors, connectors, splicers, etc.
4. Explore concepts of designing and operating principles of optical fiber communication.
5. Apply the knowledge developed in class to contemporary research and industrial areas.
6. Design simple and basic optical fiber communication system with various basic faults, configurations, techniques in mind.

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Overview of Optical Fiber Communication	1.1-Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, 1.2-Optical fiber waveguides,	08	CO1

		1.3-Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wavelength, and mode field diameter.		
II	Fiber Optic Technology	2.1-Fiber materials, 2.2-Fiber fabrication, 2.3-Fiber optic cables, couplers, splices, connectors	06	CO2
III	Transmission Characteristics	3.1Attenuation, absorption, linear and nonlinear scattering losses, bending losses, 3.2-Modal dispersion, waveguide dispersion, dispersion and 3.3-Pulse broadening, dispersion shifted and dispersion flattened fibers.	07	CO3
IV	Optical Sources	4.1-Working principle and characteristics of sources (LED, LASER), 4.2- Tunable lasers Quantum well lasers , 4.3-Charge capture in Quantum well lasers, Multi Quantum well Laser diodes, 4.4-Surface Emitting Lasers: Vertical cavity Surface Emitting Lasers	06	CO4
V	Optical Detectors	5.1-Working principle and characteristics of detectors (PIN, APD), 5.2-Material requirement for RCEPD, Resonant cavity enhancement (RCE) Photo Detector, 5.3-Noise analysis in detectors, 5.4-Coherent and non-coherent detection, receiver structure, bit error rate of optical receivers, and receiver performance	06	CO5
VI	Optical Fiber Systems	6.1-Introduction, 6.2-Point to point links, 6.3-System considerations, link power budget, and rise time budget. 6.4-RF over fiber, key link parameters, 6.5-Radio over fiber links, microwave photonics	06	CO6

Lab Syllabus Lab

Prerequisite:

- Analog and Digital Communication, Physics, Electromagnetic Engineering

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced	**Detailed Lab/Tutorial Description**	**Hours**

1	1	To study optic fiber analog link.	02
2	1	To set up fiber optic analog link.	02
3	1	To study propagation loss in fiber optic.	02
4	2	To study Bending loss.	02
5	2	To measure Numerical Aperture.	02
6	3	To determine cutoff wavelength, responsivity and incident optical power by using SCILAB.	02
7	3	Comparison of acceptance angle for meridional & skew rays using SCILAB.	02
8	2	Determination of Quantum efficiency of photo diodes using SCILAB.	02
9	2	To determine the outer diameter of the Optical fiber in micrometer using SCILAB.	02
10	2	To determine the multiplication factor of the Photodiode using SCILAB.	02
11	4	Design a Optical fiber case study 1.	02
12	4	Design a Optical fiber with given parameters - case study 2.	02

Software Requirements: Scilab or Matlab

Hardware Requirements: Optical Communication kit

Theory Assessment:

Internal Assessment for 40 marks:

Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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. **Termwork:** At least 08 Experiments 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 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 student term work assessment must be based on the overall performance of the student with every experiment graded from time to time

2. **Oral/Viva :** Practical and Oral exams will be based on the entire syllabus**.**

Textbooks:

1. Optical Fiber Communication - John Senior Prentice Hall of India Publication.
2. Optical Fiber Communication - Gred Keiser Mc- Graw Hill Publication.

References:

1. Fiber Optic Communication - Djafar K. Mynbarv, Lowell L. Scheiner.
2. Optical Fiber Communication - Selvarajan, Subartkar, T. Srinivas Tata Mc-Graw Hill Publication.
3. Fundamentals of Fibre Optics in Telecommunication and sensor System, PalB.P., New Age International
4. Fiber Optic Communication, Agrawal, 3rd edi, Wiley
5. Fibre optics and Optoelectronics by Khare,Oxford University Press
6. Rajappa Papannareddy, Lightwave Communication Systems: A Practical Perspective, Penram International Publishing

Back to Scheme

Subject Code	Subject Name	Credits
ET 323	**Advanced Network Technologies**	**04**

Prerequisite: Computer Communication Network Concepts

Course Objectives:

1. To make students familiar with data communication technologies and how to use them to Design, Implement, Operate, Manage enterprise networks.
2. To introduce the concept of wireless WAN,WAP and different IEEE standards.

Course Outcomes:

On completion of the course, students should be able to:

1. Explain optical networking technology and its applications
2. Set up WLAN,PAN
3. Understand Mobile Networks.
4. Understand WANS: ATM and Frame Relay
5. Determine the network performance using monitor tools.
6. Computing the quality of service for desired applications

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	Optical Networking	SONET/SDH standards DWDM Performance and Design Considerations	04	CO1
2	Wireless LANs	IEEE 802.11 Architecture , MAC sublayer, Addressing mechanism, Physical Layer Bluetooth -Architecture and Bluetooth layers	08	CO2
		Mobile computing Architecture: Three Tier Architecture for Mobile computing, Design considerations, Mobile computing through Internet		
3	Mobile Networks	Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunneling and Encapsulation, Optimizations, Reverse tunneling, IPv6, Dynamic host configuration protocol, Ad hoc networks MANET: ROUTING, DESTINATION SEQUENCE DISTANCE VECTOR, Dynamic source routing, Hierarchical algorithms, Alternative metrices.	06	CO3

4	WAN Technologies	ATM: Faces of ATM, ATM Protocol operations. (ATM cell and Transmission) ATM Networking basics, Theory of Operations, B-ISDN reference model, PHY layer, ATM Layer (Protocol model), ATM layer and cell ,Traffic Descriptor and parameters, Traffic Congestion control defined, AAL Protocol model, Traffic contract and QoS, User Plane overview, Control Plane AAL, Management Plane, Sub S3 ATM,ATM public services Frame relay concept, FR specifications, FR design and VoFR and Performance and design considerations	10	CO4
5	Network Design	Network layer design Access layer design Access network capacity, Network topology and Hardware and Completing the access network design	05	CO5
6	Traffic Engineering and Capacity Planning:	Traffic Engineering Basics: Traffic Characteristics and Source Models, Poisson Arrivals and Markov Processes Voice Traffic Modelling (Erlang Analysis) Queued Data and Packet Switched Traffic Modeling Lan Traffic Modelling, Queuing System Models Notation, Markovian Queuing System Models,Bernoulli Processes and Gaussian Approximation	06	CO6

Lab

Syllabus

Lab

Prerequisi

te:

Computer Communication Network, Basic Networking Knowledge.

Software Requirements: NS2,WireShark

Hardware Requirements: Routers. Cables, Switches, Servers.

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project /Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**

1	Basic	Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.	02
2	Design	Setting up a Bluetooth Network	02
3	Design	Setting up a ZigBee Network	02
4	Design	Simulating a Wireless Sensor Network	02
5	Advanced	Simulating a Mobile Adhoc Network	02
6	Advanced	Simulating a WiMAX Network	02
7	Advanced	Measuring Network Performance	02

Theory Assessment:
Internal Assessment for 40 marks:
Consisting of Two Compulsory Internal assessment of **40 Marks each** on 40% syllabus for each test. The final marks will be the average of the 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.

Textbooks

1. Data Network Design by Darren Spohn, 3e McGraw Hill publications
2. Communication Networks by Leon-Garcia and Indra Widjaja, 2e, Tata McGraw- Hill Publications.

Reference Books

1. Behrouz A Forouzan, Data communications and Networking 4th Edition, 6. McGraw-Hill Publication.
2. William Stallings, Data Computer Communications, Pearson Education

Back to Scheme

Course Code	Course Name	Credits
ET324	Big Data Analytics	04

Prerequisite: DBMS

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5. To introduce to the students several types of big data like social media, web graphs and data streams.
6. To enable students to have skills that will help them to solve complex real-world problems in decision support.

Course Outcomes:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store, retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in Big Data
5. Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.
6. Design and implement successful Recommendation engines for enterprises.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Big Data	Data Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications	3	CO1
II	Introduction to Big Data Frameworks	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Overview of : Apache Spark, Pig, Hive,	7	CO2

	: Hadoop, NOSQL	Hbase, Sqoop What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, MongoDB		
III	Map Reduce Paradigm	Map Reduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of Map Reduce Execution, Coping With Node Failures. Algorithms Using Map Reduce: Matrix-Vector Multiplication by Map Reduce ,Relational-Algebra Operations, Computing Selections by Map Reduce, Computing Projections by Map Reduce, Union, Intersection, and Difference by Map Reduce, Computing Natural Join by Map Reduce, Grouping and Aggregation by Map Reduce, Matrix Multiplication, Matrix Multiplication with One Map Reduce Step . Illustrating use of Map Reduce with use of real life databases and applications.	6	CO3
IV	Mining Big Data Streams	The Stream Data Model: A Data Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk Motwani Algorithm, Query	6	CO4
V	Big Data Mining Algorithms	Frequent Pattern Mining : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and Map Reduce. Clustering Algorithms: CURE Algorithm. Canopy Clustering, Clustering with Map Reduce Classification Algorithms: Parallel Decision trees, Overview SVM classifiers, Parallel SVM, K-Nearest Neighbor classifications for Big Data, One Nearest Neighbour.	8	CO5
VI	Big Data Analytics Applications	Link Analysis : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using Map Reduce, Topic	9	CO6

		sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. Mining Social- Network Graphs : Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map-Reduce. Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering.		

Laboratory Syllabus:

Lab Prerequisite: DBMS

Sr.No.	Level 1.Basic 2.Design 3.Advance 4.Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	Hours
1	1	Assignment on Study of Hadoop ecosystem	02
2	2	Programming exercises on Hadoop Using Hive, Pig, Hbase Sqoop NOSQL, MongoDB	02
3	3	Implementing simple algorithms in MapReduce Matrix multiplication, Aggregates, joins, sorting, searching etc.	02
4	3	Implementing Algorithms using MapReduce (Any 2)	02
5	3	Implementing Frequent Item set Mining	02
6	3	Implementing Clustering algorithms Implementing Classification Algorithms	02
7	4	Big Data Applications (Any 2) ● Implementing Analytics on data streams ● Implementing Social Network Analysis Algorithms	02
8	4	Implementing Web Graph Algorithms Implementing recommendation Engines	02
9	4	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web) a) Twitter data analysis b) Fraud Detection c) Text Mining d) Recommendation Engines (list of datsets also given in the text book)	02

Software Requirements: Virtual Machine, Hadoop Framework, NOSQL and MongoDB Compilers
Hardware Requirements: PC i3 or above, 8 GB RAM

Theory Assessment:

Internal Assessment for 40 marks:

Consisting of Two Compulsory Internal assessment of 40 Marks each on 40% syllabus for each
test. The final marks will be the average of the 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. Teamwork Assessment: Term work should consist of 10 experiments. Journal must include at least 2 assignments on content theory and practical of "Database Management System".The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Attendance Theory & Practical: 05-marks, Assignments: 05-marks).

2. Oral/Viva Assessment: Practical & oral exam to be conducted by Internal & External examiners. Practical execution (10 marks) & Oral (15 marks)

Text Books:
1. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", Wiley Publications
2. Anand Rajaraman and Jeff Ullman "Mining of Massive Datasets", Cambridge University Press.
3. Alex Holmes "Hadoop in Practice", Manning Press, Dreamtech Press.
4. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press.
5. MongoDB: The Definitive Guide Paperback, Kristina Chodorow (Author), Michael Dirolf, O'Reilly Publications.

References:
1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications
4. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services
5. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence by Pramod J. Sadalage, Addison Wesley

Back to Scheme

Course Code	Course Name	Credits
ET 392	**Final Year Project A**	02

Course Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome:

1. Learner will be able to…
2. Identify problems based on societal /research needs.
3. Apply Knowledge and skill to solve societal problems in a group.
4. Develop interpersonal skills to work as member of a group or leader.
5. Draw the proper inferences from available results through theoretical/ experimental/ simulations.
6. Analyze the impact of solutions in societal and environmental context for sustainable development.
7. Use standard norms of engineering practices
8. Excel in written and oral communication.
9. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
10. Demonstrate project management principles during project work.

Guidelines for Project A :

- 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 survey and identify needs, which shall be converted into problem statement for project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover activity of Project A,B,C
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during major project-A,B &C activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

Guidelines for Assessment of Major Project:

Term Work

1. The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in each semester VI,VII and VIII.

2. 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.

3. Distribution of Term work marks for all the three semesters shall be as below;

   A. Marks awarded by guide/supervisor based on log book
   B. Marks awarded by review committee
   C. Quality of Project report

Oral & Practical:

Oral & Practical examination of Project-A should be conducted by Internal and External examiners approved by University of Mumbai. Students have to give presentation and demonstration on the Project-A.

Back to Scheme