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 2021-22

First Year - Effective from Academic Year **2021-22**

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

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

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

as per

Choice Based Credit and Grading System

Mahatma Education Society's

Pillai College of Engineering

Vision

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

Mission

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

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

Department of Electronics and Telecommunication Engineering

Vision

Strive towards producing world class engineers who will continuously innovate, upgrade telecommunication technology and provide advanced, hazard-free solutions to the mankind.

Inspire, educate and empower students to ensure green and sustainable society.

Mission

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

Program Educational Objectives (PEOs):

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

Program Outcomes:

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

Program Specific Outcomes (PSOs):

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

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

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

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

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

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

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

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

The Department of Electronics and Telecommunication Engineering offers a B. Tech. programme in Electronics and Telecommunication Engineering. This is an eight semester course. The complete course is a 162 credit course which comprises core courses and elective courses. The elective courses are distributed over 4 specializations. The specializations are:

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

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

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

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

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

Category	Credits
Humanities and Social Sciences including Management courses	9
Basic Science courses	25
Engineering Science courses including workshop, drawing, basics of Electrical/Mechanical/Computer etc	14
Professional core courses	53
Program Specific Elective Courses	24
Institute Electives	9
Project work, seminar and internship in industry or elsewhere	22
Innovation/Skill Based Learning	8
Total Credits	**164**

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
ET 101	Engineering Mathematics I	TLP	3	2	3	1	4
ET 102	Engineering Physics I	TL	2	1	2	0.5	2.5
ET 103	Engineering Chemistry I	TL	2	1	2	0.5	2.5
ET 104	Engineering Mechanics	TL	3	2	3	1	4
ET 105	Basic Electrical Engineering	TL	3	2	3	1	4
ET 106	Basic Engineering Workshop I	L	-	3	-	1.5	1.5
Total			**13**	**11**	**13**	**5.5**	**18.5**

Examination Scheme Semester I

Course Code	Course Name	Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 101	Engineering Mathematics I	40	40	40	60	2	25	-	125
ET 102	Engineering Physics I	30	30	30	45	2	25	-	100
ET 103	Engineering Chemistry I	30	30	30	45	2	25	-	100
ET 104	Engineering Mechanics	40	40	40	60	2	25	25	150
ET 105	Basic Electrical Engineering	40	40	40	60	2	25	25	150
ET 106	Basic Engineering Workshop 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
ET 107	Engineering Mathematics II	TLP	3	2	3	1	4
ET 108	Engineering Physics II	TL	2	1	2	0.5	2.5
ET 109	Engineering Chemistry II	TL	2	1	2	0.5	2.5
ET 110	Engineering Drawing and Graphics	TL	1	4	1	2	3
ET 111	Python Programming I	TL	3	2	3	1	4
ET 112	Professional Communication and Ethics I	TLC	2	2	2	1	3
ET 113	Basic Engineering Workshop II	L	-	3	-	1.5	1.5
Total			**13**	**15**	**13**	**7.5**	**20.5**

Examination Scheme Semester II

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 107	Engineering Mathematics II	40	40	40	60	2	25	-	125
ET 108	Engineering Physics II	30	30	30	45	2	25	-	100
ET 109	Engineering Chemistry II	30	30	30	45	2	25	-	100
ET 110	Engineering Drawing and Graphics	40	40	40	60	2	25	25	150
ET 111	Python Programming I	40	40	40	60	2	25	25	150
ET 112	Professional Communication and Ethics I	20	20	20	30	1	-	25	75
ET 113	Basic Engineering Workshop II	-	-	-	-	-	50	-	50
Total									**750**

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	TL	3	2	3	1	4
ET 202	Electronics Devices	TL	3	2	3	1	4
ET 203	Network Theory	T	3	-	3	-	3
ET 204	Instruments and Control System	T	3	-	3	-	3
ET 205	Signal and Systems	T	3	-	3	-	3
ET 206	Python Programming II	LP	-	2	-	1	1
ET 291	Mini Project I	LC	-	2	-	1	1
Total			**15**	**8**	**15**	**4**	**19**

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	25	150
ET 202	Electronics Devices	40	40	40	60	2	25	25	150
ET 203	Network Theory	40	40	40	60	2	-	-	100
ET 204	Instruments and Control System	40	40	40	60	2	-	-	100
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									**700**

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

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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	-	3	-	3
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	-	3	-	3
ET 211	Microprocessor & Microcontroller	TL	3	2	3	1	4
ET 212	Personal Finance Management	T	2	-	2	-	2
ET 213	Programming (Matlab and Scilab)	LP	-	2	-	1	1
ET 292	Mini Project II	LC	-	2	-	1	1
	Internship*		-	-	-	-	-
Total			**17**	**10**	**17**	**5**	**22**

Examination Scheme Semester IV

Course Code	Course Name	Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 207	Engineering Mathematics IV	40	40	40	60	2	-	-	100
ET 208	Electronic Communication System	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	-	-	100
ET 211	Microprocessor & Microcontroller	40	40	40	60	2	25	25	150
ET 212	Personal Finance Management	20	20	20	40	2	-	-	60
ET 213	Programming (Matlab and Scilab)	-	-	-	-	-	25	25	50
ET 292	Mini Project II	-	-	-	-	-	25	25	50
Total									**810**

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	Electromagnetic Engineering	T	3	-	3	-	3
ET 303	Image Processing & Machine Vision	T	3	-	3	-	3
ET 304	Embedded Systems	TL	3	2	3	1	4
ET 305	Programming (Java and Scripting)	LP	-	2	-	1	1
ET 306	Professional Communication & Ethics II	TLC	2	2	-	2	2
ET 3xx	Elective I	TL	3	2	3	1	4
ET 391	Mini Project III	LC	-	2	-	2	2
Total			**17**	**12**	**15**	**8**	**23**

Examination Scheme Semester V

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 301	Digital Communication	40	40	40	60	2	25	25	150
ET 302	Electromagnetic Engineering	40	40	40	60	2	-	-	100
ET 303	Image Processing & Machine Vision	40	40	40	60	2	-	-	100
ET 304	Embedded Systems	40	40	40	60	2	25	25	150
ET 305	Programming (Java and Scripting	-	-	-	-	-	25	25	50
ET 306	Professional Communication & Ethics II	-	-	-	-	-	50	-	50
ET 3xx	Elective I	40	40	40	60	2	25	25	150
ET 391	Mini Project III	-	-	-	-	-	25	25	50
Total									**800**

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

Department Elective is to be chosen from Group I or Group II

Semester V Electives	Department Level Optional Courses (DLOC)			
Specialization	Group I	Group II	Group III	Group IV
	IOT	Product Design	Advanced Communication System	Cloud Computing
Course Code Course Name DLOC I	ET 307	ET 308	-	-
	IOT Basics & Smart sensors	PCB Design and Electronics Equipment Troubleshooting	-	-

Bachelor of Technology in Electronics and Telecommunication Engineering

Semester VI

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 309	Wireless & Mobile Communication	T	3	-	3	-	3
ET 310	Antenna Theory & Design	T	3	-	3	-	3
ET 311	WM & AT Lab	L	-	2	-	1	1
ET 312	R Programming	LP	-	2	-	1	1
ET 3xx	Elective II	TL	3	2	3	1	4
ET 3xx	Elective III	TL	3	2	3	1	4
IL 3xx	Institute Elective I	Course Specific Assessment					3
ET 392	Major Project A	LC	-	2	-	2	2
	Internship*		-	-	-	-	-
Total			**15**	**10**	**15**	**6**	**21**

Examination Scheme Semester VI

Course Code	Course Name	Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 309	Wireless & Mobile Communication	40	40	40	60	2	-	-	100
ET 310	Antenna Theory & Design	40	40	40	60	2	-	-	100
ET 311	WM & AT Lab	-	-	-	-	-	25	25	50
ET 312	R Programming	-	-	-	-	-	25	25	50
ET 3xx	Elective II	40	40	40	60	2	25	25	150
ET 3xx	Elective III	40	40	40	60	2	25	25	150
IL 3xx	Institute Elective I	Course Specific Assessment							100
ET 392	Major Project A	-	-	-	-	-	50	50	100
	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 or group II
Second department Elective is to be chosen from group III or group IV
Institute elective is to be chosen from any of the Institute level groups

Semester VI Electives	Department Level Optional Courses (DLOC)			
Specialization	**Group I**	**Group II**	**Group III**	**Group IV**
	IOT	**Product Design**	**Advanced Communication System**	**Cloud Computing**
Course Code	ET 313	ET 314	-	-
Course Name DLOC II	Robotics and Automation	Electronic Product Design	-	
Course Code	-	-	ET 315	ET 317
Course Name DLOC III	-	-	Data Processing and Coding	Database Management
			ET 316	ET 318
			TV & Video Engineering	Computer Communication & Network

Semester VI Electives	Institute Level Optional Courses (ILOC)					
Specialization	**Group I**	**Group II**	**Group III**	**Group IV**	**Group V**	**Group VI**
	Business and Entrepreneurship	**Bioengineering**	**Engineering Design**	**Art and Humanities**	**Applied Science**	**Life Skills, Repair, Maintenance and Safety**
Course Code	IL 360	IL362	IL363	IL 364	IL 366	IL 368
Course Name ILOC I	Entrepreneurship	Introduction to Bioengineering	Product Design	Visual Art	Computational Physics	Vehicle Safety
	IL 361			IL 365	IL 367	IL 369
	IPR and Patenting			Journalism, Media and Communication studies	Polymers and Polymeric Materials	Maintenance of Electronics Equipment

Bachelor of Technology in Electronics and Telecommunication

Semester VII

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

Examination Scheme Semester VII

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

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

In continuation with chosen department specialization, one department Elective is to be chosen from group I.

In continuation with chosen department specialization, second department Elective is to be chosen from group II

In continuation with chosen department specialization, Institute elective is to be chosen from any of the Institute level groups

In continuation with chosen department specialization, Institute elective is to be chosen from any of the Institute level groups

Semester VII	**Department Level Optional Courses (DLOC)**			
Specialization	**1**	**2**	**3**	**4**
	IOT	**Product Design**	**Advanced Communication System**	**Cloud Computing**
Course Code	ET 404	ET 406	ET 407	ET 410
Course Name DLOC-VII ET 4XX	AI In Neural Network	Communication System Design and Integration	Speech and Audio Processing	Advanced Network Technologies
	ET 405		ET 408	
	Wearable Devices and Industrial IoT applications		Radar Engineering	
			ET 409	
			Optical Communication	

Semester VII Electives	**Institute Level Optional Courses (ILOC)**					
Specialization	**Group I**	**Group II**	**Group III**	**Group IV**	**Group V**	**Group VI**
	Business and Entrepreneurship	**Bioengineering**	**Engineering Design**	**Art and Humanities**	**Applied Science**	**Life Skills, Repair, Maintenance and Safety**
Course Name	IL 470	IL 472	IL 473	IL 474	IL 475	IL 476
Course Code **ILOC** IL 4XX	E- Commerce and e-Business	Biomedical Instrumentation	Design for sustainability	Political Science	Research Methodology	Maintenance of Mechanical Equipment
	IL 471					IL 477
	Business analytics					Cooking and Nutrition

Bachelor of Technology in Electronics and Telecommunication

Semester VIII

Course Code	Course Name	Course Component	Teaching Scheme (Contact Hours)		Credits Assigned		
			Theory	Practical /Tutorial	Theory	Practical /Tutorial	Total
ET 4xx	Elective VI	TL	3	2	3	1	4
IL 4xx	Institute Elective III	T	3	-	3	-	3
ET 492	Major Project C	LC	-	8	-	4	4
ET 493	Internship			-	-	8	8
Total			**6**	**10**	**6**	**13**	**19**

Examination Scheme Semester VIII

Course Code	Course Name	Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs)			
		1	2	Avg					
ET 4xx	Elective VI	40	40	40	60	2	25	25	150
IL 4xx	Institute Elective III	40	40	40	60	2	-	-	100
ET 492	Major Project C	-	-	-	-	-	100	50	150
ET 493	Internship	-	-	-	-	-	100	100	200
Total									**600**

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

In continuation with chosen department specialization, Department Elective is to be chosen from group III or group IV
In continuation with chosen department specialization, Institute Elective is to be chosen from any of the Institute level groups

Semester VIII	Department Level Optional Courses (DLOC)			
Specialization	**1**	**2**	**3**	**4**
	IOT	**Product Design**	**Advanced Communication System**	**Cloud Computing**
Course Code	-	-	ET 421	ET 424
Course Name DLOC VI	-	-	Blockchain for Communication	Cloud Computing
			ET 422	
			AIML in Communication Systems	
			ET 423	
			MIMO System for 5G	

Semester VIII Electives	Institute Level Optional Courses (ILOC)					
Specialization	**Group I**	**Group II**	**Group III**	**Group IV**	**Group V**	**Group VI**
	Business and Entrepreneurship	**Bioengineering**	**Engineering Design**	**Art and Humanities**	**Applied Science**	**Life Skills, Repair, Maintenance and Safety**
Course Code	IL 480	IL 481	IL 482	IL 483	IL 484	IL 485
Course Name ILOC III	Digital Business Management and Digital Marketing	Medical Image Processing	Technologies for Rural Development	Economics	GIS and Remote Sensing	Physical Education
						IL 486
						Environmental Management

Course Code	Course Name	Credits
ET 101	**Engineering Mathematics I**	3+1

Course Objectives:
The course is aimed

1. To develop the basic Mathematical skills of engineering students that are imperative for effective understanding of complex numbers in engineering subjects.
2. To acquaint students with the hyperbolic, logarithmic functions.
3. To understand differentiation and expansions of functions which will serve as basic tools for specialized studies in many fields of engineering and technology.
4. To learn the partial differentiation techniques and its applications used in engineering problems.
5. To learn the applications of Matrices useful in engineering.
6. To provide hands on experience using SCILAB software to handle Mathematical modelling.

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

1. Apply the basic concept of complex numbers and use it to solve problems in engineering.
2. Apply the basic concept of Hyperbolic and logarithmic functions in engineering problems.
3. Apply the concept of expansion of functions, successive differentiation and vector differentiation in optimization problems.
4. Use the basic concepts of partial differentiation in finding the Maxima and Minima required in engineering problems.
5. Use the concept of matrices in solving the system of equations used in many areas of research.
6. Apply the concept of numerical Methods for solving the engineering problems with the help of SCILAB software.

Module	Detailed Contents	Hrs.
1	**Complex Numbers** **Pre-requisite:** Review of Complex Numbers-Algebra of Complex Number, Cartesian, polar and exponential form of complex number. 1.1. De Moivre's Theorem.(Without Proof) 1.2. Expansion of sinnθ, cosnθ in terms of sines and cosines of multiples of θ and Expansion of sinnθ, cosnθ in powers of sinθ, cosθ 1.3. Powers and Roots of complex number.	2 2 2
2	**Hyperbolic function and Logarithm of Complex Numbers** 2.1 Introduction to Hyperbolic and Inverse Hyperbolic functions and simple examples. 2.2 Logarithmic functions, Separation of real and Imaginary parts of Logarithmic Functions	3 3

3	**Successive Differentiation, Expansion of Function and Vector Differentiation** **Pre-requisite: Derivative of standard functions and Rules of derivative.** 3.1 Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems	2

	3.2 Taylor's Theorem (Statement only) and Taylor's series, Maclaurin's series (Statement only). Expansion of□^ (□), sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x),log(1+x), sin−1(□), cos−1 (□),tan−1 (□). 3.3 Vector function of scalar quantities, Vector operator del,gradient,Grad Phi,Directional derivatives.Divergence and curl and their Physical interpretation	2 2
4	**Partial Differentiation and Applications of Partial Differentiation.** 4.1 Partial Differentiation: Function of several variables, Partial derivatives of first and higher order. Differentiation of composite function. 4.2.Euler's Theorem on Homogeneous functions with two independent variables (without proof). Deductions from Euler's Theorem. 4.3 Maxima and Minima of a function of two independent variables, Lagrange's method of undetermined multipliers with one constraint. Jacobian of two independent variables.	4 2
5	**Matrices :** **Pre-requisite:** Inverse of a matrix, addition, multiplication and transpose of a matrix ,Elementary row and column transformation 5.1.Symmetric, Skew- Symmetric, Hermitian, Skew Hermitian,Unitary, Orthogonal Matrices and properties of Matrices (Without Proof). 5.2 Rank of a Matrix using Echelon forms, reduction to normal form and PAQ form. 5.3.System of homogeneous and non –homogeneous equations, their consistency and solutions.	2 2 2
6	**Numerical Methods** 6.1 **Solution of system of linear algebraic equations**, (1) Gauss Elimination,(2)Gauss Jacobi Iteration Method (3) Gauss Seidel Iteration Method, 6.2 **Solutions of Transcendental equations** (1) Bisection method (2) Secant Method (3) Newton Raphson	3 3

List of Practicals

1. Basic Mathematical Operations, Functions and Introduction to Programming in Scilab
2. Basic operations on Matrices
3. Programing on Gauss Elimination Method
4. Programing on Gauss Jacobi Method
5. Programing on Gauss Seidal Method
6. Programing on Numerical Solution of transcendental Equations by Bisection Method
7. Programing on Numerical Solution of transcendental Equations by Newton Raphson Method
8. Programing on Numerical Solution of transcendental Equations by Secant Method
9. Programing on Maxima and Minima of functions

List of Assignments

1. Complex Numbers
2. Hyperbolic and Logarithmic Functions
3. Successive Differentiation and Expansion of Functions
4. Partial Differentiation
5. Applications of Partial Differentiation
6. Matrices
7. Numerical solution of system of linear equations and transcendental equation**s**

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.

References:

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,Matrices, Shanti Narayan, S. Chand publication.
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra,McGraw Hill

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Course Code	Course Name	Credits
ET 102	**Engineering Physics I**	2+0.5

Course Objectives:

1. To impart knowledge of basic concepts in applied physics and founding principles of technology.
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.
3. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Course Outcomes:

Upon successful completion of this course, the learner will be able to

1. Explain the limits of Classical Physics and apply the fundamentals of quantum mechanics to study the one dimensional motion of microscopic particles.
2. Apply the knowledge of superconductivity to SQUID and Magnetic levitation.
3. Able to understand fundamental concepts of classical optics and applications of interference in science and technology.
4. Analyze the intensity variation of light due to Polarization and its use in various applications
5. Comprehend the concepts of electrodynamics and Maxwell's equations and their use in telecommunication systems.
6. Apply the concepts of electromagnetism in focusing systems and CRO.

Module	Detailed Contents	Hrs.
1.	**Quantum Mechanics:** Dimensional infinite potential well, Quantum Computing. De Broglie hypothesis of matter waves; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg uncertainty principle; non existence of electron in nucleus; Schrodinger's time dependent wave equation; time independent wave equation; Free electron, Particle trapped in one	6
2.	**Superconductivity:** Critical temperature, critical magnetic field, Meissner's effect, Type I and Type II and high Tc superconductors; BCS Theory (concept of Cooper pair); Josephson effect. Applications of superconductors- SQUID, MAGLEV	3
3.	**Thin Film Interference :** Interference by division of amplitude and by division of wave front; Interference in thin film of constant thickness due to reflected and transmitted light; origin of colours in thin film; Wedge shaped film(angle of wedge and thickness measurement); Newton's rings Applications of interference - Determination of thickness of very thin wire or foil; determination of refractive index of liquid; wavelength of incident light; radius of curvature of lens; testing of surface flatness; Anti-reflecting films and Highly reflecting film.	6

4.	**Polarisation of Light:** Introduction, polarisation of light, Representation of plane polarised light, partially polarised light, Production of plane polarised light by i) Reflection (Brewster's Law), ii)Refraction (pile of plates), iii) Double Refraction (Nicol Prism), iv) Selective Absorption(Dichroism), HWP, QWP, Optically active materials and their applications like polaroids, LCD.	4
5.	**Electrodynamics:** Scalar and vector fields, Cartesian, Cylindrical and Spherical Coordinate system, gradient, curl and divergence in Cartesian coordinate system, line integral, surface integral, volume integral, divergence theorem, Stoke's theorem, Maxwell's Equations.	4
6.	**Electron Optics:** Electrostatic focusing , Magnetostatic focusing, Cathode Ray Tube(CRT), Construction and working of CRO. Lissajous figures.	2

Lab Objectives:

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental results and write laboratory reports.

Lab Outcomes:

Learners will be able to

1. Perform the experiments based on interference in thin films and analyze the results.
2. Perform the experiments based on polarisation of light and analyze the results.
3. Able to measure frequency and amplitude of a given electrical signal using CRO.

Suggested Experiments: (Any five)

1. Determination of radius of curvature of a lens using Newton's ring set up
2. Determination of diameter of wire/hair or thickness of paper using Wedge shape film method and estimation of Young's modulus of the material.
3. Brewster's law (Polarisation of light by reflection through glass slab.)
4. To study the nature of polarisation of laser light using photocell and quarter wave plate (QWP)
5. Use of CRO for measurement of frequency and amplitude.
6. Determination of unknown frequency by Lissajous figures.

Theory Assessment:

Internal Assessment: 30 marks

Consisting of Two compulsory internal assessments 30 Marks each. The final marks will be average of score of both the tests.

End Semester Examination: 45 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.

Books/References:

1. A text book of Engineering Physics-Avadhanulu & Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Modern Engineering Physics – Vasudeva, S.Chand
5. Concepts of Modern Physics- ArtherBeiser, Tata McGraw Hill
6. A TextBook of Engineering Physics, S. O. Pillai, New Age International Publishers
7. Optics - Ajay Ghatak, Tata McGraw Hill8. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication
8. Introduction to Electrodynamics- D. J. Griffiths, Pearson publication
9. Physics for Engineers, M.R. Srinivasan, New Age International Publishers.

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Course Code	Course Name	Credits
ET 103	**Engineering Chemistry I**	2+0.5

Course Objectives:

1. To impart a scientific approach and to familiarize the applications of chemistry in the field of engineering.
2. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various problems related to chemistry in the industry/engineering field.
3. To develop abilities and skills that are relevant to the study and practice of chemistry.

Course Outcomes:

On successful completion of course learner/student will be able to

1. To understand and analyse the combustion mechanisms of various fuels and be able to characterize the fuels.
2. To select various lubricants for different industrial applications.
3. To become familiarized with corrosion forms and their effects and to recognize and use the method of corrosion protection.
4. To analyse the quality of water and will be able to suggest methods to improve water quality.
5. To assess the environmental impact and understand the methods for their minimisation.

Module	Detailed Contents	Hrs.
1	**Fuels and Combustion** **Pre-requisite:** What are fuels, Types of fuels, Characteristics of fuels. 1.1. Calorific value of a fuel - HCV and LCV, Theoretical determination of calorific value of fuel by Dulong's formula, Numerical problems 1.2 Solid fuels : Coal, Analysis of coal - Proximate and Ultimate analysis, Numerical problems Liquid fuels: Composition and classification, Octane number, Cetane number, Biodiesel Gaseous Fuels:, LPG and CNG 1.3. Combustion of fuels – Numerical problems for calculating the amount of air needed for the complete combustion of solid and gaseous fuels.	5
2	**Lubricants** **Pre - requisites** : Definition of Lubricants and Lubrication, functions of lubricants 2.1 Mechanisms of lubrication – Thick film, Thin film and Extreme pressure 2.2 Classification of lubricants - Solid (MoS_2, graphite), Semi solid (greases), Liquid (animal/vegetable oils, mineral oils, synthetic oils) 2.3 Properties of lubricants and their significance - Viscosity and Viscosity Index, Flash and Fire Points, Cloud and Pour Points, Acid Number, Saponification Number, Steam Emulsification Number and related numerical problems.	4
3	**Corrosion** **Pre-requisite:-** corrosion , corrosion product, electrochemical series, corrosive and non corrosive metals.	4

	3.1 Mechanism of corrosion - Chemical and Electrochemical corrosion. 3.2 Types of corrosion : Galvanic corrosion, Differential aeration corrosion, Pitting corrosion, Intergranular corrosion, Waterline corrosion, Stress corrosion. 3.3 Factors Affecting Corrosion Rate : - (i) Nature of metal, (ii) Nature of environment.	
4	**Corrosion Control** 4.1 Methods of Corrosion Control : Material selection, Design, Cathodic protection, Anodic protection 4.2 Protective Coatings: Metallic coatings anodic coating (galvanizing) and cathodic coating (Tinning), Different Methods of Applying Metallic Coatings (No explanation needed) 4.3 Organic coatings – Paints and Special Paints.	3
5	**Water and its Treatment** **Pre-requisite** : Knowledge of sources of water, Possible impurities in water, Characteristics imparted by impurities in water. 5.1 Hardness in water – types & its units, Determination of hardness by EDTA method, and numerical problems. 5.2. Effects of Hard water in boilers - Priming and Foaming, Scales and Sludges, Boiler corrosion, caustic embrittlement, 5.3 Softening of water- Ion exchange process. 5.4 Desalination of brackish water- Reverse Osmosis, Electrodialysis, Ultrafiltration . 5.5 Municipal water treatment – Primary, secondary and tertiary, BIS specification of drinking water	5
6	**Environmental And Green Chemistry** **Pre- requisites:** Definition of Environment and Primary concept of environmental pollution**.** 6.1 Concept and Scope of Environmental Chemistry. 6.2 Environmental Pollution and Control - Water pollution - BOD and COD, determination and numerical problems. E- pollution and N- pollution 6.3 Concept of 12 principles of Green chemistry, discussion with examples, numericals on atom economy.	3

Lab Objectives:

1. Provide the students with a basic understanding in the Chemistry laboratory required to solve engineering problems.
2. Learn to design and carry out experiments as well as accurately record and analyze the results of such experiments.

Lab Outcomes:

The student will be able to

1. Analyse & generate experimental skills.
2. Anhance the thinking capabilities in the modern trends in Engineering & Technology.
3. Learn and apply basic techniques used in chemistry laboratories for preparation, purification and identification.
4. Learn safety rules in the practice of laboratory investigations.

List of Experiments:

1. Determination of Hardness in water
2. Determination of Viscosity of oil by Redwood Viscometer

3. Determination of Flash point of a lubricant using Abel‘s apparatus
4. Determination of Acid Value and Saponification Value of an oil.
5. Determination of Chloride content of water by Mohr‘s Method
6. Determination of moisture content in coal sample.
7. Study of the effect of different environments (Acid, Base) on corrosion rate.
8. Determination of COD Value of water.
9. Removal of hardness using ion exchange column.
10. Calorific value of liquid fuel

Theory Assessment:
Internal Assessment: 30 marks
Consisting of Two compulsory internal assessments 30 Marks each. The final marks will be average of score of both the tests.
End Semester Examination: 45 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.

Books/References:

1. Engineering Chemistry – P.C.Jain and Monika Jain, Dhanpat Rai Publications
2. A Textbook of Engineering Chemistry, - Shashi Chawla(DhanpatRai publications)
3. A textbook of Engineering Chemistry - S.S. Dara, S. Chand Publishing House
4. Engineering Chemistry – O.G. Palanna , Tata Mc Graw Hill
5. Essential of Physical Chemistry by Arun Bahl, B S Bahl & G D Tuli
6. Environmental Chemistry – A.K.De, New Age International

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Course Code	Course Name	Credits
ET 104	**Engineering Mechanics**	3+1

Course Objectives:
The course is aimed

1. To develop the capacity to predict the effects of force and motion and to acquaint the concept of static and dynamic equilibrium.
2. Ability to visualize physical configurations in terms of actual systems and it's constraints, and able to formulate the mathematical function of the system.
3. To study, analyse and formulate the motion of moving particles/bodies.

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

1. The ability to verify the law of moments and draw Free Body Diagram and label the reactions on it.
2. Determine the centroid and MI of plane lamina.
3. Makes the students able to apply equilibrium equations in statics.
4. Evaluate co-efficient of friction between the different surfaces in contact.
5. The ability to understand Newton's law in motion, and recognize different kinds of particle motions.

Module	Detailed Contents	Hrs.
1	**Coplanar and Non-Coplanar Force System and Resultant:** 1.1 System of Coplanar Forces: Classification of force systems, Principle of transmissibility, composition and resolution of forces. 1.2 Resultant: Resultant of coplanar and non-coplanar force system (Concurrent forces, parallel forces and non-concurrent Non-parallel system of forces). Moment of force about a point, Couples, Varignon's Theorem. Force couple system. Distributed Forces in plane. 1.3 Equilibrium of System of Coplanar Forces and Beams: Conditions of equilibrium for concurrent forces, parallel forces and non-concurrent non- parallel general forces and Couples. Equilibrium of rigid bodiesfree body diagrams. Types of beams, simple and compound beams, type of supports and reaction. Determination of reactions at supports for various types of loads on beams. (Including problems on internal hinges)	**08** 02 03 03
2	**Centroid and MI:** 2.1 First moment of Area, Centroid of composite plane Laminas 2.2 Second moment of Area, MI of composite plane Laminas	**05** 02 03
3	**Forces in Space:** 3.1 System of Non-Coplanar Force System 3.2 Resultant of Non-Coplanar Force System	**05** 02 03
4	**Friction:** 4.1 Static and Dynamic Friction: Systems of Statics and Dynamic/ Kinetic Friction, Coefficient of Friction, Angle of Friction, Laws of friction. Concept of Cone of friction. 4.2 Wedge Friction: Equilibrium of bodies on inclined plane. Application to problems involving wedges and ladders.	**06** 02 02 02

	4.3 Rope and Belt Friction: Block Friction including Rope and Belt Friction.	
5	**Kinematics of Particle and Rigid Body:** 5.1 Kinematics of Particle and Rigid Body: Motion of particle with variable acceleration. General curvilinear motion. Tangential & Normal component of acceleration, Motion curves (a-t, v-t, s-t curves). Application of concepts of projectile motion and related numerical. 5.2 Kinematics of Rigid Body: Translation, Rotation and General Plane motion of Rigid body. The concept of Instantaneous center of rotation (ICR) for the velocity. Location of ICR of mechanism. Velocity analysis of rigid body using ICR	**06** 03 03
6	**Kinetics of a Particle:** 6.1 Kinetics of a Particle: Force and Acceleration: -Introduction to basic concepts, D'Alemberts Principle, concept of Inertia force, Equations of dynamic equilibrium, Newton's second law of motion. (Analysis limited to simple systems only.) 6.2 Kinetics of a Particle: Work and Energy: Work Energy principle for a particle in motion. Application of Work – Energy principle to a system consists of connected masses and Springs. 6.3 Kinetics of a Particle: Impulse and Momentum: Principle of linear impulse and momentum. Impact and collision: Law of conservation of momentum, Coefficient of Restitution. Direct Central Impact and Oblique Central Impact. Loss of Kinetic Energy in collision of inelastic bodies.	**06** 02 02 02

Lab Objectives:

1. To acquaint the concept of equilibrium in two- and three-dimensional system.
2. To study and analyse motion of moving particles/bodies.

Lab Outcomes:

Learners will be able to

1. Verify equations of equilibrium of coplanar force system
2. Verify the law of moments.
3. Determine the centroid of plane lamina.
4. Evaluate co-efficient of friction between the different surfaces in contact.
5. Demonstrate the types of collision/impact and determine corresponding coefficient of restitution.
6. Differentiate the kinematics and kinetics of a particle.

List of Experiments:

Minimum six experiments from the following list of which minimum one should from dynamics.

1. Verification of Polygon law of coplanar forces
2. Verification of Principle of Moments (Bell crank lever.)
3. Determination of support reactions of a Simply Supported Beam.
4. Determination of coefficient of friction) using inclined plane
5. Collision of elastic bodies (Law of conservation of momentum).
6. Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)
7. Kinetics of particles. (Collision of bodies)

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:

1Term 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.

Books/References:

1. Engineering Mechanics by Beer &Johnston, Tata McGrawHill
2. Engineering Mechanics (Statics) by Meriam and Kraige, WileyBools
3. Engineering Mechanics (Dynamics) by Meriam and Kraige, WileyBools
4. Engineering Mechanics by F. L. Singer, Harper& RawPublication
5. Engineering Mechanics by ShaumSeries

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Course Code	Course Name	Credits
ET 105	**Basic Electrical Engineering**	3+1

Course Objectives:
The course is aimed

1. To provide knowledge on fundamentals of D.C. circuits.
2. To provide knowledge of D.C network theorems and its applications.
3. To impart knowledge on fundamentals of A.C. circuits
4. To impart knowledge on fundamentals of single phase A.C circuits and its applications.
5. To impart knowledge on fundamentals of 3-Φ A.C. circuits and its applications.
6. To impart knowledge on basic operation and applications of electrical machines.

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

1. Apply basic concepts to analyse D.C circuits.
2. Apply various D.C network theorems to determine the circuit response/ behavior.
3. Apply basic concepts to analyze A.C waveforms.
4. Evaluate and analyze single phase A.C circuits.
5. Evaluate and analyze three phase A.C circuits.
6. Understand the constructional features and operation of electrical machines.

Module	Detailed Contents	Hrs.
1	**DC Circuits** Series and Parallel circuits, Concept of short and open circuits,Star-delta transformation, Ideal and practical voltage and current source,Kirchhoff 's laws, Mesh and Nodal analysis (super node and super mesh included), Source transformation.	6
2	**DC Theorems** Linear and Nonlinear Circuit,Active and passive network,Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, (Source transformation not allowed for Superposition theorem).	6
3	**AC fundamentals** Generation of alternating voltages, A.C terminology, RMS and Average value, form factor, crest factor, Phasor representation of alternating quantities, addition and subtraction of alternating quantities using phasors.	3
4	**Single Phase AC Circuits** AC through pure resistor, inductor and capacitor. AC through R-L , R-C and R-L-C series and parallel circuits, phasor diagrams, power and power factor, series and parallel resonance, Q-factor**.**	7
5	**Three Phase AC Circuits** Three phase voltage and current generation, star and delta connections (balanced load only), relationship between phase and line currents and voltages, Phasor diagrams, Basic principle of wattmeter, measurement of power by two wattmeter method .	6
6	**Electrical Machines**Working principle of single-phase transformer, EMF equation of a transformer, Transformer losses, Phasor diagram, Equivalent circuit, Efficiency.	8

	• Principle of operation, construction and classification of DC machines, emf equation, speed control of DC motors and its applications. • Principle of operation of Single-Phase induction motors, stepper motors and their applications.	

Lab Objectives:

1. Provide the students with a basic understanding in the Basic Electrical laboratory required to solve engineering problems.

Lab Outcomes: The student will be able to.

1. Compute electrical parameters for the given circuit using network theorem
2. Verify the resonance phenomenon for a given RLC circuit
3. Measure three phase power
4. Illustrate the performance of electrical machines

List of Experiments

1. Mesh and Nodal analysis.
2. Verification of Superposition Theorem.
3. Verification Thevenin's Theorem.
4. Study of R-L series and R-C series circuits.
5. R-L-C series resonance circuit
6. R-L-C parallel resonance circuit.
7. Relationship between phase and line currents and voltages in three phase system (star & delta)
8. Power and phase measurement in a three phase system by one wattmeter method.
9. Power and phase measurement in a three phase system by two wattmeter methods.
10. To demonstrate cut-out sections of the DC machine.
11. To control the speed of the DC motor.

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.

References:

1. B.L.Theraja "Electrical Technology" Vol-I and II, S. Chand Publications, 23 rd ed. 2003.

2. Joseph A Edminister, “Schaum‟s outline of theory and problems of electric circuits” Tata McGraw Hill, 2 nd edition
3. D P Kothari and I J Nagrath “Theory and Problems of Basic Electrical Engineering”, PHI 13 th edition 2011.

Textbooks:

1. “Basic Electrical Engineering”, by Prof. B. R. Patil, Oxford Higher Education
2. “Basic Electrical Engineering (BEE)”, by Prof.Ravish Singh”, McGraw Hill Education

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Course Code	Course Name	Credits
ET 106	**Basic Engineering Workshop I**	1.5

Course Objectives:

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Course Outcomes: Learners will be able to…

1. Develop the necessary skill required to handle/use different fitting tools.
2. Develop skill required for hardware maintenance.
3. Able to install an operating system and system drives.
4. Able to identify the network components and perform basic networking and crimping.
5. Able to prepare the edges of jobs and do simple arc welding.
6. Develop the necessary skill required to handle/use different plumping tools.
7. Demonstrate the turning operation with the help of a simple job.

Trade	Detailed Content	Hrs.
Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic at trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to **Compulsory Trades.**		
Trade-1	**Fitting (Compulsory):** • Use and setting of fitting tools for chipping, cutting, filing, marking, center punching, drilling, tapping. • Term work to include one job involving following operations : filing to size, one simple male- female joint, drilling and tapping	10
Trade-2	**Hardware and Networking: (Compulsory)** Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc. · Assembling of PC, Installation of Operating System (Any one) and Device drivers, Boot-up sequence. Installation of application software (at least one) · Basic troubleshooting and maintenance · Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping. NOTE: Hands on experience to be given in a group of not more than four students	08

Trade-3	**Welding:** Edge preparation for welding jobs. Arc welding for different job like, Lap welding of two plates, butt welding of plates with simple cover, arc welding to join plates at right angles.	06
Trade 4	**Plumbing:** Use of plumbing tools, spanners, wrenches, threading dies, demonstration of preparation of a domestic line involving fixing of a water tap and use of coupling, elbow, tee, and union etc.	06
Trade-5	**Machine Shop:** At least one turning job is to be demonstrated and simple job to be made for Term Work in a group of 4 students.	06

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/tutorial and mini-projects (if included) are graded from time to time.

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Course Code	Course Name	Credits
ET 107	**Engineering Mathematics II**	3+1

Course Objectives:
The course is aimed

1. To develop the basic mathematical skills of differential equations of engineering students
2. To understand the linear differential equation with constant coefficients used in mathematical modelling.
3. To acquaint the students with the Beta, Gamma functions and DUIS.
4. To learn different techniques to solve double integrations.
5. To learn the applications of integration in solving the complex engineering problems.
6. To provide knowledge of numerical techniques using SCILAB software to handle Mathematical modelling.

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

1. Apply the basic concept of linear differential equations to solve problems in engineering.
2. Apply the basic concept of applications of higher order differential equations in mathematical modelling to solve real life problems.
3. Apply the basic concepts of beta, gamma and DUIS to solve engineering problems.
4. Apply the concept of double integration in solving problems of engineering and technology.
5. Apply the concept of double integrations to find length, area and volume.
6. Apply the concept of differentiation and integration numerically for solving the engineering problems with the help of SCILAB software.

Module	Detailed Contents	Hrs.
1	**Differential Equations of First Order and First Degree:** 1.1 Exact differential Equations, Equations reducible to exact form by using integrating factors. 1.2 Linear differential equations , equations reducible to linear form. 1.3 Application of differential equation of first order and first degree in engineering.	 2 2 2
2	**Linear Differential Equations With Constant Coefficients and Variable coefficients of higher order:** 2.1. Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is □ ^□□ , sin(□□ + □) , cos (□□ + □), □^n, □ ^□□□, □□. 2.2. Cauchy Differential equation, Method of variation of parameters two variables	 4 3
3	**Beta and Gamma Function, Differentiation under Integral sign** 3.1 Beta and Gamma functions and its properties. 3.2 Differentiation under integral sign with constant limits of integration (One parameter).	 3 3

4	**Double Integration:** **Prerequisite**:Tracing of curves 4.1. Double integration- Evaluation of Double Integrals.(Cartesian & Polar),Change of order of Integration and evaluation 4.2. Evaluation of integrals over the given region.(Cartesian & Polar) 4.3. Evaluation of double integrals by changing to polar coordinates.	 4 2 2
5	**Applications of integration** :- 5.1 Rectification of plane curves.(Cartesian and polar) 5.2. Application of double integrals to compute Area 5.3.Triple integration**:** Evaluation (Cartesian, cylindrical and spherical polar coordinates)	 2 2 2
6	**Numerical Techniques:-** 6.1. **Numerical solution of ordinary differential equation** (a) Euler's method (b) Modified Euler method, (c)Runge-Kutta fourth order method 6.2. **Numerical integration**- (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule	 3 3

List of Practicals

1. Euler's Method
2. Euler's Modified Method
3. Runge Kutta Fourth Order
4. Trapezoidal Rule
5. Simpson's 1/3rd Rule
6. Simpson's 3/8th Rule
7. Differential Equations
8. Integration

List of Assignments

1. Differential equation first order and first degree
2. Linear differential equation with constant coefficients
3. Beta and Gamma Function and DUIS
4. Double integration
5. Triple integration and Applications of double integration
6. Numerical methods

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 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/tutorial and mini-projects (if included) are graded from time to time.

Books/References:

1. Higher Engineering Mathematics, Dr.B.S.Grewal, Khanna Publication
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley EasternLimited, 9thEd.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication,
4. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill .

Back to Scheme

Course Code	Course Name	Credits
ET 108	**Engineering Physics II**	2+0.5

Course Objectives:

1. To impart knowledge of basic concepts in applied physics and founding principles of technology.
2. To provide the knowledge and methodology necessary for solving problems in the field of engineering.
3. To develop scientific temperament for scientific observations, recording, and inference drawing essential for technology studies.

Course Outcomes: Upon successful completion of this course, the learner will be able to

1. Explain the functioning of lasers and their various applications.
2. Able to explain the working principle of optical fibres and their applications especially in the field of communication.
3. To comprehend the basic concepts of semiconductor physics and apply the same to electronic devices.
4. To analyze digital logic processes and implement logical operations using various combinational logic circuits.
5. To analyze design and implement logical operations using various sequential logic circuits.
6. Interpret and explore basic sensing techniques for physical measurements in modern instruments.

Module	Detailed Contents	Hrs.
1.	**Lasers :** Laser: spontaneous emission and stimulated emission; metastable state, population inversion, types of pumping, resonant cavity, Einstein's equations; Helium Neon laser; Nd:YAG laser; Semiconductor laser, Applications of laser- Holography (construction and reconstruction of holograms) and industrial applications(cutting, welding etc), Applications in the medical field.	4
2.	**Optical Fibres:** Working Principle and structure , Numerical Aperture for step index fibre; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fibres. Application: Fibre optic communication system; sensors (Pressure, temperature, smoke, water level), applications in the medical field.	4
3.	**Semiconductor Physics** Splitting of energy levels for band formation; Classification of semiconductors(direct & indirect band gap, elemental and compound); Conductivity, mobility, current density (drift & diffusion) in semiconductors(n type and p type); Fermi Dirac distribution function; Fermi energy level in intrinsic & extrinsic semiconductors; effect of impurity concentration and temperature on fermi level; Fermi Level	7

	diagram for p-n junction(unbiased, forward bias, reverse bias); Breakdown mechanism (zener avalanche), Hall Effect Applications of semiconductors: Rectifier diode, LED, Zener diode, Photo diode, Photovoltaic cell, BJT, FET, SCR., MOSFET	
4.	**Logic gates and combinational Logic circuits:** Review of Binary,Octal and Hexadecimal Number systems and their interconversion, Difference between analog and digital signal, Logic levels, Digital logic gates,, Universal gates, Realization using NAND and NOR gates, Half adder and Full adder circuit, MUX - DEMUX, ENCODERS and DECODERS**.**	3
5.	**Sequential Logic Circuits:** Flip Flops: R-S and J-K Flip Flops, Conversion of flip-flops to shift registers. Counters: Up/Down and BCD counter.	4
6.	**Physics of Sensors:** Temperature Sensor- Resistance Temperature Detectors(RTDs) (PT-100) Pressure Transducers- Capacitive pressure transducer, Inductive pressure transducer. Piezoelectric transducers: Concept of piezoelectricity, use of piezoelectric transducer as ultrasonic generator and application of ultrasonic transducer for distance measurement, liquid and air velocity measurement.	3

Lab Objectives:

1. To improve the knowledge about the theory learned in the class.
2. To improve ability to analyze experimental results and write laboratory reports.

Lab Outcomes:

Learners will be able to

1. Perform the various experiments using laser source and analyze the results.
2. Perform the experiments using optical fibre to measure numerical aperture of a given fibre.
3. Perform the experiments on various semiconductor devices and analyze their characteristics.
4. Analyze, design and implement logical operations using various combinational and sequential logic circuits

Suggested Experiments: (Any five)

1. Determination of number of lines on the grating surface using LASER Source.
2. Determination of Numerical Aperture of an optical fibre.
3. Determination of wavelength using Diffraction grating. (Laser source)
4. Determination of angular divergence of laser beam.
5. Study of Hall Effect.
6. Determination of energy band gap of semiconductor.
7. Study of I-V characteristics of LED.
8. Determination of ‘h’ using Photocell.
9. Study of I-V characteristics of semiconductor photodiode and determination of its spectral response.
10. Study of I-V characteristics of a photovoltaic solar cell and finding the efficiency.
11. Design AND, OR, NOT, EXOR, EXNOR gates using Universal gates: NAND and NOR
12. Implement Half adder, Full adder, Half subtractor and Full subtractor circuits.
13. Verify the truth table of different types of flip flops.

14. Design asynchronous/synchronous MOD N counter using IC7490.
15. Zener Diode as a voltage regulator.

Theory Assessment:
Internal Assessment: 30 marks
Consisting of Two compulsory internal assessments 30 Marks each. The final marks will be the average score of both the tests.
End Semester Examination: 45 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/tutorial and mini-projects (if included) are graded from time to time.

Books/References:

1. A text book of Engineering Physics-Avadhanulu & Kshirsagar, S. Chand
2. A textbook of Optics - N. Subramanyam and Brijlal, S.Chand
3. Fundamentals of optics by Jenkins and White, McGrawHill
4. Modern Engineering Physics – Vasudeva, S.Chand
5. Concepts of Modern Physics- ArtherBeiser, Tata McGraw Hill
6. A TextBook of Engineering Physics, S. O. Pillai, New Age International Publishers.
7. Optics - Ajay Ghatak, Tata McGraw Hill
8. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher
9. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill Education, Fourth Edition (2010).
10. Handbook of Modern Sensors Physics design and application- Jacob Fraden, Springer, AIP press.
11. Physics for Engineers, M.R. Srinivasan, New Age International Publishers.

Back to Scheme

Course Code	Course Name	Credits
ET 109	**Engineering Chemistry II**	2+0.5

Course objectives:

1. With the knowledge of the basic chemistry, the student will be able to understand and explain scientifically the various chemistry related problems in the industry/engineering field.
2. The student will be able to understand the new developments and breakthroughs efficiently in engineering and technology.

Course outcomes:

Students will be able to

1. To recognize the electrochemical processes and apply the concepts in electrochemistry.
2. To develop knowledge on electrochemical energy storage systems considering the operation and design of various battery technologies.
3. To identify various polymeric materials and their applications in engineering.
4. To acquire theoretical background of types of nanomaterials and their applications.
5. To acquire basic knowledge of the materials used in electronics
6. To describe the theoretical background of spectroscopic techniques such as NMR, IR, UV spectroscopy.

Module	Detailed Contents	Hrs.
1	**Engineering Electrochemistry** **Pre-requisite:** redox reaction,cell reaction, electrode and its type, salt bridge 1.1. Electrode potential, electrode reaction, derivation of Nernst equation for single electrode potential, numerical problems.. 1.2 Electrochemical cell -Weston standard Cadmium cell 1.3 Reference electrodes -Introduction, Construction, working of SHE, Calomel electrode. 1.4 Ion selective electrodes: Introduction, Construction and working of glass electrode, 1.5 Electrochemical Sensors	5
2	**Battery Technology** **Pre- requisite** : Electrochemical Reactions, Cell potential, Electrochemical series 2.1 Introduction, classification – primary, secondary and reserve batteries. Characteristics – Capacity, Electricity storage density, energy efficiency, cycle life and shelf life. 2.2 Construction, working and applications of Ni – Cd rechargeable batteries 2.3 Lithium batteries - Introduction, construction, working and applications of Li-MnO2 2.4 Fuel Cells: Introduction, classification of fuel cells, limitations & advantages of fuel cells, Construction of Hydrogen oxygen alkaline fuel cells.	5
3	**Polymeric Materials** **Pre-requisite** : Polymer, Monomer, Polymerization, Degree of polymerisation, Classification of polymers, Mechanism of polymerisation. 3.1 Molecular weight of polymers: number average and weight average, numerical problems. , Polydispersity Index,	5

	3.2 Polymer crystallinity - glass transition temperature and its significance 3.3 Thermoplastic & Thermosetting polymers- Characteristics 3.4 Preparation , properties and uses of PMMA, Urea- Formaldehyde, Phenol - formaldehyde 3.5 Conducting polymers – Types, Mechanism of conduction in polymers, Examples, and applications. 3.6. Polymers for electronics – Polymer resists for integrated circuit fabrications, lithography and photolithography, 3.7. Polymer films in sensor applications	
4	**Nanochemistry** **Pre-requisite:** Concept of nano scale, definition of nanoparticles 4.1. Importance of nano size, Properties of nanomaterials – Size, optical properties, magnetic properties, electrical properties. 4.2 Nanoscale materials- carbon nanotubes, nano wires, fullerenes. 4.3 Synthesis of Nano particles by Chemical vapor deposition (CVD) method and Laser Ablation Method 4.4 Nano electronics 4.5 Applications of nano materials	4
5	**Materials For Electronics** 6.1. Introduction,Electronic properties of materials, classification based on conductivity of materials , Specific conducting materials (graphite, Au, Pt, Ag, Al, Cu and steel) 6.2. Factors influencing the conductivity of materials ,Applications of Optoelectronic and Dielectric materials.	3
6	**Spectroscopic Techniques** **Pre-requisites :** Electromagnetic radiation, characteristics of electromagnetic radiation, electromagnetic spectrum. 5.1. Spectroscopy - Principle, Interaction of radiation with matter, Selection rules. 5.2 Types of spectroscopy,: IR, UV, NMR, Emission Spectroscopy, (Flame Photometry), 5.3 Fluorescence and Phosphorescence, Jablonski diagram	3

Lab Objectives:

1. Provide the students with a basic understanding in Chemistry laboratory required to solve engineering problems.
2. Learn to design and carry out experiments as well as accurately record and analyze the results of such experiments.

Lab Outcome:

The student will be able to

1. Analyse & generate experimental skills.
2. Enhance the thinking capabilities in the modern trends in Engineering & Technology.
3. Learn and apply basic techniques used in chemistry laboratories for preparation, purification and identification.
4. Learn safety rules in the practice of laboratory investigations.

List of Experiments

1. Determination of Cell potential of Zn- Cu system
2. Molecular weight determination of polymers by Oswald Viscometer
3. Preparation of Urea Formaldehyde
4. Preparation of biodegradable polymer using corn starch or potato starch.
5. Preparation of Magnetic Nanoparticles.

6. Synthesis of Biodiesel
7. Determination of electrical conductivity of unknown solution.
8. Preparation of Hand Sanitizer using ethyl alcohol
9. Determination of Caffeine in Tea
10. Determination of pH using glass electrode.

Theory Assessment:

Internal Assessment: 30 marks

Consisting of Two compulsory internal assessments 30 Marks each. The final marks will be the average score of both the tests.

End Semester Examination: 45 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/tutorial and mini-projects (if included) are graded from time to time.

Books/References:

1. Engineering Chemistry – P.C.Jain and Monika Jain, Dhanpat Rai Publications
2. A Textbook of Engineering Chemistry, - Shashi Chawla(DhanpatRai publications)
3. A textbook of Engineering Chemistry - S.S. Dara, S. Chand Publishing House
4. Engineering Chemistry – O.G. Palanna , Tata Mc Graw Hill
5. Material Science and Engineering by W.D.Callister
6. Fundamentals of Molecular Spectroscopy – C.N . Banwell, Tata Mc Graw Hill
7. Instrumental methods of chemical analysis – B.K.Sharma, Goel Publishing House
8. "Nanomaterials: Synthesis, Properties and Applications", A. S. Edelstein and R. C. Cammarata- Institute of Physics Pub., 2001

Back to Scheme

Course Code	Course Name	Credits
ET 110	**Engineering Drawing and Graphics**	1+2

Course Objectives: The course is aimed

1. To develop graphic skills for communication of concepts, ideas and design of Engineering products.
2. To impart and inculcate proper understanding of the theory of projection.
3. To impart the knowledge of reading a drawing
4. To improve the visualization skill.

Course Outcomes:

On successful completion of course learner/student will be able to

1. Apply the basic principles of projections in Projection of Lines and Planes
2. Apply the basic principles of projections in Projection of Solids.
3. Apply the basic principles of sectional views in Section of solids and development of surfaces.
4. Apply the basic principles of projections in converting 3D view to 2D drawing.
5. Read a given drawing.
6. Visualize an object from the given two views.

Module	Detailed Contents	Hrs.
1	**Introduction to Engineering Graphics** Principles of Engineering Graphics and their significance, usage of Drawing instruments, Types of Lines, Dimensioning Systems as per IS conventions. Introduction to plain and diagonal scales. **Engineering Curves** Basic construction of Cycloid, Involutes and Helix (of cylinder) only.	2 3
2	**Projection of Points and Lines** Lines inclined to both the Reference Planes (Excluding Traces of lines) and simple application based problems on Projection of lines. **Projection of Planes** Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular planes inclined to either HP or VP only. (Exclude composite planes).	3 2
3	**Projection of Solids** (Prism, Pyramid, Cylinder, Cone only) Solid projection with the axis inclined to HP and VP. (Exclude Spheres, Composite, Hollow solids and frustum of solids). Use change of position or Auxiliary plane method	5
4	**Orthographic and Sectional Orthographic Projections: -** Fundamentals of orthographic projections. Different views of a simple machine part as per the first angle projection method recommended by I.S. Full or Half Sectional views of the Simple Machine parts.	5
5	**Isometric Views:-** Principles of Isometric projection – Isometric Scale, Isometric Views, Conversion of Orthographic Views to Isometric Views (Excluding Sphere).	4

Lab Objectives

1. To inculcate the skill of drawing with the basic concepts.
2. To Use AutoCAD for daily working process.
3. To teach basic utility of Computer Aided drafting (CAD) tool

Lab Outcomes:

Learners will be able to…

1. Apply the basic principles of projections in 2D drawings using a CAD software.
2. Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
3. Apply the concepts of layers to create drawing.
4. Apply basic AutoCAD skills to draw different views of a 3D object.
5. Apply basic AutoCAD skills to draw the isometric view from the given two views.

Component-1

Self-study problems/ Assignment: (In A3 size Sketch book, to be submitted as part of Term Work)

1. Engineering Curves. (2 problems)
2. Projection of Lines (2 problems)
3. Projection of planes (2 problems)
4. Projection of solids. (2 problems)
5. Orthographic Projection. (With section 1 problem, without section 1 problem).
6. Isometric Drawing. (2 problems)

Component- 2

Computer Graphics: Engineering Graphics Software - Orthographic Projections, Isometric Projections, Co-ordinate Systems, Multi-view Projection.

PART	To be Taught in laboratory.	Hrs.
PART - A	**Overview of Computer Graphics Covering:** Listing the computer technologies that impact on graphical communication, demonstrating knowledge of the theory of CAD software such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.	3
	Customization & CAD Drawing: Consisting of set up of the drawing page and the printer including scale settings, Setting up of units and drawing limits, ISO and ANSI standards for coordinate dimensioning.	3
	Annotations, layering & other Functions Covering: Applying dimensions to objects, applying annotations to drawings, Setting up and use of layers, layers to create drawings, Create, edit and use customized layers, Changing line lengths through modifying existing lines (extend/lengthen), Printing documents to paper using the print command, orthographic projection techniques, Drawing sectional views of objects (simple machine parts).	2
PART -B	**Activities to be completed in the CAD Laboratory. (All printouts to be the part of Term Work. Preferably, Use A3 size sheets for print out.)**	
	1. Orthographic Projections (without section)- 1 problem	2
	2. Orthographic Projection (with section)- 2 problem	4
	3. Orthographic Reading – 1 problem	2
	4. Isometric Drawing – 4 problem.	4

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/tutorial 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. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

Reference Books:

1. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies) : Auto CAD 2012 (For engineers and Designers)", Dreamtech Press NewDelhi.
3. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Back to Scheme

Course Code	Course Name	Credits
ET 111	**Python Programming I**	**3+1**

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore the various types of data structures.
3. To learn how to use indexing and slicing to access data in Python programs.
4. To learn how to use exception handling in Python applications for error handling.
5. To learn how to write functions and pass arguments in Python.
6. Develop applications using variety of libraries and functions

Course Outcomes:

1. Describe syntax and semantics in Python
2. Interpret the python syntax and semantics of control flow statements
3. Determine the methods to create and manipulate programs with Python data structures
4. Able to understand the exceptions and file handling methods.
5. Apply functions and modules in Python to solve a problem
6. Interpret object-oriented programming in Python

Theory Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**CO Mapping**
1	Basic	**Introduction to Python** 1.1 Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global) 1.2 Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats	CO1
2	Basic	**Data structures & Control Statement** 2.1 Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures. 2.2 Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements 2.3 Working with Strings String Indexes, string with a loop, String slices, Looping and counting, in operator, String comparison, Parsing strings, Format operator	CO2

3	Basic	**File I/O Handling** 3.1 File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, with keywords, Moving within a file, Manipulating files and directories, OS and SYS modules. 3.2 MS Excel files: Introduction to MS Excel files	CO2, CO3
4	Design	**Exception, Testing and Debugging:** 4.1 Handling if exceptions to handle the code cracks, handling and helping file operations, coding with the exceptional handling and testing Anonymous method, Properties, Indexers, Exception Handling	CO4
5	Design	**Functions** 5.1 Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code. 5.2 Numeric and Date Functions: Dates and Times, Advanced Data and Time Management, Random Numbers, The Math Library, OS and SYS modules, The dir Function.	CO5
6	Advanced	**Object Oriented Programming** 6.1 Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes. 6.2 Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Data Abstraction, Data Hiding, Encapsulation, Modularity, Polymorphism	CO6

Lab Syllabus:

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4.Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**
1	Basic	Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc.
2	Basic	Write Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc)
3	Basic	Write a Python program to implement control structures.
	Basic	Write python program to print list of numbers using range and for loop
4	Design	Write python program to understand different File handling operations
5	Design	Write python program in which an function is defined and calling that function print Hello World
6	Advanced	Write a program to find the factorial value of any number entered

		through the keyboard.
7	Advanced	Write a Python program to study, define, edit arrays and perform arithmetic operations.
8	Advanced	Write a python program in which a function (with a single string parameter) is defined and calling that function prints the string parameters given to the function.
9	Advanced	Write Python program to implement classes, object, Static method and inner class

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/tutorial 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. Introduction to computing and problem solving using python , E Balagurusamy, McGraw Hill Education.
2. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
3. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
4. 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).
5. Yashavant Kanetkar, "Let us Python: Python is Future, Embrace it fast", BPB Publications; 1 edition (8 July 2019).
6. Dusty Phillips, "Python 3 object-oriented Programming", Second Edition PACKT
7. Publisher August 2015.
8. 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

Course Code	Course Name	Credits
ET 112	**Professional Communication and Ethics I**	2+1

Course Objectives:
The course is aimed

1. To understand, compare and demonstrate the importance and relevance of communication with specific emphasis on listening skill.
2. To promote practice in speaking skill and encourage learners to compose on the spot speeches for the purpose of developing and generating ideas.
3. To train learners in reading strategies that will enhance their global understanding of the text and help them to comprehend academic and business correspondence.
4. To illustrate effective writing skills in business, academic and technical areas.
5. To inculcate confident personality traits with grooming and social etiquette.
6. To train learners in producing words on the basis of contextual cues and reflect on errors in sentences.

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

1. Listen, comprehend and identify potential barriers in spoken discourse with ease and accuracy.
2. Develop confidence and fluency in speaking at social,academic and business situations as well as make effective professional presentations.
3. Implement reading strategies for systematic, logical understanding, that will enhance the skill of comprehension, summarisation and evaluation of texts.
4. Understand and demonstrate effective writing skills in drafting academic, business and technical documents.
5. Communicate effectively in academic as well as business settings, displaying refined grooming and social skills.
6. Anticipate the meaning of unfamiliar words with the help of contextual cues and construct grammatically correct sentences.

Module	Detailed Contents	Hrs.
1	**The Importance and Strategies of Effective Listening** **Prerequisite: Able to listen, read, speak, write and comprehend the target language** Introduction to communication 1.1 Importance and relevance of communication 1.2 Listening skill - ability to discriminate stress and intonation - Comprehend meaning of audio text-graded on the basis of vocabulary, sentence construction and theme. - potential barriers	4
2	**Developing Speaking Skills** 2.1 Intensive Speaking- on the spot topics 2.2 Responsive speaking-answering a question 2.3 Interactive speaking-conversations 2.4 Extensive speaking-speech, oral presentations-specific emphasis on plagiarism check and generating the report	4

3	**Strategies and Techniques to build Reading Skill** 3.1 Global understanding of the text- inference, anticipation and deduction 3.2 Detailed understanding of text-scanning for specific information (special emphasis on reading comprehension exercises and summarisation)	2
4	**Developing Professional Writing Skills** 4.1 Effective introduction with emphasis on general statement, opposing statement and thesis statement 4.2 Critical response to a text with special reference to purpose, evaluation of the content, theme and style of a text 4.3 Organization of ideas, sentence construction and word choice, grammar and usage 4.4 Explanation and support of ideas (special reference to writing paragraphs and business letters- Sales and complain letters)	4
5	**Etiquette and Grooming for Personality Development** 5.1 Social Etiquette 5.2 Corporate etiquette 5.3 Confidence building and Personality development	1
6	**Vocabulary and Grammar** 6.1 Contextual vocabulary Development- Word Maps 6.2 Identifying errors in a sentence.	1

Lab Prerequisite: Basic language skills

Lab Objectives:

L1. To train learners in listening strategies that will enhance their global understanding of the audio text and help them to comprehend potential barriers in listening.
L.2. To aid learners to speak English accurately, effectively and confidently.
L.3. To train learners in reading strategies that will enhance their global understanding of the text and help them to comprehend academic and business correspondence.
L.4. To illustrate effective writing skills in business, academic and technical areas.
L.5. Grooming and projecting appropriate behaviour in all interactions.
L.6. To understand the importance of vocabulary development in using and producing words with the help of word maps, images and contextual clues.

Lab Outcomes:

LO1: Able to listen and comprehend in audio texts with ease and accuracy as well as resolve potential barriers.
LO2: Learners will be able to take part in the on the spot speech competition, respond to a question with accuracy and demonstrate appropriate non-verbal signals required in interactive speaking, oral and speech presentations.
LO3: Implement reading strategies for systematic, logical understanding that will enhance the skill of comprehension, summarization and evaluation of texts.
LO4: Understand and demonstrate effective writing skills in drafting academic, business and technical documents.
LO5: Dress and conduct themselves appropriately as required in a given situation.
LO6: Anticipate the meaning of unfamiliar words with the help of contextual cues and assess their vocabulary building skills.

Detailed Syllabus:

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Assignment 1	Written record of listening activities - Listening practice tasks of 3 types (through audio recordings of (1) Monologues (2) Dialogues (3) Formal/Expert Talk or Lecture)	LO1
2	Assignment 2	Transcription of the public speech along with a plagiarism report-Practice public speech	LO2
3	Assignment 3	Summarization through graphic organisers (1. Text to graphic organizer 2. Graphic organizer to text)	LO3
4	Assignment 4	1. Case studies on critical thinking 2. 2 business letters in complete block format	LO4
5	Assignment 5	Documentation of case studies/Role play based on Module 5	LO5
6	Assignment 6	1. Contextual Vocabulary Development 2. Aptitude Test	LO6

Theory Assessment:

Internal Assessment: 20 marks

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

End Semester Examination: 30 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:

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

Books/References:

1. Raman Meenakshi & Sharma Sangeeta, Communication Skills, Oxford University Press
2. Kumar Sanjay &Lata Pushp, Communication Skills, Oxford University Press
3. Locker, Kitty O. Kaczmarek, Stephen Kyo. (2019). Business Communication: Building Critical Skills. Place of publication not identified: Mcgraw-hill.
4. Murphy, H. (1999). Effective Business Communication. Place of publication not identified: Mcgraw-Hill.
5. Lewis, N. (2014). Word power made easy. Random House USA.

Back to Scheme

Course Code	Course Name	Credits
ET 113	**Basic Engineering Workshop II**	1.5

Course Objectives:

1. To impart training to help the students develop engineering skill sets.
2. To inculcate respect for physical work and hard labor.
3. To get exposure to interdisciplinary engineering domain.

Course Outcomes:

Learner will be able to…

1. Develop the necessary skill required to handle/use different carpentry tools.
2. Identify and understand the safe practices to adopt in electrical environment.
3. Demonstrate the wiring practices for the connection of simple electrical load/ equipment.
4. Design, fabricate and assemble pcb.
5. Develop the necessary skill required to handle/use different masons tools.
6. Develop the necessary skill required to use different sheet metal and brazing tools.
7. Able to demonstrate the operation, forging with the help of a simple job.

Trade	Detailed Content	Hrs.
Note: Trade 1 and 2 are compulsory. Select any ONE trade topics out of the topic trade 3 to 5. Demonstrations and hands on experience to be provided during the periods allotted for the same. Report on the demonstration including suitable sketches is also to be included in the term work CO-1 is related to Trade-1 CO-2 to CO-4 is related to Trade-2 CO-5 is related to Trade-3 CO-6 is related to Trade-4 CO-7 is related to Trade-5 CO evaluation is to be done according to the opted Trades in addition to Compulsory Trades.		
Trade-1	**Carpentry(Compulsory)** 6. Use and setting of hand tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood tuning and modern wood turning methods. 7. Term work to include one carpentry job involving a joint and report on demonstration of a job involving wood turning	10
Trade-2	**Basic Electrical work shop:(Compulsory):** 8. Single phase and three phase wiring. Familiarization. of protection switchgears and their ratings (fuse, MCB, ELCB). Wiring standards, Electrical safety in the work place safe work practices. Protective equipment, measures and tools. 9. Layout drawing, layout transfer to PCB, etching and drilling and soldering technique	08
Trade-3	**Masonry:** 10**.** Use of masons tools like trowels, hammer, spirit level, square, plumb line and pins etc. demonstration of mortar making, single and one and half brick masonry , English and Flemish bonds, block masonry, pointing and plastering.	06

Trade 4	**Sheet metal working and Brazing:** 11.Use of sheet metal, working hand tools, cutting , bending , spot welding	06
Trade-5	**Forging (Smithy):** 12.At least one forging job to be demonstrated and a simple job to be made for Term Work in a group of 4 students.	06

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/tutorial and mini-projects (if included) are graded from time to time.

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

Prerequisite:
Engineering Mathematics-I and Engineering Mathematics-2

Course Objectives:

1. To Learn the Laplace Transform, Inverse Laplace Transform of various functions, its applications.
2. To understand the concept of Fourier series, its complex form and enhance the problem-skills.
3. To Understand Matrix algebra for engineering problems
4. To understand the concept of complex variables, C-R equations with applications.
5. To understand the concepts of Quadratic forms and Singular value decomposition.
6. To Learn Fourier Integral, Fourier Transform and Inverse Fourier transform.

Course Outcomes:

The learner will be able to

1. Understand the concept of Laplace transform and its application to solve the real integrals, understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
2. Expand the periodic function by using the Fourier series for real-life problems and complex engineering problems.
3. Apply the concepts of eigenvalues and eigenvectors in engineering problems.
4. Understand complex variable theory, application of harmonic conjugate to get orthogonal trajectories and analytic functions.
5. Use the concept of Quadratic forms and Singular value decomposition which are very useful tools in various Engineering applications
6. Apply the concept of Fourier transform and its inverse in engineering problems.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Laplace Transform**	Definition of Laplace transform and Laplace transform of standard functions, Properties of Laplace Transform: Linearity, First Shifting Theorem, change of scale Property, multiplication by t, Division by t, (Properties without proof). Inverse of Laplace Transform by partial fraction and convolution theorem.	7	1
II	**Fourier Series,**	Dirichlet's conditions, Fourier series of periodic functions with period 2π and 2L, Fourier series for even and odd functions, Half range sine and cosine Fourier series, Orthogonal and Ortho-normal functions, Complex form of Fourier series.	7	2

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

Lab Prerequisite:
Applied Mathematics -I , Applied Mathematics -II, Scilab programming SEM I and SEM II.

Software Requirements: Sci Lab

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	**Basic**	Write a program in scilab to find Laplace transform of a function and show graphically.	**2**
2	**Basic**	Write a program in scilab to find fourier series of a function and show graphically.	**2**
3	**Basic**	Write a program in scilab to find eigenvalues of a matrix	**2**
4	**Advanced**	Write a program in scilab to find eigenvalues and eigenvectors	**2**
5	**Design**	Write a program in scilab to find the exponential or trigonometric functions of a matrix.	**2**

6	**Advanced**	Write a program in scilab to find a quadratic form	**2**
7	**Advanced**	Write a program in scilab to apply the congruent transformations on matrix	**2**
8	**Advanced**	Write a program in scilab to find SVD of a matrix	**2**
9	**Basic**	Write a program in scilab to find fourier transform	**2**
10	**Basic**	Write a program in scilab to find determinant of a matrix	**2**
11	**Basic**	Write a program in scilab to find the value of a complex integral.	**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:
1. 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.

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

Text Books and References:

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

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Subject Code	Subject Name	Total
ET 202	Electronic Devices	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 amplifier. High and low frequency analysis of CS (E-MOSFET) amplifier.	7	CO3,CO6
V	**Large Signal Amplifiers**	Difference between small signal & large signal amplifiers. Classification and working of Power amplifier. 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

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	**Basic**	Study of pn junction diode characteristics.	2
2	**Basic**	To study zener as a voltage regulator.	2
3	**Design**	To study characteristics of CE configuration.	2
4	**Design**	To study BJT biasing circuits.	2

5	**Advanced**	To study BJT as a CE amplifier.	2
6	**Advanced**	To study frequency response of a CE amplifier.	2
7	**Design**	To study EMOSFET biasing circuits.	2
8	**Design**	Simulation experiment on study frequency response of CS amplifier.	2
9	**Advanced**	Simulation experiment on study of differential amplifier.	2
10	**Advanced**	Simulation experiment on multistage amplifier.	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 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:
1. 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.

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

Text Books:

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

References:

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

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Subject Code	Subject Name	Total
ET 203	Network Theory	03

Prerequisite:

1. Basic Electrical Engineering
2. Engineering Mathematics

Course Objectives:

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

Course Outcomes: The learner will be able to

1. Apply their knowledge in analysing Circuits by using network theorems.
2. Apply the knowledge of graph theory for analysing 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 average of score of both the tests.

End Semester Examination: 60 Marks

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

Text Books:

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

References:

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

Subject Code	Subject Name	Total
ET 204	Instruments and Control System	03

Prerequisite:
Basic Electrical Engineering

Course Objectives:

1. To provide basic knowledge about generalized measurement system and its performance characteristics.
2. To provide basic knowledge about various sensors and transducers.
3. To provide fundamental concepts of control system such as mathematical modeling, block diagram and signal flow graph.
4. To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and develop concepts of stability and its assessment criteria in time domain analysis.
5. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.
6. Develop and analyze state space models.

Course Outcomes: The learner will be able to:

1. Distinguish between various types of measurement systems and their performance characteristics.
2. Apply the knowledge of various transducers for measurement of temperature, displacement and pressure.
3. Determine the transfer function of the system using block diagram reduction and signal flow graph technique.
4. Analyze systems using time domain analysis techniques.
5. Apply concepts of frequency domain techniques in stability analysis of control systems.
6. Derive the state variable models of systems and analyze their controllability and observability.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	**Principle of Measurement, Testing and Measuring instruments**	Introduction to basic instruments: components of generalized measurement system, concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration. Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Megohm bridge, Measurement of Inductance: Maxwell bridge and Hay bridge, Measurement of Capacitance: Schering bridge.	5	CO1

II	**Sensors and Transducers**	Basics of sensors and transducers-Active and passive transducers, characteristics and selection criteria of transducers. Displacement and pressure- potentiometers, pressure gauges, linear variable differential transformers (LVDT) and strain gauges. Temperature transducers-working principle, ranges and applications of resistance temperature detectors (RTD), thermistors and thermocouples.	6	CO2
III	**Introduction to Control System Analysis**	Introduction: open and closed loop systems, example of control systems. Transfer function model of Electrical system, Block diagram reduction techniques and Signal flow graph.	7	CO3
IV	**Time Response Analysis**	Standard test signals, transient and steady state behavior of first and second order systems, steady state errors in feedback control systems and their types. Concept of stability: Routh and Hurwitz stability criterion, Root locus Analysis: Root locus concept, general rules for constructing root-locus, and root locus analysis of control system.	8	CO4
V	**Frequency Response Analysis**	Introduction: Frequency domain specifications, relationship between time and frequency domain specifications of system. Bode Plot: Magnitude and phase plot, method of plotting Bode plot, stability margins and analysis using bode plot. Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion.	7	CO5
VI	**State Space Analysis**	State space representation of the system, state space equations, state space representation from transfer function, state space representation of electrical network, transfer matrix, eigen values and eigen vector, solution of state equations, controllability and observability.	6	CO6

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.

Text Books:

1. A.K. Sawhney, “Electrical & Electronic Measurement & Instrumentation” – DRS . India
2. M.M.S. Anand, “Electronic Instruments and instrumentation Technology”.
3. H.S.Kalsi, “Electronic Instrumentation”-TMH, 2nd Edition.
4. Nagrath, M.Gopal, “Control System Engineering”, Tata McGraw Hill.
5. K.Ogata, “Modern Control Engineering, Pearson Education”, IIIrdedition.

References:

1. Helfrick & Copper, “Modern Electronic Instrumentation & Measuring Techniques” – PHI
2. W.D. Cooper, “Electronic Instrumentation And Measuring Techniques" – PHI
3. Benjamin C.Kuo, “Automatic Control Systems, Eearson education”, VIIth edition
4. Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices And Systems", Tata McGraw-Hill, 2nd Ed., 2004.
5. Bell David A."Electronic Instrumentation and Measurements", PHI Pearson Education, 2006.
6. Madan Gopal, “Control Systems Principles and Design”, Tata McGraw hill, 7th edition,1997.
7. Normon, “Control System Engineering”, John Wiley & sons, 3rd edition.

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Subject Code	Subject Name	Total
ET 205	Signals and Systems	03

Prerequisite:
Engineering Mathematics III

Course Objectives:

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

Course Outcomes:

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

Sr. No.	Module	Detailed Content	Hours	CO Mapping
1	**Introduction of Continuous and Discrete Time Signals and systems**	Introduction to Signals: Definition of Signals , Representation of continuous time signals and discrete time signals, Sampling theorem(only statement derivation not expected), sampling of continuous time signals Basic Elementary signals , Arithmetic operations on the signals- Time Shifting, Time scaling, Time Reversal of signals Classification of Continuous time signals and Discrete time signal Introduction to Systems: Definition of Systems , Classification of Continuous time systems and Discrete time systems	7	**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 Continuous time signals and Discrete time signal	7	**CO 2**
3	**Fourier Analysis of Continuous and Discrete Time Signals and Systems**	Fourier transform of periodic and non-periodic functions, Properties of Fourier Transform, Inverse Fourier Transform, Frequency Response: computation of Magnitude and Phase Response, Energy spectral density, Power spectral density(No Numericals expected),Limitations of Fourier Transform	6	**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, 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	7	**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	8	**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 average of score of both the tests.

End Semester Examination: 60 Marks

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

Text Books:

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

References:

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

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

Lab Prerequisite: Python Programming I

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

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

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

Hardware Requirements: NA

Sr. No	Level 1. Basic 2. Design 3. Advanced 4.Project/ Case Study/ Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Basic	**1. Python Fundamentals** 1.1 Basics of Control Statements, Functions, Classes, Objects and Exceptions 1.2 Python Regular Expressions What are regular expressions? The match Function The search Function Matching vs searching Search and Replace Extended Regular Expressions Wildcard 1.3 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 Matplotliblibrary, 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	01

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 Printed circuit boards(PCB)
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. Learn the technique of soldering and circuit implementation on general purpose printed circuit board (GPP).
LO2. Realize the PCB design process and gain up-to-date knowledge of PCB design software.
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	**PCB design and optimization** 3.1 Design the circuit by placing components using PCB design software. 3.2 Reduce the size of PCB by varying the position of components or devices for optimize use of copper clad material 3.3 Transfer the designed PCB on Copper clad either by using a dark room or taking printout on glossy paper, etc (use available suitable method). 3.4 Perform Etching and then Soldering.	LO1, LO2
4	2,3	**Detection of Hardware faults, Result verification and understanding Troubleshooting** 4.1 Identify the hardware faults in designed circuit and subsequently rectify it 4.2 Now again verify the hardware results by using electronic tools and equipments like millimeter, CRO, DSO etc. 4.3 Understand the trouble shooting by removing some wired connections. 4.4 Understand the trouble shooting of track. Troubleshoot the faculty components or devices	LO3
5	1,2	**Introduction to Arduino Uno board and integrated development environment (IDE)**	LO4,LO5

		5.1 Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.	
6	2,3	**GPIO (along with Analog pin) Programming** 6.1 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. 6.2 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
	2,3	**Interfacing Communication Devices and Cloud Networking** 7.1 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.	LO4 ,LO5
	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	LO4,LO5, LO6

Lab Assessments:

Teamwork, Practical and Oral:

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

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

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

Two reviews will be conducted for continuous assessment, First shall be for finalisation 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. Kraig Mitzner, "Complete PCB Design Using OrCAD Capture and PCB Editor",Academic Press; 2nd edition , 20 June 2019.
3. Arduino Projects for Dummies, by Brock Craft (2013)
4. Programming Arduino –Getting Started with Sketches, Simon Monk (2016)
5. 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**	03

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

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.

Text Books and References:

1. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
2. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
3. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
4. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
5. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
6. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
7. Beginning Linear Algebra Seymour LipschutzSchaum's outline series, Mc-Graw Hill Publication.

Back to Scheme

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

Prerequisite:
Electronic Devices and Circuits

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

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

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

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

Electronics and Communication Laboratory :

Lab Prerequisite:

Electronic Devices and Circuits

Software Requirements: Matlab

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

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

5	1	Generation of PPM, PWM signal.	2

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

Theory Assessment:

Internal Assessment: 40 marks

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

End Semester Examination: 60 Marks

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

Lab Assessments:

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

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

Text Books:

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

References:

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

Back to Scheme

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

Prerequisite:

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

Course Objectives:

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

Course Outcomes:

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

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

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

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

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

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

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

Theory Assessment:

Internal Assessment: 40 marks

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

End Semester Examination: 60 Marks

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

Lab Assessments:

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

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

Text Books:

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

Back to Scheme

Course Code	Course Name	Credits
ET 210	**Digital Signal Processing**	03

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

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.

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.

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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

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

Course objectives: The course is aimed

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

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

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

Module No	Module	Detailed Contents	Hrs.
1	Introduction to Personal Financial Planning	Financial Planning Process: Goal, Vision and mission , Components of Personal Financial Plan, Advantages and developing personal financial plan	3
2	Financial Budget	Meaning and Process of Drafting Financial Budget,Components of Financial Budget,Drafting Financial 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 McGrawHi
5. Wealth Management- Dun & Bradstreet, Tata McGrawHill
6. Wealth Management- S.K .Bagachi, Jaico publishing house

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Course Code	Course Name	Credits
ET 213	**Programming (Matlab/Scilab)**	01

Lab Prerequisite:
Signals and Systems
Engineering Mathematics I, Engineering Mathematics II, Engineering Mathematics III

Lab Objectives: To teach the students
L1. Ability to implement and develop Discrete fourier transform
L2. Ability to simulate and design of IIR digital filters
L3. Ability to simulate and design of FIR digital filters.
L4. Understand the methods of finding correlation.
L5. Understand the methods of finding probability distributions and complex Integration.
L6. Understand the processes of Gram Schmidt and Rayleigh Ritz Methods.

Lab Outcomes: The learner will be able
1. To implement and develop Discrete fourier transform
2. To simulate and design of IIR digital filters
3. To simulate and design of FIR digital filters
4. To implement the Correlation methods in engineering problems in data science
5. To implement the methods of finding probability distributions and complex Integration in engineering problems.
6. To implement the processes of Gram Schmidt and Rayleigh Ritz Methods in engineering problems.

Applied Mathematics -IV, Scilab programming SEM I and SEM II.
Software Requirements: Sci Lab, Matlab

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	LO Mapping
1	Basic	To perform DFT and IDFT of the discrete time sequence and sketch the magnitude and phase spectrum.	LO1
2	Basic	To perform circular convolution of discrete time sequences using DFT and IDFT method and compute linear convolution using circular convolution.	LO1
3	Design	To Design analog low pass Butterworth and Chebyshev filter	LO2
4	Design	To Design an IIR butterworth low pass filter using impulse in-variance method .	LO2
5	Design	To Design an IIR butterworth low pass filter using bilinear transformation method .	LO2
6	Design	To Design an IIR Chebyshev low pass filter using bilinear transformation method .	LO2

7	Advanced	To Design a FIR low pass, high pass filter using various windowing methods and plot their frequency response.	LO3
8	Basic	Write a program in scilab to find Karl Pearson's coefficient of correlation..	LO4
9	Basic	Write a program in scilab to find Spearman's Rank correlation.	LO4
10	Basic	Write a program in scilab to find Probability Distributions.	LO5
11	Advanced	Write a program in scilab for Gram Schmidt Process.	LO6
12	Advanced	Write a program in scilab for Rayleigh Ritz method.	LO6
13	Advanced	Write a program in scilab to find Complex Integration.	LO5

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. 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
6. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication
7. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education

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.
4. Advanced engineering mathematics H.K. Das, S . Chand, Publications.
5. Applied Numerical Methods with MATLAB for Engineers and Scientists by Steven Chapra, McGraw Hill.
6. Scilab spoken tutorials videos. (https://spoken-tutorial.org/tutorial-search/?search_foss=Scilab&search_language=English)

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Course Code	Course Name	Credits
ET 292	**Mini Project II**	01

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)

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Course Code	Course Name	Credits
ET 301	**Digital Communication**	4

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	1.1 Information, Probability, Conditional Probability of independent events, Relation between probability and probability Density , Rayleigh Probability Density , CDF, PDF. 1.2 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	2.1 Block diagram and sub-system description of a digital communication system, measure of information and properties, entropy and its properties 2.2 Shannon‘s Source Coding Theorem, Shannon-Fano Source Coding, Huffman Source Coding 2.3 Differential Entropy, joint and conditional entropy, mutual information and channel capacity, channel coding theorem, channel capacity theorem	06	02

3	Error Control Systems	3.1 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 3.2 Systematic and Non-systematic Cyclic codes: encoding with shift register and error detection and correction 3.3 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 4.2 Inter-symbol interference, Nyquist criterion for zero ISI, sinusoidal roll-off filtering, correlative coding, equalizers, and eye pattern	05	04
5	Bandpass Modulation & Demodulation	5.1 Band-pass digital transmitter and receiver model, digital modulation schemes 5.2 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	6.1 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 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. 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	Credit
ET 302	**Electromagnetic Engineering**	3

Prerequisite:
Basics of Vector Algebra.

Course Objectives:

1. To learn electromagnetics and the laws governing it.
2. To learn electromagnetics, including static and dynamic electromagnetic fields and waves within and at the boundaries of media.
3. To understand the basics of transmission lines and solve problems using smith chart.
4. To extend the students' understanding about the propagation of the waves by different types such as ground waves, sky wave and space wave.

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

1. To analyze Static electric field and laws governing it.
2. To analyze Steady magnetic field and laws governing it.
3. To describe electromagnetics field including steady and time varying in terms of Maxwell's equations.
4. To apply Maxwell's equation to solve various electromagnetic phenomenon such as electromagnetic wave propagation in different medium, power in EM wave.
5. To understand the basics of transmission lines and solve problems related to it.
6. To understand different types of wave propagation.

Theory Syllabus:

Module no	Module	Detailed Content	Hours	CO Mapping
I	Electrostatics	1.1 Coulomb's Law & Electric Field Intensity, Electric Field due to point charge, line charge and surface charge distributions. 1.2 Electric Flux Density, Gauss's Law and its Application ,Divergence theorem. 1.3 Electric potential, Relationship between Electric field & potential , Potential Gradient. 1.4 Poisson's and Laplace's equation.	07	CO1
II	Steady Magnetic field	2.1-Biot-Savart's Law 2.2-Ampere's circuital law and its application, Magnetic flux density 2.3-Magnetic vector potential	03	CO2
III	Maxwell's Equation for steady and time varying field	3.1 Faraday's Law, Displacement current 3.2 Maxwell's equation for a static field. 3.3 Maxwell's equation for time varying field 3.4 Boundary conditions for electric and magnetic fields	09	CO3

IV	Uniform Plane Waves	4.1-Uniform Plane Waves in free space and conducting medium. 4.2-Helmholtz equation, Solution of wave equation. 4.3-Wave propagation in conducting medium, skin depth 4.4 Poynting theorem, power flow for a plane wave	06	CO4
V	Transmission Lines	5.1 Transmission line parameters, equivalent circuit, Transmission line equations, Input impedance, Standing wave ratio, reflection coefficient 5.2 Smith Chart, Applications of Smith Chart in finding VSWR ,and reflection coefficient, admittance calculations, impedance calculations over length of line.	08	CO5
VI	Radio Wave Propagation	6.1-Types of wave propagation: Ground wave,, sky wave, space wave. 6.2 Curvature of earth, effect of interference zone, shadowing effect of hills and building, atmospheric absorption, Super-refraction, scattering phenomena, troposphere propagation and fading. 6.3 Measures of Ionosphere Propagation: Critical frequency, Angle of incidence, Maximum usable frequency, Skip distance, Virtual height, Attenuation and fading of waves in ionosphere	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. Electromagnetic Waves and Radiating Systems- Jordan and Balmain, PHI, 2nd edition
2. Principles of Electromagnetics Engineering- Matthew N. O.Sadiku , S.V.Kulkarni, Oxford university press, 6th edition.
3. Engineering Electromagnetics, William H Hayt and John A Buck, Tata McGraw-Hill
4. Publishing Company Limited, 7th edition

References:

1. R.K. Shevgaonkar, Electromagnetic Waves, TATA McGraw Hill Companies.
2. J.A. Administer, “Electromagnetic”, McGraw Hill Companies, 2nd Edition, 2006
3. Bhag Guru and Huseyin Hiziroglu, “Electromagnetic field theory fundamentals”, Cambridge University Press, 2nd Edition, 2010.

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Course Code	Course Name	Credits
ET 303	**Image processing & Machine Vision**	3

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	2.1 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 2.2 Frequency Domain Filtering: Introduction to 2-D DFT and its application in frequency domain filtering, Wavelet transform, Haar transform 2.3 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	3.1 Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Boundary extraction , Hole filling, Thinning and thickening 3.2 Restoration : A Model of the Image Degradation/Restoration Process, Noise models, Removal periodic noise, Principle of Inverse filtering	6	CO3
IV	Image Segmentation	4.1 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) 4.2 Thresholding : Foundation, Role of illumination and reflectance, Basic global thresholding 4.3 Region Based segmentation: Region Growing, Region Splitting and merging	8	CO3,CO4
V	Introduction to machine vision and descriptors	5.1 Principle of machine vision , real world applications, chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences 5.2 Introduction to Texture, co-occurence matrix	6	CO3,CO5
VI	Machine Vision Algorithms	6.1 Knowledge representation, Classification Principles, Classifier setting, Classifier Learning, Confusion Matrix 6.2 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,
2. W Pratt, “Digital Image Processing”, Wiley Publication, 3rd Edition, 2002

Back to Scheme

Course Code	Course Name	Credits
ET 304	**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**	**1.1** Definition, Characteristics, Classification, Applications **1.2** 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**	**3.1** Program Modeling concepts: DFG, CDFG, FSM. **3.2** 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**	**5.1** 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 **6.3** 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. **Teamwork 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.
5. www.freertos.org

Back to Scheme

Course Code	Course Name	Credits
ET 305	**Programming (Java and scripting)**	1

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

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Course Code	Course Name	Credits
ET 306	**Professional Communication and Ethics II**	2

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	2.1 Format 2.2 Executive summary 2.3 Defining the problem and presenting the solution 2.4 Summarizing a technical proposal	4	CO1
III	Oral Skills for Employability	3.1 Group Discussion- with special reference to leadership qualities, assertiveness, analyzing the topic, developing different perspectives, introducing and concluding the discussion. 3.2 Interview-with special reference to introducing oneself and answering questions with confidence. 3.3 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	4.1. 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 4.2. 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*

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Course Code	Course Name	Credits
ET 307	**IOT Basics and Smart Sensors**	4

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 308	PCB Design and Electronics Equipment Troubleshooting	4

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

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Course Code	Course Name	Credits
ET 391	**Mini Project III**	2

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 .

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Course Code	Course Name	Credits
ET 309	**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

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Course Code	Course Name	Credits
ET 310	**Antenna theory & Design**	3

Prerequisite:
Electromagnetics and wave theory Transmission Line

Course Objectives:
1. Understanding of antenna fundamentals.
2. Ability to design, and analyze the performance of wire antennas.
3. Ability to design, and analyze the performance of antenna arrays.
4. Ability to design, and analyze aperture antennas and patch antennas.
5. Ability to measure antenna parameters
6. Understand the design constraints of MIMO antenna system

Course Outcomes:
On completion of this course, the students will be able to
1. Explain basic antenna parameters and the fundamentals of antenna radiations.
2. Design, analyze and classify various wire antennas
3. Design and analyze antenna arrays
4. Understand fundamentals of aperture and patch antenna design and its applications.
5. Explain the measurement techniques of various antenna performance parameters.
6. Understand the fundamentals of MIMO antenna system and relate it with SISO antenna system.

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Antenna Fundamentals	1.1 Introduction, Radiation Mechanism, basic antenna parameters, Radiation pattern, radiation power density, radiation intensity, Beamwidth, directivity, Antenna efficiency, Gain, beam efficiency, bandwidth, polarization, input impedance, antenna effective length and apertures. Antenna radiation efficiency, FRIIS transmission equation. 1.2 Basic concepts of Maxwell‘s equation, vector potential, wave equation, near field and far field radiation. (No derivation)	06	01
II	Wire Antennas	2.1 Infinitesimal dipole, radiation fields-near field, far field, radiation resistance, directivity of small dipole, finite length dipole, half wavelength dipole, Monopole antenna, Folded dipole. Design of dipole and monopole antenna.(No derivation) 2.2 Loop Antenna: Small circular loop, Large loop, comparison of small loop with short dipole, Ferrite loop, radiation patterns and their application. 2.3 Helical Antennas: Axial mode and normal mode antenna, Circular polarization using Helical Antenna.	10	02

III	Arrays	3.1 Linear arrays, Array of two isotropic point sources, linear arrays of N elements, principle of pattern multiplication applicable to non-isotropic sources, broadside and End-fire Array, Increased Directivity end fire array, Calculations of Directivity, Beam width, Maxima and null directions for N-element Array. 3.2 Introduction to planar and circular arrays . 3.3 Design of Yagi antenna and Log Periodic antenna.	8	03
IV	Aperture Antennas and patch Antennas	4.1 Horn Antennas :E-Plane Sectoral Horn, H-Plane Sectoral Horn, Pyramidal Horn, Conical Horn 4.2 Reflector Antennas: Introduction, Plane Reflector, Corner Reflector, Parabolic Reflector-feeding techniques. 4.3 Microstrip antenna (MSA): Introduction, Feeding Techniques, Design of regular Shape MSAs (Rectangular, Circular)	8	04
V	Antenna Measurements	5.1 Measurement of Antenna parameters: Radiation Pattern, Gain (Two and Three antenna method), Polarization.	3	05
VI	5G antennas	6.1 : Introduction to MIMO antenna system (SISO, SIMO, MISO, MIMO) 6.2 Performance Parameters of MIMO antenna (R.L, Isolation/mutual coupling,)	4	06

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. 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.

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.

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Course Code	Course Name	Credits
ET 311	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 (1st Edition), Wiley Publication
6. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, ―AD HOC & Sensor Networks – Theory & Applications , Cambridge University Press India Pvt. Ltd

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Course Code	Course Name	Credits
ET 312	**R Programming**	1

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.
3. R for Data Science Learning Dan Toomey December 2014 Packt

Back to Scheme

Course Code	Course Name	Credits
ET 313	**Robotics and Automation**	4

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 314	**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

Software Requirements:

1. EAGLE
2. Ki-CAD
3. ORCAD
4. Express-PCB
5. Altium
6. Proetis
7. CST Microwave studio
8. Other open source simulators

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.

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Course Code	Course Name	Credits
ET 315	**Data Processing & Coding**	4

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 316	**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 317	**Database Management System (DBMS)**	04

Prerequisite: Data Structure 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 SQL queries
4. Apply normalization techniques to normalize the database
5. Understand the concept of transaction, concurrency control and recovery techniques.
6. Understand the Data Storage and querying of DBMS

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. Apply the concept of normalization to relational database design.
5. Describe the concept of transaction, concurrency and recovery.
6. Describe Data Storage and querying of DBMS

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 , Three schema Architecture and Data Independence , Database Languages and Interfaces, The Database System Environment , Centralized and Client / Server Architecture for DBMS, ORDBMS, OODBMS.	4	CO1
II	Entity- Relationship Model and Relational Model and Relational Algebra	Entity Types ,Entity Sets ,Attributes and Keys ;Relationship Types, Relationship sets , Roles and structural Constraints; Design Issues; Entity Relationship diagram; Weak entity sets; Extended E-R features; Design of an E-R database schema; Reduction of an E-R schema to tables. Relational Model Concept of a relation; Relational Model Constraints; Relational Database Schema, Entity Integrity, Referential Integrity and foreign keys; the relational algebra and extended relational-algebra operations; Relational Database Design using ER-to Relational Mapping.	5	CO2
III	Structured Query Language	DDL : Create, Modify, Alter, Drop, View definition, etc.DML : SELECT, INSERT, DELETE, Update, Nested Query, SQL with SET operations: Union, Intersect, Except, etc, Aggregate Functions: Group By, Having, SUM, etc, SQL with Logical operations, Nested and Complex Queries, Join Queries. DCL : GRANT, REVOKE, etc DBA level	10	CO3

		query. Cursors and Triggers, Procedures and Functions		
IV	Relational-Database Design	First normal form; Pitfalls in relational-database design ;Functional dependencies; Decomposition; Desirable properties of decomposition; Boyce-Codd normal form; 3rd and 4th normal form; Mention of other normal forms; Overall database design process.	6	CO4
V	Transaction Processing Concurrency & Database 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.	8	CO5
VI	Data Storage and Querying	File organization, Indexing and Hashing Organization of records in files; Data dictionary storage. Basic Concepts of Indexing ; Types of Single Level Ordered Indices; Multilevel Indices using B+ Tree Index Files; B- Tree Index Files; Static Hashing; Dynamic Hashing; Index Definition in SQL; Multiple-Key Access. Fundamentals of Query Optimization.	6	CO6

Laboratory Syllabus:
Lab Prerequisite: Data Structures

Sr. No.	**Level** 1. Basic 2. Design 3. Advance 4. Project/ Case Study/ Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	1,2	Identify the case study and detail statement of the problem. Design an Entity-Relationship(ER)/ Extended Entity-Relationship (EER) Model.	02
2	2	Mapping ER/EER to Relational schema model.	02
3	3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System.	02
4	3	Apply DML Commands for the specified system.	02
5	3	Perform Simple queries, string manipulation operations and aggregate functions.	02
6	3	Implement Views and Join operations.	02
7	3	Perform Nested and Complex queries	02
8	3	Perform DCL and TCL commands.	02
9	3	Implement function and trigger.	02
10	4	Demonstrate Database connectivity	02
11	4	Implementation and demonstration of Transaction and Concurrency control techniques using locks.	02

Software Requirements: SQL server (Oracle/MySQL/PostGreSQL) Hardware Requirements: 2GB RA

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. 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)
2. 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 318	**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
IL 360	**Entrepreneurship**	3

Course Objectives:

1. To understand the basic concepts of entrepreneurship.
2. To understand the role of entrepreneurship in economic development
3. To understand the importance of opportunity recognition and internal and external analyses to the success of a business venture
4. To enable the learners to know the factors contributed in failure of the enterprise

Course Outcomes: Learner will be able to

1. Analyse the business environment in order to identify business opportunities
2. Identify the elements of success of entrepreneurial ventures
3. Evaluate the effectiveness of different entrepreneurial strategies,
4. Interpret their own business plan

Module	Detailed Contents	Hrs
1	Conceptual definition of entrepreneurs and entrepreneurship, Advantages and Disadvantages of Being an Entrepreneur , Entrepreneurial motivation, Entrepreneurial characteristics	8
2	Recognizing, assessment and Exploiting the Opportunity, Conducting Internal and External Analyses, Determining the Feasibility of the Concept, Selecting a Marketing Strategy	6
3	Entrepreneurial Business Types A. Overview of Franchising and Their Advantages and Disadvantages B. Overview of Buyouts & Their Advantages and Disadvantages C. Overview of Family Businesses and Their Advantages and Disadvantages	6
4	The Overall Business Plan, Purpose of the Business Plan, Components of the Business Plan, Presentation of the Business Plan, Matching the Business Plan to the Needs of the Firm	6
5	The Marketing Plan, Conducting a Market Analysis, Understanding the Target Market, Reaching the Target Market through Locale and Engagement	8
6	Entrepreneurial failure, early stage failure, late stage failure	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation : Test/Assignments /Quiz/Case studies/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.

Reference Books:

1. Fundamentals of Entrepreneurship by H. Nandan, PHI
2. Entrepreneurship by Robert Hisrich, Michael Peters, Dean Shepherd, Sabyasachi Sinha, Mc Graw Hill
3. Why startups fail: A new roadmap for entrepreneurial success by Tom Eisenmann

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Course Code	Course Name	Credits
IL 361	IPR and Patenting	3

Course Objectives:

1. To introduce fundamental aspects of Intellectual property Rights to learner who are going to play a major role in development and management of innovative projects in industries.
2. To get acquaintance with Patent search, patent filing and copyright filing procedure and applications, and can make career as a patent or copyright attorney.
3. To make aware about current trends in IPR and Govt. steps in fostering IPR,

Course Outcomes: Learner will be able to…

1. Understand the importance of IPR, types of Patent type and its importance in industries.
2. Able to search, draft and file the patent and copyright application to patent office.
3. Learn the recent trends of IPR and can open the way for the students to catch up Intellectual Property (IP) as a career option:
   a) R&D IP Counsel in research organization
   b) Government Jobs – Patent Examiner
   c) Private Jobs
   d) Patent agent and Trademark agent.

Module	Detail Content	Hrs.
1	**Overview of Intellectual Property:** Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994	9
2	**Patents:** Patents - Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board	7
3	**Copyright:** Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights	6
4	**Trademark:** Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non-Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademark's registry and appellate board.	6
5	**Patent Acts:** Section 21 of the Indian Patent Act, 1970 (and corresponding Rules and Forms) with specific focus on Definitions, Criteria of Patentability, Non-Patentable Subject Matters, Types of Applications, and Powers of Controllers. Section 25 - Section 66 of the Indian Patent Act, 1970 with	9

	specific focus on the Oppositions, Anticipation, Provisions of Secrecy, Revocations, Patent of Addition, and Restoration of Patents. Section 67 - Section 115 of the Indian Patent Act, 1970 with specific focus on Patent Assignments, Compulsory Licensing, Power of Central Government, and Infringement Proceedings. Section 116 - Section 162 of the Indian Patent Act, 1970 with specific focus on Convention/PCT Applications, Functions of Appellate Board and other Provisions. Amendment Rules 2016 with emphasis on important revisions to examination and Hearing procedures; provisions for start-ups and fees.	
6	**Indian IP Policy:** India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes in IPR – Career Opportunities in IP – IPR.	3

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation : Test/Assignments /Quiz/Case studies/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.

Books/References:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
3. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
4. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

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Course Code	Course Name	Credits
IL 362	**Introduction to Bioengineering**	3

Course Objectives:

1. To understand and analyze the human body as a mechanical assembly of linkages and describe the fundamentals of biomechanics.
2. To Study the deformability, strength, viscoelasticity of bone and flexible tissues, modes of loading and failure and describe the types and mechanics of skeletal joints.
3. To describe movement precisely, using well defined terms (kinematics) and also to consider the role of force in movement (kinetics).
4. To teach students the unique features of biological flows, especially constitutive laws and boundaries.
5. To teach students approximation methods in fluid mechanics and their constraints.
6. To consider the mechanics of orthopedic implants and joint replacement , mechanical properties of blood vessels and Alveoli mechanics

Course Outcomes: Learner will be able to

1. Apply a broad and coherent knowledge of the underlying principles and concepts of biomechanics, particularly in the fields of kinematics and kinetics as applied to human and projectile motion.
2. Understand and describe the properties of blood , bone and soft tissues like articular cartilage tendons and ligaments.
3. Gain broad knowledge about the mechanics of moving systems and familiarity with human anatomy to competently analyze gross movement of the human body.
4. Be able to computationally analyze the dynamics of human movement from the most commonly used measurement devices in the field, such as motion capture and force platform systems.
5. Use knowledge gained to competently interpret the current understanding of human movement and present recommendations for further study.

Module	Detail Content	Hrs.
1	**Introduction:** Definition of Biomechanics, Selected Historical highlights, The Italian Renaissance, Gait century, Engineering Physiology & Anatomy	6
2	**Tissue Biomechanics:** Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle	8
3	**Joints Biomechanics:** Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle.	7
4	**Biomaterials:** Brief Anatomy, Bone, cartilage, ligament, tendon, Muscles, biofluid their physical properties	6
5	**Implants:** General concepts of Implants, classification of implants, Soft tissues	6
6	Application of advanced engineering techniques to the human body, case studies.	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation : Test/Assignments /Quiz/Case studies/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.

Books/References:

1. Nigg, B.M.and Herzog, W., "BIOMECHANICS of Musculo skeleton system", John Willey & Sons, 1st Edition.
2. Saltzman, W.L., "BIOMEDICAL ENGINEERING: Bridging medicine and Technology", Cambridge Text, First Edition.
3. Winter, D., "BIOMECHANICS and Motor Control of Human Movement", WILEY Interscience Second edition
4. Prof. Ghista,Biomechanics, Private Publication UAF, 2009
5. White &Puyator, Biomechanics, Private publication UAE, 2010
6. R. M. Kennedy, A textbook of Biomedical Engineering, GTU, 2010
7. Richard Shalak & ShuChien, Handbook of Bioengineering,
8. Sean P. Flanagan, Flanagan, Biomechanics: A case based Approach, Jones & Bartlett Publishers, 2013
9. Y. C. Fung, Yuan-Cheng Fung, Biomechanics: mechanical Property of living Tissue, Springer, 1996.
10. Carol A. Oatis, The Mechanics and Pathomechanics of Human Movement, Lippincott Williams & Wilkins, 2010

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Course Code	Course Name	Credits
IL 363	**Product Design**	3

Course Objectives:

1. To familiarize with fundamental product design concepts
2. To acquaint with product design methodologies
3. To understand product design needs and issues in industry

Course Outcomes: Learner will be able to

1. Demonstrate product design and development process.
2. Analyze a product in perspective of aesthetic and ergonomic considerations.
3. Illustrate considerations of Design for Manufacturing and Assembly in product development.
4. Apply appropriate tools and techniques in the design of solutions that are usable and functional for various applications.
5. Design the products as per the customer/industry requirements
6. Apply principles of economy and demonstrate legal and social issues pertaining to product development.

Module	Detail Content	Hrs.
1	Product definition, specification, Phases of product development: conceptual, embodiment and detailed design, product and technology development cycle, Concept generation and evaluation methods, product architecture, Product life cycle Management with case studies, Product analysis. Creativity and Idea generation technique, importance of Quality Dimensions: Performance, Features, aesthetics, Ergonomics, Reliability, Sustainability, Serviceability, Brand value, Value Vs cost, Importance of shape, color, feature & Resemblance.	6
2	Design Factors: Ergonomics, Aesthetics, Anthropometry, Comforts, Economic factors Axiomatic design principles and case studies. Design Thinking, Design by Innovation and collaboration Material and Process selection Methods, Expert systems. Computer Database Approach, performance indices decision matrix, AHP and fuzzy approach, Introduction to material and process selection software.	6
3	Design for Manufacturing (DFM) and Design for Assembly (DFA) Designs for Maintainability and Reliability and some methods for reliability assessment, Designs for Environment, Design for Robustness: Taguchi Designs & Design of Experiments (DOE).	8
4	Product Design Tools and Techniques: Value Engineering / Value Analysis: definition, methodology- FAST, Benchmarking, Supplier involvement robust design, QFD, Design & process FMEA. Reverse Engineering, Concurrent engineering & Sequential engineering, Case studies.	8

5	Product Development Cycle and Importance of Prototyping. Types of prototypes. Principal and advantages & Different Type of Generative Manufacturing process, Viz. Stereo lithography. FDM, SLS etc. Factors Concerning to RP: Consideration for Adoptions, Advantages, Accuracy and Economic Consideration. Introduction to Assembly Modeling, Top-Down and Bottom-Up Approaches of AM, Mating Conditions, representation Schemes. Generation of Assembly Sequences. Case studies	6
6	Economics of Product Development: Product costing, Principals of Economy, Engineering Economy and Design Process, Economic Analysis, Inflation, Time Value of Money, Numerical on Internal Rate of Return and Net Present Value (NPV) method. Legal and social issues, Patents and IP acts.	6

Assessment:

Internal Assessment: 40 marks

Mini project on product design from idea generation to prototyping

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 syllabus.

Reference Books:

1. Product Design and Manufacturing by A.K.Chitale, R.C.Gupta, PHI.
2. Product Design and Development by Ulirich Karl T. and Eppinger Steven D, McGraw Hill.
3. Engineering Design by Dieter George E., McGraw Hill.
4. Handbook of Product Design for Manufacturing by Bralla, James G, McGraw Hill.
5. Product Design by Kevin Otto & Kristin Wood

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Course Code	Course Name	Credits
IL 364	Visual Art	3

Course Objectives:

1. To enable learners to develop aesthetic judgement, visual perception, critical thinking skills in the different forms of art and understand its application.
2. To promote the concept of visual design and understand the different meanings assigned to colours, its impact and problems.
3. To provide the opportunity and scope to use the image editing software for creating images for Web and Video.
4. To inculcate the basic skills required in drawing and painting through exposure in nature and study of still objects.
5. To train students to express their feelings and write imaginatively.
6. To prepare the learners for the use of clay modelling techniques and its industrial applications.

Course Outcomes: Learner will be able to

1. Acquire the skills necessary for aesthetic judgement, visual perception and critical thinking required in different forms of art.
2. Demonstrate the understanding of the concept of visual design with respect to the different meanings assigned to colours and the problems associated.
3. Illustrate effective use of image editing software for creating images for the Web and Video.
4. Determine the importance of drawing and painting with respect to nature and still objects.
5. Perform successfully in expressing their feelings creatively.
6. Develop the techniques required for clay modelling and sculpture for industrial use.

Module	Detail Content	Hrs.
1	History of Art and Architecture- Changing needs and forms of art from the Palaeolithic period to The Renaissance period with special reference to Roman, Indian and Chinese art	4
2	Introduction and concepts of visual design with special emphasis on the psychological impact of colour	5
3	Introduction to image editing software, tools, application and creating Images for Web and Video. With special reference to Adobe Photoshop	7
4	Fundamentals of Drawing- study of forms in nature, study of objects and study from life, creative painting- basic techniques, tools and equipment, medium of painting.	6
5	Creative writing- Movie critique, book reviews, Poems, short plays and skits, Humorous Essays, Autobiography and short stories.	7
6	Creative sculpture- Introduction to clay modelling techniques, study of natural and man-made objects in clay, Sculpture with various materials - Relief in Metal Sheets – Relief on Wood – Paper Pulp - Thermocol. Sculpture with readymade materials.	7

Assessment:

Internal Assessment:

Test 1	: 10 marks (Practical)
Test 2	: 10 marks (Practical)
Total	: 20 marks

End Semester Examination:

Theory	: 40 marks
Practical	: 40 marks

Reference Books:

1. Gill Martha. (2000). Color Harmony Pastels: A Guidebook for Creating Great Color Combinations. Rockport Publishers.
2. Janson, Anthony F. (1977). History of art, second edition, H.W. Janson. Instructor's manual. Englewood Cliffs, N.J.: Prentice-Hall.
3. Brommer, Gerald F. (1988). Exploring Drawing. Worcester, Massachusetts: Davis Publications.
4. Wendy Burt Thomas. (2010). The Everything Creative Writing Book: All you need to know to write novels, plays, short stories, screenplays, poems, articles, or blogs: All You Need ... - Stories, Screenplays, Blogs and More. Fw Media; 2nd edition.
5. Élisabeth Bonvalot. (2020). Sculpting Book: A Complete Introduction to Modeling the Human Figure.

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Course Code	Course Name	Credits
IL 365	**Journalism, Media and Communication studies**	3

Course Objectives:

1. Provide a good grounding in the basic concepts of Journalism, Mass communication and Media.
2. Familiarize learners with reporting and editing practices.
3. Teach students to write editorials, feature articles, interviews, reviews, criticism etc.
4. To inculcate the skills required for writing in online newspapers, blogs, email and cell phone.
5. To prepare the learners for understanding the importance of Press laws and Ethics.
6. To train learners in advertising techniques and Public Relation Communication

Course Outcomes: Learner will be able to

1. Acquire conceptual and theoretical knowledge of Journalism, Mass Communication and Media Studies and learn to think critically about issues and topics of the subject.
2. Demonstrate the understanding of reporting and editing from Newspaper and the Organization.
3. Perform successfully in writing effective editorials, featured articles reviews etc.
4. Illustrate the skills required for writing in online newspapers, blogs, emails etc.
5. Determine the importance of Press Laws and Ethics.
6. Develop an understanding of the techniques required for advertising and Public Relation Communication.

Module	Detail Content	Hrs.
1	Introduction to Journalism, Communication, Media and Cultural Studies- Basics of Mass communication, Pioneers of Indian Journalism, Introduction to newspapers, magazines and other publications. Introduction to broadcast journalism with special reference to television	5
2	Reporting and Editing Practices-Reporting different news, stories from Newspaper, and Organization. Principles of editing, rewriting, and translation	7
3	Writing for Print- Newspaper Content Writing Opinion pieces, editorials, feature articles, interviews, profiles, reviews, criticism etc.	7
4	Writing for Media- Introduction to New Media Writing for Online newspapers Blogs Cell phone Communication E-mail	6
5	Press Laws and Ethics- Origin and definition of Law, Law and Morality, Types of Law – Civil and Criminal, Press Legislations, Freedom of the Press Defamation Contempt of Court	4
6	Public Relations and Advertising- Introduction to Public Relations Stages of PR Communication with Public Need and Meaning of Advertising, Advertising strategies and Sales Promotion	7

Assessments:

Internal Assessment:

Test 1 : 15 marks
Test 2 : 15 marks
Total : 30 marks

End Semester Examination:

Theory: 45 marks

Term work:

25 marks (10 marks for assignment, 10 marks for practical and 5 marks for attendance)

Books/References:

1. Rangaswamy, Parthasaratihi, (1985). *Journalism in India*, Sterling Publication, New Delhi.
2. Jeffrey, Robin, (2009). *India's Newspaper Evolution*, Oxford University Press, Delhi.
3. Singh, Devvrat. (2012). *Indian Television: Content, Issues and Challenges*, HarAnand Publications Delhi.
4. Daryl L. Frazell, George Tuck. (1996). *Principles of Editing: A Comprehensive Guide for Students and Journalists Principles of Editing: A Comprehensive Guide for Students and Journalists.* McGraw-Hill
5. Barry Newman. (2015). *News to Me: Finding and Writing Colorful Feature Stories*. Paperback
6. The Associated Press. (2017). *The Associated Press Stylebook: and Briefing on Media Law*. Revised, Updated Edition. Paperback.
7. Kristina Halvorson. (2012) *Content Strategy for the Web*, 2nd Edition. New Riders

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Course Code	Course Name	Credits
IL 366	**Computational Physics**	3

Course Objectives:

1. To expose the students to the vast field of computational physics.

Course Outcomes: Learner will be able to

1. To understand various approaches of simulating physical systems on a computer.
2. To choose the correct method to solve a computational problem.

Module	Detail Content	Hrs.
1	**Introduction to Statistical Mechanics :** Thermodynamics and kinetic theory, specification of state of system, Concept of ensemble, phase space, microcanonical ensemble (NVE), statistical concept of temperature, canonical ensemble (NVT), equipartition theorem, Maxwell-Boltzmann velocity distribution, grand canonical ensemble (μVT), chemical potential	6
2	**Molecular Dynamics (MD):** Integrating equation of motion of a few variables, role of molecular dynamics (MD), the basic machinery, Lennard-Jones potentials modeling physical system, boundary conditions, time integration algorithm	7
3	Starting a simulation, simulation of microcanonical (NVE) and canonical ensemble (NVT), controlling the system (temperature, pressure), thermostats and barostats, equilibration, running, measuring and analyzing MD simulation data, measurement of statistical quantities, interatomic potentials, force fields.	7
4	**Monte Carlo (MC) Method :** Random number: Definition, True and Pseudo random number generators (RNG), uniform and non-uniform RNG, Linux RNG, testing a RNG.	6
5	**Monte Carlo simulations :** Buffon's needles, MC Integration, hit and miss (estimation of pi and e), stochastic processes, sample mean integration, importance sampling, Markov Chain, Metropolis method, master equation, introduction to 2D-Ising model. **Random walk:** 1-D and 2-D random walk, calculation of rms displacement.	7
6	Introduction to Simulations of quantum systems	3

Internal Assessment:

Internal Examination : 20 marks
Internal Term work : 20 marks

End Semester Examination:

Theory : 40 marks
Practical Examination : 20 Marks

Books/References:

1. Statistical Physics – Vol. 5 (from the series of Berkeley Physics Course)
2. Introduction to Computational Physics by Tao Pang (Cambridge University Press)
3. An Introduction to Computer Simulation Methods : Applications to Physical Systems by Harvey Gould and
4. Jan Tobochnik, (Pearsom Publications)
5. Understanding Molecular Simulations by Frenkel and Smit (Academic Press)

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Course Code	Course Name	Credits
IL 367	**Polymers and Polymeric Materials**	3

Course Objectives:

1. To impart a scientific approach and to familiarize the applications of polymeric materials in the field of engineering.
2. The student with the knowledge of the basic polymer science will understand and explain scientifically the various problems related to polymeric materials in the industry/engineering field.
3. To develop abilities and skills that are relevant to the study and practice of polymer science and engineering.

Course Outcomes: Learner will be able to

1. To understand and analyze various polymeric materials and to establish the structure property relationship.
2. To select the proper polymeric material for specific industrial applications.
3. To become familiarized with various characterization techniques related to polymeric materials.

Module	Detail Content	Hrs.
1	**Basic understanding of Polymeric aspects:** Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; metallocene polymers and other newer techniques of polymerization, copolymerization, monomer reactivity ratios and its significance, different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, concept of average molecular weight, determination of number average, weight average	9
2	**Polymer Technology:** Compounding of plastics, Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, crosslinking and vulcanization	5
3	**Polymer Processing:** Fabrication of plastics by different moulding process, Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer	6
4	**Polymer blends:** Thermo- dynamical aspects of polymer blends and its miscibility, Role of compatibilizer, Composition based structure (dispersed and co-continuous), properties and its application, choice of polymers for blending, thermodynamics, phase morphology, polymer alloys, polymer eutectics, plastic-plastic, rubber-plastic and rubber-rubber blends	6
5	**Polymer composites:** Fundamentals of polymer composites, Advanced polymer nanocomposites, Fillers used for polymer composites, Effect of processing condition and composition, Polymer composites structure,	6

	characterisation and design, physical and chemical modification of polymer composites. 1-D and 2-D random walk, calculation of rms displacement.	
6	**Testing of Polymeric Materials:** Samples preparation, Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, aging resistance, establishment of structure property relationship	7

Assessments:

Internal Assessment:

Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test student may need to perform experiments related to polymeric material synthesis or polymer testing depending on the available facilities.

End Semester Examination:

In question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 4 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

Books/References:

1. "Fundamentals of Polymer Engineering" by Anil Kumar and Rakesh Gupta.
2. " Principles of Polymer Systems" by F Rodriguez.
3. " Polymer Science" by V R Gorwankar.
4. " Textbook of Polymer Science" by F W Billmeyer. 5. " Polymer Chemistry" by P C Heimenz.

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Course Code	Course Name	Credits
IL 368	**Vehicle Safety**	3

Course Objectives:

1. To familiarize basic concepts of vehicle safety.
2. To familiarize accident reconstruction analysis methods
3. To acquaint with different issues related to vehicle safety in India

Course Outcomes: Learner will be able to

1. Comprehend Vehicle design from safety point of view.
2. Apply concepts of accident reconstruction analysis in real world.
3. Enumerate interrelationship among occupant, restraint systems and vehicles in accidents.
4. Illustrate role and significance of seat in Rear crash safety
5. Demonstrate different active and passive safety systems available in vehicles
6. Contribute to the society by being proactive to the cause of safety on roads and in vehicles

Module	Detailed Contents	Hrs.
1	Introduction to vehicle safety-the integrated approach and its classification SAVE LIVES- by WHO Importance of Risk evaluation and communication, Concepts of Universal design, India's BNVSAP and its outcomes	6
2	Crash and distracted driver, Human error control Crash Testing, Use of Dummies, evolution and built of dummies. Relevance of Star ratings,NCAPs around the world- Accident Data, Biomechanics and Occupant Simulation Vehicle Body Testing, Dynamic Vehicle Simulation Tests Occupant Protection,Compatibility, Interrelationship Among Occupants, Restraint Systems and Vehicle in Accidents	8
3	Significance of Rear Crash Safety Role of seat in Rear crash safety Self aligning head restraints Pedestrian Protection testing and systems Under run Protection Devices	6
4	Introduction to Accident Analysis Reconstruction methods Skid distances and Critical speed from Tire Yaw marks Reconstruction of Vehicular Rollover Accidents Analysis of Collisions Reconstruction Applications Impulse Momentum Theory Crush Energy Photogrammetry for accident constructions	8
5	Antilock braking system Electronic Stability Program Low tire pressure warning system Collision avoidance systems	5
6	Basic Vehicle Operations and Road/Helmet Safety Activity	6

Assessment:

Internal Assessment: 40 marks

1. Consisting of One Compulsory Class Tests of 40 Marks
2. Continuous evaluation : Test/Assignments /Quiz/Case studies/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.

References Books:

1. Automotive vehicle safety by George Peters and Barbara Peters, CRC Press, 2002.
2. Vehicle Accident Analysis and Reconstruction Methods by Raymond M. Brach and R. Matthew Brach, SAE International, Second Edition, 2011.
3. Role of the seat in rear crash safety by David C. Viano, SAE International, 2002.
4. Automotive Safety Handbook by Ulrich W. Seiffert and LotharWech, SAE International, 2007.
5. Public Safety Standards of the Republic of India

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Course Code	Course Name	Credits
IL 369	Maintenance of Electronics Equipment	3

Lab Objectives:

1. To demonstrate use of different types of hand tools
2. To understand testing of different active and passive components mounted on PCB
3. To understand functionality TTL and CMOS digital IC tester
4. To demonstrate computer assembling, troubleshooting and software installation
5. To understand/demonstrate concept of circuit diagram of LED/LCD TV, DTH and mobile phone troubleshooting
6. To understand concept of medical equipments

Lab Outcomes:

1. Demonstrate use of different types of hand tools
2. Understand testing of different active and passive components mounted on PCB
3. Understand functionality TTL and CMOS digital IC tester
4. Demonstrate computer assembling, troubleshooting and software installation
5. Understand/demonstrate concept of circuit diagram of LED/LCD TV, DTH and mobile phone troubleshooting
6. Understand concept of medical equipments

SN	Detailed Lab/Tutorial Description	Hrs.
1	Demonstrate use of various hand held tools.	2
2	Test the performance of different passive electronic components (fixed/variable)	2
3	Test the performance of active electronic components like general purpose transistor/FET/MOSFET/SCR/ DIAC/TRIAC with DMM and CRO OR Components Tester	4
4	Verify the functionality of TTL and CMOS Digital IC's using IC tester	4
5	Explore a datasheet of minimum any five electronics components and analog/ Digital IC's.	2
6	Draw the given regulated power supply circuit/ SMPS (from any television/fridge/ computer system/ laboratory etc)	2
7	Identify basic sections of a personal computer/Laptop	2
8	Demonstrate Assembling of Personal Computer/Laptop	4
9	Troubleshoot the booting process of computer system and install different hardware associated with computer (HDD, LAN Card, Audio System etc)	4
10	Study Installation of Software and Configure Internet	4
11	Explore circuit diagram of LED/LCD TV.	2
12	Demonstrate Installation of DTH system	4
13	Demonstrate installation Solar power system	4
14	Practice steps for mobile troubleshooting	4
15	Visit to Medical Equipment Industry/Laboratory	8

Assessment:

Internal Assessment:

Internal Assessment 1	: 20 marks
Internal Assessment 2	: 20 marks
Total	: 40 marks

End Semester Examination:

Term work	: 30 marks
Practical Examination	: 30 Marks

Books/References:

1. Troubleshooting and Maintenance of Electronics Equipment, Singh K. Sudeep, Katson Book ,New Delhi ,II edition , Reprint 2014
2. Mobile repairing Books, Manohar Lotia, BPB Publication, New Delhi , latest edition
3. Troubleshooting Electronic Equipment: Includes Repair and Maintenance Second Edition, Khandpur R. S. , Tata McGraw-Hill Education, New Delhi ,India , latest edition.
4. Data Books, National semiconductor.

Back to Scheme

Course Code	Course Name	Credits
ET 392	**Major Project A**	2

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.

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Subject Code	Subject Name	Credits
ET 401	Microwave & RF Design	3+1

Prerequisite:

Electronic Communication Systems

Electromagnetic Engineering

Filter Basics

Course Objectives: Students will try:

1. Understand the basics of Microwave Systems.
2. Learn working principles of waveguides and passive components.
3. Illustrate Microwave generators.
4. Discuss Microwave Semiconductor Devices.
5. Design of composite filters
6. Design small signal RF Amplifiers

Course Outcomes: Learners will be able to:

1. Analyze microwave networks and components using scattering parameters and design impedance matching networks.
2. Solve problems on waveguides and identify passive components.
3. Describe the construction and operation of Microwave generators/Tubes.
4. To describe Microwave Semiconductor Devices and the measurements techniques and parameters measured as frequency ,VSWR ,power etc.
5. To design the RF Filters
6. To design small signal rf amplifiers

Sr. No.	Module	Detailed Content	Hours	CO Mapping
01	Introduction to Microwaves	1.1 Microwave Frequency Bands in Radio Spectrum, Characteristics, Advantages and Applications of Microwaves. 1.2 Scattering Parameters: Characteristics and Properties. 1.3 Design of Impedance matching network using distributed parameters. Quarter Wave Transformer 1.4 Strip lines , Micro strip lines and coupled lines, Coplanar Waveguides and its applications	06	CO1
02	Waveguides	2.1 Rectangular and circular waveguides:	08	CO2

	and Passive Devices and semiconductor devices	Construction, Working and Mode analysis. 2.2 Resonators, Re-entrant cavities, Microwave Junctions, Hybrid ring, Directional couplers, Attenuators and Ferrite devices such as Isolators, and Circulators.		
03	Microwave Tubes	Microwave Tubes : 3.1 Two Cavity Klystron, Reflex Klystron. 3.2 Helix Travelling Wave Tube and Cross Field Amplifier. 3.3 Backward Wave Oscillator ,Cylindrical Magnetron , Gyrotron	08	CO3
04	Microwave Semiconductor devices and Measurements	4.1 Diodes: Gunn, Varactor, PIN, Tunnel, Point Contact, Schottky Barrier 4.2 , IMPATT, TRAPATT, and BARITT 4.3 Measurement of VSWR, Frequency, Power, Noise, Q-Factor, Impedance, Attenuation	05	CO4
05	RF Filter Design	5.1 Composite Filters, Filter Design Using I.L method, Microstrip Low pass filter design Using Kuroda's Identity, Low pass filter Design 5.2 RF High pass, band pass and band stop filter Design	06	CO5
06	RF Small signal Amplifier Design	6.1 Characteristics and various gains of amplifier, RF amplifier Design for maximum gain and specific Gain, 6.2 Low Noise amplifier -Design and its applications	06	CO6

Text Books:

1. Samuel Liao, Microwave Devices and Circuits‖, Prentice Hall
2. David Pozar, Microwave Engineering, Wiley Publication, Fourth Edition
3. Annapurna Das and S. K Das, ―Microwave Engineering, McGraw Hill Education, Third Edition
4. Ludwig R. and Bogdanov G, RF Circuit Design, Prentice Hall, 2007.
5. Microwave Circuit Analysis And Amplifier Design ,Samuel Liao

References:

1. Colin, Foundations of Microwave Engineering, Second Edition, Wiley Interscience, 2nd Edition
2. Devendra Misra, ― Radio Frequency and Microwave Communication Circuits- Analysis and Designs, John Wiley & Sons, 2nd Edition

Subject Code	Subject Name	Credits
ET L401	Microwave & RF Design Lab	01

Sr. No	TITLE OF EXPERIMENT	H/W or S/W	Hours	CO mapping
1	Introduction to Microwave test bench and components	MW Test Bench	2	CO1,CO 2
2	Measure and plot power frequency characteristics of the reflex klystron (Microwave Tube)	MW Test Bench	2	CO3
3	Measurement of VSWR using slotted Line section	MW Test Bench	2	CO4
4	Measure the wavelength of rectangular waveguide	MW Test Bench	2	CO2
5	To study and plot the VI characteristics of Gunn Diode	MW Test Bench	2	CO4
6	Generate and study the field patterns of various modes inside a rectangular waveguide	Virtual Lab Kanpur IIT	2	CO2
7	Generate and study the field patterns of various modes inside a rectangular waveguide cavity	Virtual Lab Kanpur IIT	2	CO2
8	To design a Low Pass Filter (LPF) for Cutoff Frequency of 4 GHz, Impedance of 50Ω and 3 rd Order 3dB ripple Chebyshev Filter using FR4 substrate in CST Studio.	CST Tool	2	CO5
9	To design the Hybrid Coupler (Power Divider) for Cutoff Frequency of 900 MHz using FR4 substrate using CST Studio.	CST Tool	2	CO1,CO2
10	To plot Stability circles,Gain circles for given amplifier data	VSmith Tool	2	CO6
11	To design a maximum gain amplifier with biased BJT of 1 GHz with following S-parameter, S 11 = 0.60∠ -155 O ; S 12 = 0.0∠ 0 O ; S 21 = 6∠ 180 O ; S 22 = 0.48∠ -20 O using VSmith Simulator.	VSmith Tool	2	CO6
12	To plot noise figure circles and gain circles for source and load sections of 3 GHz	Vsmith Tool	2	CO6

	of input and output matching networks for a GaAs FET low noise amplifier with following Specification, S 11 = 0.6∠ -60 O , S 12 = 0.05∠ 26 O , S 21 = 1.9∠ 81 O , S 22 = 0.5∠ 60 O , O pt = 0.62∠ 100 O , F min = 1.6 dB and R n = 20Ω.			

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 attempt to make experiments more meaningful, interesting and innovative.

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

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Subject Code	Subject Name	Credits
ET 402	Human Values and Social Ethics	02

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

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

Course Outcomes: By the end of the course, students are expected1.

1. To become more aware of themselves, and their surroundings (family, society, nature);
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5. They would be able to apply what they have learnt to their own self in different day-to-day settings in real life.

SN	Details	Hours
1	**Ethics and Values** : Meaning & Concept of Ethics Difference between Ethics and Values Ethical code of conduct	03
2	**Professional Ethics** : Professional Ethics vs Personal ethics Components of professional ethics Professional values and its importance	05

3	**Ethics and Society** : Relevance of values and ethics in social work Ethical dilemmas Values and ethical principles of social work · Service · Dignity and worth of a person · Importance of Human relationships · Integrity · Competence · Social Justice	05
4	**Ethics in Technical writing** : Documenting sources Presentation of Information Ethics & Plagiarism	06
5	**Ethics and Technology Development** : Risk management and Individual rights Moral issues in development and application of technology Privacy/confidentiality of information Managing Technology to ensure fair practices	06

Assessment:

Term Work : 50 Marks (Continuous Evaluation)

Reference Books:

1. Martin Cohen, *101 Ethical Dilemmas* Routledge, 2nd edition, 2007.
2. M. Govindarajan, S. Natarajan & V.S. Senthilkumar, *Professional Ethics and Human Values,* Prentice Hall India Learning Private Limited, 2013.
3. Mike W. Martin, *Ethics in Engineering*, McGraw Hill Education; Fourth edition, 2017.

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Subject Code	Subject Name	Total
ET 404	AI in Neural Networks	04

Prerequisite: Basic Mathematics, Algorithms

Course Objectives:

1. To conceptualize the basic ideas and techniques underlying the design of intelligent systems.
2. To become familiar with the basics of Neural Networks.
3. To understand and design linear neural networks.
4. To distinguish Supervised and Unsupervised Learning techniques.
5. To become familiar with the basics of Feedback Neural Networks.
6. To understand radial basis function neural networks.

Course Outcomes:

1. Ability to Identify the various characteristics of Artificial Intelligence
2. Able to compare the biological neural network system and artificial neural network system.
3. Able to design various real time applications using Multilayer perceptron.
4. Able to use the unsupervised learning techniques in machine learning applications.
5. Able to apply knowledge of the feedback neural network in machine learning.
6. Able to design radial basis neural networks for classification and regression.

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Basics of Artificial Intelligence	AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	05	CO1
II	Artificial Neural Network	ANN and their biological roots and motivations. ANNs as numerical data/signal/image processing devices. a summing dendrite, synapses and their weights, pre- and postsynaptic signals, activation potential and activation function. Excitatory and	06	CO2

		inhibitory synapses. The biasing input. Types of activating functions. Encoding (training phase) and decoding (active phase).		
III	Linear Networks	Adaptive linear element, Linear regression. The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm. Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm. Multi-Layer Feed-forward Neural Networks:- Multi-Layer Perceptrons. Supervised Learning. Approximation and interpolation of functions. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptrons: Image coding, Paint-quality inspection, Net talk.	09	CO3
IV	Self-Organizing Systems:	Unsupervised Learning, Pattern clustering, Topological mapping, Kohonen's self-organizing map, Local learning laws-Generalized Hebbian Algorithm. The Oja's and Sanger's rules. Principal component analysis - Karhunen-Loeve transform.	07	CO4
V	Feedback neural networks:	Pattern storage and retrieval, Hopfield model, Boltzmann machine, Recurrent neural networks, Convolution neural network.	05	CO5
VI	Radial basis function networks:	Regularization theory, RBF networks for function approximation, RBF networks for pattern classification. Kernel methods for pattern analysis:- Statistical learning theory, Support vector machines for pattern classification, Support vector regression for function approximation, Relevance vector machines for classification and regression.	07	CO6

Lab Syllabus

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4.Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	Basic	Write a program to generate a few activation functions that are being used in neural networks.	02
2	Design	To implement Mc-Culloch Pitts Model for a Problem. (AND, OR, NOT, ANDNOT, XOR)	02
3	Design	Write a program for hebb net to classify two dimensional input patterns.	02
4	Design	Write a program for perceptron net for an AND function with bipolar input and targets.	02

5	Design	Write a program for pattern classification using the perceptron network.	02
6	Advanced	Write a XOR function with momentum factor using a back propagation algorithm.	02
7	Advanced	Write a radial basis function network to note the effect of regularization.	02
8	Advanced	Write a program for Kohonen Self organizing map to cluster the input vector.	02
9	Project	Design an algorithm using back propagation for data compression.	02
10	Project	Design algorithm for character recognition using Khonen network.	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:

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 attempt to make experiments more meaningful, interesting and innovative.

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

Text Books:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education
2. S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.

References:

1. B.Yegnanarayana , Artificial Neural Networks, Prentice Hall of India.
2. Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill.
3. S.Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall

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Subject Code	Subject Name	Total
ET 405	**Wearable devices and Industrial IOT Applications**	4

Prerequisite: IOT Basics & Smart sensors

Course Objectives: Six

1. Identify the need for development of wearable devices and its implications on various sectors.
2. Discuss the usage of various biochemical and gas sensors as wearable devices.
3. To provide the overview of flexible electronics technology and the issues with materials processing for thin film electronics.
4. To acquaint the students with basics of various Powertrain sensors and associated systems for proper vehicle dynamics and stability in Automotive systems.
5. To describe the process involved in transferring the flexible electronics from foils to textiles and also the challenges, opportunities and the future of wearable devices.
6. To provide a basic understanding of the evolution of Industrial IoT and its functional modules to develop the skill set to implement Industrial IoT systems.

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

Students will be able to

1. Identify the need for development of wearable devices and its influence on various sectors.
2. Analyze the usage of various biochemical and gas sensors as wearable devices and acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.
3. Design and develop various wearable devices for detection of biochemical and physiological body signals, environmental monitoring, safety and navigational assistive devices.
4. Gain the competency in transferring the conducting and semiconducting fibers to smart textiles to solve the need for smart systems in a distributed environment.
5. Develop Business Outcome based IIoT Methodology using Economics of IIoT Data driven Analytics
6. Analyze the IIoT Market Size, Market Segments and Verticals considering the Importance of Security and Architecture

Sr. No.	Module	Detailed Content	Hours	CO Mapping
		Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors : Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety.		
I	Introduction to Wearable Sensors and Devices	Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors and Magnetic sensors; Modality of Measurement- Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications: Fall Risk Assessment, Fall Detection , Gait Analysis, Physical Activity monitoring: Human Kinetics, Cardiac Activity, EnergyExpenditure measurement: Pedometers, Actigraph. Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring, Detection principles – thermistor, infrared radiation, thermopile, Modality of measurement wearable, adhesive/tattoo type. Conductive textile electrodes, Knitted PiezoresistiveFabric (KPF) sensors.	5	1
		Wearable Biochemical Sensors: Parameters of interest, System Design –Textile based, Microneedle based; Types: Noninvasive Glucose Monitoring Devices, GlucoWatch® G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeters, wearable pulse oximeter; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type, new materials - CNTs, graphene, Zeolites; Detection of atmospheric pollutants.		
		Wearable Cameras and Microphones for Navigation:		

		Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist, forearm and feet, vests and belts, head-mounted devices. Other Wearable DevicesWearable devices with Global Positioning System (GPS) integration for tracking and navigation. Wearable Optical Sensors - chemical sensors, optical glucose sensors, UV exposure indicators, speech recognition using lasers; Photoplethysmography (PPG), 3D imaging and motion capture.		
II	Wearable Devices for Healthcare	Electrode – design, geometry,material; Fabrication of interdigitated (IDE) electrodes, choice of substrate, sensing film; Wearable Bioelectric impedance devices for Galvanic skin response; Wearable ECGdevices: Basics of ECG and its design, Electrodes and the Electrode–Skin Interface; Wearable EEGdevices: Principle and origin of EEG, Basic Measurement set-up, electrodes and instrumentation; Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement – wearable surface electrodes, SEMG Signal Conditioning, Applications. Smart textile for neurological rehabilitation system (NRS), Study of flexible and wearable EMG sensors. Epidermal electronics system (EES), Study of Multiparametric(ECG, EEG, EMG) Epidermal Electronics Systems.Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor.Study of flexible and wearable Piezoresistive sensors for cuffless blood pressure measurement.	6	2

III	Overview of flexible electronics technology : Flexible electronics from foils to textiles	History of flexible electronics - Materials for flexible electronics: degrees of flexibility, substrates, backplane electronics, front plane technologies, encapsulation - Fabrication technology for flexible electronics - Fabrication on sheets by batch processing, fabrication on web by Roll-to Roll processing - Additive printing. Social Aspects of Wearability.Thin film transistors: Materials and Technologies - Review of semiconductors employed in flexible electronics - Thin film transistors based on IGZO - Plastic electronics for smart textiles - Improvements and limitations.Introduction-Systems design- Challenges in chemical and biochemical sensing - Application areas -Wearable inertial sensors - obtained parameters from inertial sensors - Applications for wearable motion sensors - Practical considerations for wearable inertial sensor - Application in clinical practice and future scopeWearable haptics: World of wearables - Attributes of wearables - Textiles and clothing: The meta wearable - Challenges and opportunities - Future of wearables - Need for wearable haptic devices - Categories of wearable haptic and tactile display	5	3
IV	Wearable Technologies - Energy Expenditur e and Energy Harvesting .	Wearable Algorithms, Web of Things – Architecture Standardization, Data Mining for Body Sensor Network. Internet of Things – Embedded Device UX Design.Introduction to surface, surface charge, surface energy, Thermodynamics of surfaces, Fluids in Electrical fields, The Navier Stokes equation, Boundary and Initial conditions problemsEnergy Harvesting Sources, Models, and Circuits, Interface Circuits for Thermoelectric Generator, Polarity Mechanism for Thermoelectric Harvester, Energy scavenging sources for biomedical sensors. Evaluation Methodology of a Smart Clothing Biomechanical Energy Harvesting System for Mountain Rescuers. Thermal Energy Harvesting on the Bodily Surfaces through a	5	4

		Wearable Thermo-Electric Generator.		
V	Industrial Internet of Things	Introduction: History of IIoT, Components of IIoT - Sensors, Interface, Networks, People & Process, Hype cycle, IoT Market, Trends & future Real life examples, Key terms – IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining & Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT Industry 4.0: Globalization, The Fourth Revolution, LEAN Production Systems, Cyber Physical Systems and Next Generation Sensors, Collaborative Platforms and Product Lifecycle Management, Industrial Sensing & Actuation Technology and Business outcome based methodology: Big Data Analytics and Software Defined Networks: IIoT Analytics - Introduction, Machine Learning and Data Science, Security and Fog Computing - Fog Computing in IIoT, Security in IIoT Industrial Manufacturing: From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics. Wearable and Non-Invasive Assistive Technologies: Human Body Communication for a Data Rate Sensor Network. IIoT– Networking, Wireless Body Area Networks. IIoT – Cloud Computing, Wearable Sensors for Monitoring of Physical and Physiological Changes and for Early Detection of Diseases.	8	5

VI	Industrial IoT Applications	Applications in agriculture: Smart Farming: Weather monitoring, Precision farming, Smart Greenhouse, Drones for pesticides. Applications in IoT enabled Smart Cities: Energy Consumption Monitoring, Smart Energy Meters, Home automation, Smart Grid and Solar Energy Harvesting, Intelligent Parking, Data lake services scenarios. Healthcare applications: Architecture of IoT for Healthcare, Multiple views coalescence, SBC-ADL to construct the system architecture. Use Cases : Wearable devices for Remote monitoring of Physiological parameters, ECG, EEG, Diabetes and Blood Pressure. Applications in Manufacturing: Power Plants Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.	10	6

Lab Syllabus

Lab Prerequisite: IOT Basics & Smart sensors Laboratory

Sr. No.	**Level** 1.Basic 2.Design 3.Advanced 4.Project/Case Study/Seminar	**Detailed Lab/Tutorial Description**	**Hours**
1	1	Study of Textile based electrodes as temperature sensors Study of Wearable body temperature sensors. Study of Wearable Galvanic Skin Response monitoring system. Study of Wearable motion sensors using textile based MEMS accelerometers.	02
2	1	Study of Wearable PPG and SpO_2 monitoring system. Kinematic monitoring using wearable FBG sensors.	02
3	2	Study of Wearable ECG electrodes: Design and measurement of electrical activity of the heart. Design and measurement of electrical activity of muscle cells.	02
4	2	Study the process involved in screen printing technology (thick film) and construct a miniaturized Interdigitated comb type electrode (1 mm line width & 1 mm inter electrode gap) which can be used for sensing applications. After developing the	02

		electrodes, measure the actual electrode conductivity. The overall printing surface of the electrodes on the substrate can be restricted to one square inch.	
5	2	Understand the dip coating / spin coating methods (thin film technology) and how they are being used for developing thin films for sensing applications. After the study, deposit a thin film layer of Tin oxide on the screen printed IDT electrodes. Measure the conductivity of the coated thin film using suitable electronic circuits. Based on the observation, propose how it can be used for chemical sensing applications.	02
6	2	Pulse oximetry can be a useful aid in decision-making, everyone's oxygen saturation fluctuates, due to changing activities and health conditions. Design a circuit to determine oxygen range, and record each measurement in the activity log. A SpO2 of greater than 95% is generally considered to be normal. If SpO2 of 92% or less (at sea level) indicates the condition using an alarm. Use two led sources and two detectors to measure the saturation of oxygen in the test subject.	02
7	3	Anti-collision systems are preferred for all the automotive systems to improve the passenger safety. Using the Doppler effect as the detection principle, develop an anti-collision system using ultrasonic transceivers	02
8	3, 4	Tire Pressure Monitoring Systems use a wireless radio frequency signal to communicate the tire pressure from sensors inside the wheel to a receiver centrally located in the vehicle. The sensors are powered by batteries that eventually wear out, so the amplitude of the transmitted signal is minimized in order to conserve power. Unfortunately, this has resulted in unreliable communication and it is not uncommon to lose communication with the sensors resulting in a false low-pressure indication. Develop a better way of sending RF signals from the wheels to the vehicle to conserve power and improve communication.	02
9	3, 4	Develop a suitable electrochemical cell which can distinguish normal and contaminated water samples. Cyclic voltammetry technique can be used as the detection method. Develop the electronic circuitry and display to indicate the type of water	02
10	3	Cloud Platforms: Microsoft Azure/IBM Bluemix Language: Python 1. Pushing documents 2. Pushing Images and Processing 3. Mini Weather Station 4. Image analytics at cloud 5. Python Scikit learn 6. Tensor flow 7. Live video	02

Software Requirements:

LabVIEW, Microsoft Azure, IBM Bluemix

Hardware Requirements:

Microcontroller prototyping boards, GPRS/ GSM Modules, Zigbee modules, Ethernet Shield, LoRaWAN module, LabVIEW DAQ and peripherals

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.
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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/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 entire syllabus.

Text Books:

1. "Seamless Healthcare Monitoring", Toshiyo Tamura and Wenxi Chen, Springer 2018
2. "Wearable Sensors -Fundamentals, Implementation and Applications", by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014.
3. "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010
4. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, "Sensor Technologies: Healthcare, Wellness and Environmental Applications", 201, 1st Edition , Apress Media LLC, New York.
5. William S. Wong, Alberto Salleo, Flexible Electronics: Materials and Applications, 2011, 1st Edition, Springer, New York.
6. Edward Sazonov, Michael R. Neuman (editors), Wearable Sensors: Fundamentals, Implementation and Applications, 2014, Academic Press/Elsevier, ISBN 978-0124186620
7. Honbo Zhou, Internet of Things in the Cloud – A Middleware Perspective, 2012, CRC Press, ISBN 978-1439892992
8. Claire Rowland, Elizabeth Goodman, Martin Chalier, Ann Light, Alfred Lui, Designing Connected Products: UX for the Consumer Internet of Things, 2015, O'Reilly Media, Inc, ISBN 978-1449372569
9. John Dean, Web Programming with HTML5, CSS and JavaScript, 2018, Jones and Bartlett Publishers Inc., ISBN-10: 9781284091793
10. DiMarzio J. F., Beginning Android Programming with Android Studio, 2016, 4th ed., Wiley, ISBN-10: 9788126565580

References:

1. “Wearable Electronics Sensors - For Safe and Healthy Living”, Subhas Chandra Mukhopadhyay, Springer 2015
2. “Environmental, Chemical and Medical Sensors”, by Shantanu Bhattacharya, A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen, Springer Nature Singapore Pte Ltd. 2018
3. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
4. N. Luo, W. Dai, C. Li, Z. Zhou, L. Lu, C. C. Y. Poon, et al., "Flexible Piezoresistive Sensor Patch Enabling Ultralow Power Cuffless Blood Pressure Measurement," Advanced Functional Materials, vol. 26, pp. 1178-1187, 2016.
5. S. Yang, Y.-C. Chen, L. Nicolini, P. Pasupathy, J. Sacks, B. Su, et al., “Cut-and-Paste” Manufacture of Multiparametric Epidermal Sensor Systems," Advanced Materials, vol. 27, pp. 6423-6430, 2015.
6. Edward Sazonov, Michael R. Newman, “Wearable Sensors: Fundamentals, Implementation and Applications”, 2014, 1st Edition, Academic Press, Cambridge.
7. Kate Hartman, “Make: Wearable Electronics: Design, prototype, and wear your own interactive garments”, 2014, 1st Edition, Marker Media, Netherlands.
8. Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, 2015, 1st Edition, World Scientific Publishing Co, Singapore.
9. Yugang Sun, John A. Rogers, “Semiconductor Nanomaterials for Flexible Technologies: From Photovoltaics and Electronics to Sensors and Energy Storage (Micro and Nano Technologies)”, 2011, 1st Edition, William Andrew, New York.
10. Fadi Al-Turjman, Intelligence in IoT- enabled Smart Cities, 2019, 1st edition, CRC Press, ISBN-10: 1138316849
11. Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 2018, Packt Publishing.
12. Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 2012, Springer, ISBN-10: 3642276377

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Subject Code	Subject Name	Total
ET 406	**Communication System Design and Integration**	**04**

Prerequisite:

Mobile Communication Systems, Robotics, Microcontroller, Antenna, Microwave Engineering

Course Objectives:

1. Understand protocol processing systems.
2. Study basics of Drone technology.
3. Understand the fundamentals of Digital SLR camera System.
4. Inculcate the software and hardware integration in mobile system.
5. Understand the design considerations of RF transceiver system.
6. Inculcate the techniques to analyze the performance of real time systems.

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

1. Explain the computer communication principles: Protocols,Architecture and multimedia and optical networking.
2. Describe working principle and application of drone technology.
3. Describe working principle and application of DSLR system.
4. Identify and explain the software and hardware integration in mobile system.
5. Describe the design considerations of RF transceiver system.
6. Demonstrate the techniques to analyze the performance of real time systems.

Theory Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Computer Communication System	**Protocol processing Systems** :Network processing hardware, Basic packet processing algorithms. Protocol Software, Switching Fabrics SONET-DWDM ,DSL ,ISDN ,ATM **Multimedia Networking:** Protocols for real time interactive application-RSVP ,Network Requirements for Audio/ Video Transform, Multimedia Coding and Compression.	6	CO1

II	Drone System	**Introduction to UAVs**, Classification of UAVs, Drones / Qcadquaptors Working Principle and Design, Sensors used in drones & Calibration **PID Controller Implementation and Tuning,** Flight controller, Remote Controller, Quadcopter dynamics **Applications of UAVs** in various fields Land surveying, Urban city planning, Agriculture, Disaster management	6	CO2
III	DSLR System	Introduction to digital SLR cameras and Photography, DSLR block diagram, DSLR features, Memory Cards and Storage, Selection of lenses, Camera controls.	5	CO3
IV	Mobile System	Introduction to mobile system, Introduction to mobile software's: Android, IOS, Introduction to mobile app development Introduction to mobile hardware's: Bluetooth, Wi-Fi, GPS, Accelerometer, Camera, Fingerprints sensors Hardware and software integration	9	CO4
V	RF Transceiver Design	Communication System Requirements, Selection of Circuits and Components, Design and integration of transmitting Antenna, Amplifier, Filters, Oscillator, Mixer, Phase locked loop, Receiver requirements, Link budget analysis, Design of LNA and its integration Antenna, filter, oscillator and mixer, Image rejection techniques	9	CO5
VI	Performanc e Analysis of Real time System	EMI-EMC issues, Fading, Validation of prototype, Open air testing	4	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. David M Pozar, Microwave Engineering, John Wiely and Sons, 2005

2. Ludwig R. and Bogdanov G, RF Circuit Design, Prentice Hall, 2007.

3. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiely and Sons, 2005

4. 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

References:

1. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha Ph.D. (Author), 2016
2. Handbook of Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J. (Eds.), 2014.
3. Guillermo Gonzalez, 'Microwave Transistor Amplifiers Analysis and Design', Prentice Hall, 2nd Edition.
4. Devendra Misra, 'Radio Frequency and Microwave Communication Circuits-Analysis and Design', John Wiley & Sons, 2nd Edition.
5. Ramesh Garg, InderBahl and Maurizio Bozzi, "Microstrip Lines and Slot Lines, Artech House, 3rd Edition.

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Subject Code	Subject Name	Total
ET 407	**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 4. 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

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Subject Code	Subject Name	Total
ET 408	**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

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Subject Code	Subject Name	Total
ET 409	**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

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Subject Code	Subject Name	Total
ET 410	**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 Prerequisite:

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

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Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 470	**E Commerce and E Business**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 470	E Commerce and E Business	40	40	40	60	-	-	--	100

Objectives:

1. To understand the factors needed in order to be a successful in ecommerce
2. Identify advantages and disadvantages of technology choices such as merchant server software and electronic payment options.
3. Analyse features of existing e-commerce businesses, and propose future directions or innovations for specific businesses.

Outcomes: Learner will be able to…

1. Appreciate the global nature and issues of electronic commerce as well as understand the rapid technological changes taking place.
2. Define and differentiate various types of E-commerce
3. Discuss various E-business Strategies.

Theory Syllabus

Module	Detailed Contents	Hrs
1	**E-commerce system:** Introduction- scope of electronics commerce, definition of e-commerce, difference between e-commerce and e-business, business models of e-commerce transactions. E-commerce infrastructure: client server technology, two tier client server architecture for e-commerce, drawbacks, three tier architecture for e-commerce.	8
2	**Business strategies for e-commerce:** Introduction- elements of e-commerce strategy, simplicity, mobile responsiveness, choosing e-commerce store platform, user-based focus, compliance and security measures, e-commerce strategy: strategy overview, strategy task, technology issues. Case study: Flipkart v/s Amazon, competitive edge, marketing strategy, sales strategy	8
3	**Design of E-commerce systems:** e-commerce types- electronic market, electronics data interchange EDI, modeling of e-commerce system, three tier component model of e-commerce system, e-commerce system design- data model, web modeling, database structure design, process model, user friendly design of e-commerce site.	7
4	**Technologies for e-commerce systems:** Introduction- technologies for e-commerce, PHS and Javascript, SEO, Social Plugins, payment processes, SSL Encryption, hosting server, Service oriented architecture.	7
5	**Scalability of e-commerce systems:** Web scalability- Vertical scalability , horizontal scalability, Load balancing- working of load balancers, global server load balancers, cloud load balancing- goals of cloud balancing, automated cloud balancing. web caching and buffering	6
6	**E-commerce system implementation:** E-commerce implementation, -website testing, web maintenance, web advertisement, copyright services, SMS alert services, bulk email services, Web personalization-techniques for gathering information, analysis techniques for website personalization, domain name registration and web hosting- different types of web hosting, different components of web hosting, features in web hosting.	6

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.

References:

1. Electronic Business and Electronic Commerce Management, 2nd edition, Dave Chaffey, Prentice Hall, 2006
2. Elias. M. Awad, " Electronic Commerce", Prentice-Hall of India Pvt Ltd.
3. E-Commerce Strategies, Technology and applications (David Whitley) Tata McGrawHill
4. E-business- theory and practise, BrahmCanzer, cengage learning
5. Secure e-commerce systems (Kindle edition), Amazon publishing, P S Lokhande, B BMeshram, first edition

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Course Code	Course Name	Credits
IL 471	**Business Analytics**	3

Syllabus Under Preparation

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Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 472	**Biomedical Instrumentation**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 472	**Biomedical Instrumentation**	40	40	40	60	-	-	--	100

Objectives:

1. To familiarize students with various aspects of measuring electrical parameters from the living body.
2. To introduce students with the characteristics of medical instruments and related errors.
3. To illustrate various types of amplifiers used in biomedical instruments.
4. To familiarize students with biomedical recording devices.
5. To introduce students with patient monitoring systems & their characteristics.

Outcomes: Learner will be able to…

1. Safely and effectively use biomechanics instrumentation and equipment to record and assess human and object motion.
2. Describe and characterize the origin of bio-potentials and inspect common biomedical signals by their characteristics features
3. Understand the basic instrumentation system with their limitations & familiarize with pc based medical instrumentation & control of medical devices.
4. Describe and characterize medical instruments as per their specifications, static & dynamic characteristics and understand data acquisition system
5. Describe, analyze, characterize and design bio-potential amplifiers and design various medical recording systems & their components.
6. Understand and describe patient monitoring systems and its necessity in healthcare

system.

Theory Syllabus

Module	Detailed Contents	Hrs
1	**Medical Instrumentation**: Sources of Biomedical Signals, Basic medical Instrumentation system, Performance requirements of medical Instrumentation system, Microprocessors in medical instruments, PC based medical Instruments, General constraints in design of medical Instrumentation system, Regulation of Medical devices.	6
2	**Measurement systems:** Specifications of instruments, Static & Dynamic characteristics of medical instruments, Classification of errors, Statistical analysis, Reliability, Accuracy, Fidelity, Speed of response, Linearization of technique, Data Acquisition System.	6
3	**Bioelectric signals and Bioelectric amplifiers:** Origin of bioelectric signals, Electrodes, Electrode Tissue interface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector. ECG, EEG, EMG, ERG, Lead systems and recording methods.	8
4	**Biomedical recording systems:** Basic Recording systems, General consideration for signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrocardiograph, Phonocardiograph, Electroencephalograph, Electromyography, Digital stethoscope Other biomedical recorders, Biofeedback instrumentation, Electrostatic and Electromagnetic coupling to AC signals, Proper grounding, Patient isolation and accident prevention.	7
5	**Patient Monitoring Systems:** System concepts, Cardiac monitor, selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, Measurement of respiration rate, Holter monitor and Cardiac stress test, Catheterization Laboratory Instrumentation , Organization and equipments used in ICCU and ITU.	6
6	**Biological sensors:** Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, Chemoreceptor: hot and cold receptors, barro receptors, sensors for smell, sound, vision, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors & BIOMEMS, basic idea about Smart sensors.	6

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.

References:

1. Joseph Bronzino, "Biomedical Engineering and Instrumentation", PWS Engineering, Boston.
2. Cromwell, Weibell& Pfeiffer, "Biomedical Instrumentation & Measurement", Prentice Hall, India.
3. R. S. Khandpur, "Handbook of Bio-Medical Instrumentation", 2nd Edition, Tata McGraw Hill.
4. J.Webster, "Bioinstrumentation", Wiley & Sons.
5. Joseph D.Bronzino, "The Biomedical Engineering handbook", CRC Press.
6. D. L. Wise, "Applied Bio Sensors", Butterworth, London.
7. J.J.Carr&J.M.Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia

Back to scheme

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 473	**Design for Sustainability**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 473	**Design for Sustainability**	40	40	40	60	-	-	--	100

Objectives:

1. Understand the complex environmental, economic, and social issues related to sustainable engineering
2. Become aware of concepts, analytical methods/models, and resources for evaluating and comparing sustainability implications of engineering activities
3. Critically evaluate existing and new methods
4. Develop sustainable engineering solutions by applying methods and tools to research a specific system design
5. Clearly communicate results related to their research on sustainable engineering

Outcomes: Learner will be able to…

1. Account for different theoretical and applied design principles and models for sustainable design
2. Account for and critically relate to sustainable design from an ethical, cultural and historical perspective

3. Critically review different design solutions ecological, social and economical consequences, risks, possible uses and functions in the work for a sustainable development
4. Independently apply a specific design theory on a specific challenge within the sustainability field.

Theory Syllabus

Module	Detailed Contents	Hrs
1	Introduction - Need, Evolution of sustainability within Design, environmental - economic sustainability concept, Challenges for sustainable development, Environmental agreement & protocols	6
2	Product Life Cycle Design – Life Cycle Assessment, Methods & Strategies, Software Tools	6
3	Sustainable Product - Service System Design, Definition, Types & Examples ,Transition Path and Challenges, Methods and Tools, Design thinking and design process for sustainable Development	8
4	Design for Sustainability – Engineering Design Criteria and Guidelines	6
5	Design for Sustainability – Architecture, Agriculture, Cities & Communities, Carbon Footprint	6
6	Green Building Technologies - Necessity, Principles, low energy materials, effective systems	7

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.

References:

1. C. Vezzoli, System Design for sustainability. Theory, methods and tools for a sustainable / satisfaction system/design, Rimini, Maggioli Edition, 2007.
2. C. Vezzoli and E. Manzini, Design for Environmental Sustainability, Springer – Verlag, London, 2008.
3. L. Nin and C. Vezzoli, Designing Sustainable Product-Service Systems for all. Milan: Libreria, CLUP, 2005
4. A. Tukker and U. Tischner (eds.), New Business for Old Europe, Product Services, Sustainability and Competitiveness, Greenleaf Publishing, Shefield, 2008.
5. A. Tukker, M. Charter, C. Vezzoli, E. Sto and M.M. Andersen (eds.), System innovation for Sustainability Perspective on Radical Changes to sustainable

consumption and production, Greenleaf Publishing, Shefield, 2008 UNEP, Product-Service Systems and Sustainability. Opportunities for sustainable solutions, CEDEX, Paris, 2002, http://www.uneptie.org/pc/sustain/reports/pss/pss-imp-7.pdf

Back to scheme

Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 474	**Political Science**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 474	**Political Science**	40	40	40	60	-	-	--	100

Objectives:

1. Provide a good grounding in the basic concepts of Political Theory.
2. Familiarize learners with fundamental rights and duties.
3. Teach students the structure and process of the electoral system, the features and trends of the party system and create an awareness of the social movements in India.
4. To inculcate the values of renowned thinkers on law, freedom of thought and social justice.
5. To prepare the learners for understanding the importance of Comparative Government and Politics.
6. To train learners in understanding International Relations.

Outcomes: Learner will be able to…

1. Acquire conceptual and theoretical knowledge in the basic concepts of political theory.
2. Demonstrate understanding of fundamental rights and duties and directive principles.
3. Perform successfully in expressing the process of the electoral system, the features and trends of the party system and the importance of the social movements in India.

4. Illustrate the contribution of renowned thinkers and relate it to the current scenario.
5. Compare and contrast Indian Government and Politics with European countries.
6. Develop an understanding of International Relations with respect to Indian foreign policy.

Theory Syllabus

Module	Detailed Contents	Hours
1	Understanding Political Theory- Evolution of State, Nation, Sovereignty, Types and Linkages between Power and Authority; Interrelationships between Law. Liberty, Equality, Rights; Justice and Freedom, Democracy vs Authoritarianism	4
2	Constitutional Government in India -Evolution of the Indian Constitution, . Fundamental Rights and Duties. Directive Principles. Union-State Relations, Union Legislature: Rajya Sabha, Lok Sabha: Organisation, Functions – Law making procedure, Parliamentary procedure, 6. Government in states: Governor, Chief Minister and Council of Ministers: position and functions – State Legislature: composition and functions. 7.Judiciary: Supreme Court and the High Courts: composition and functions – Judicial activism. 8.Constitutional amendment. Major recommendations of National Commission to Review the Working of the Constitution.	6
3	Politics in India: Structures and Processes- Party system: features and trends – major national political parties in India: ideologies and programmes. Coalition politics in India: nature and trends. Electoral process: Election Commission: composition, functions, role. Electoral reforms. 3. Role of business groups, working class, peasants in Indian politics, Role of (a) religion (b) language (c) caste (d) tribe. 5. Regionalism in Indian politics. 6. New Social Movements since the 1970s: (a) environmental movements (b) women's movements (c) human rights movements.	6
4	Indian Political Thought- 1 Ancient Indian Political ideas: overview. 2. Kautilya: Saptanga theory, Dandaniti, Diplomacy. 3. Medieval political thought in India: overview (with reference to Barani and Abul Fazal). Legitimacy of kingship. 4. Principle of Syncretism, Modern Indian thought: Rammohun Roy as pioneer of Indian liberalism – his views on rule of law, freedom of thought and social justice. 6. Bankim Chandra Chattopadhyay, Vivekananda and Rabindranath Tagore: views on nationalism. 7. M.K. Gandhi: views on State, Swaraj, Satyagraha.	7
5	Comparative Government and Politics- Evolution of Comparative Politics. Scope, purposes and methods of comparison. Distinction between Comparative Government and Comparative Politics.	6
6	Perspectives on International Relations- Understanding International Relations: outline of its evolution as academic discipline. 2. Major theories: (a) Classical Realism and Neo-Realism (b) Dependency (c) World Systems theory. 3. Emergent issues: (a) Development (b) Environment (c) Terrorism	7

	(d) Migration. 4. Making of foreign policy. 5. Indian foreign policy: major phases: 1947-1962; 1962-1991; 1991-till date. 6. Sino-Indian relations; Indo-US relations.	

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.

References:

1. O.P. Gauba. (2021). An Introduction to Political Theory. Mayur books
2. Vibhuti Bhushan Mishra. (1987). Evolution of the Constitutional History of India (1773-1947 : With Special Reference to the Role of the Indian National Congress and the Minorities).South Asia Books
3. Chetna Sharma Pushpa Singh. (2019). Comparative Government and Politics.SAGE Publications India Pvt Ltd.
4. Henry R. Nau. (1900). Perspectives on International Relations: Power, Institutions and Ideas. CQ Press

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Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 475	**Research Methodology**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 475	**Research Methodology**	40	40	40	60	-	-	--	100

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: At the end of the course **l**earner will be able to…

1. Prepare a preliminary research design for projects in their subject matter areas.
2. Accurately collect, analyse and report data.
3. Present complex data or situations clearly.
4. Review and analyse research findings.

Theory Syllabus

Module	Detailed Contents	Hours
1	**Introduction and Basic Research Concepts** **1.1** Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Philosophy and validity of research **1.2** Objectives of Research **1.3** Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical **1.4** Need of Research in Business and Social Sciences **1.5** Issues And Problems in Research	8
2	**Types of Research** **2.1.** Pure and Applied Research **2.2.** Descriptive and Explanatory Research **2.3.** Analytical Research **2.4** Qualitative and Quantitative Approaches **2.5** Literature review **2.6** Developing the objectives.	8
3	**Research Design and Sample Design** **3.1** Research Design – Meaning, Types and Significance **3.2** Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	7
4	**Research Methodology** **4.1** Meaning of Research Methodology **4.2.** Stages in Scientific Research Process: **a.** Identification and Selection of Research Problem **b.** Formulation of Research Problem **c.** Review of Literature **d.** Formulation of Hypothesis **e.** Formulation of research Design **f.** Sample Design **g.** Data Collection **h.** Data Analysis **i.** Hypothesis testing and Interpretation of Data **j.** Preparation of Research Report	8
5	**Formulating Research Problem** **5.1** Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis.	4
6	**Outcome of Research** **6.1** Preparation of the report on conclusion reached. **6.2** Validity Testing & Ethical Issues **6.3** Suggestions and Recommendation	4

	6.4 Identification of future scope	

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.

Reference :

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education

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Course Code	Course Name	Credits
IL 476	**Maintenance of Mechanical Equipment**	**3**

Syllabus Under Preparation

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Course Code	Course Name	Scheme	Theory	Practical	Tutorial	Total
IL 477	**Cooking and Nutrition**	Contact Hours	3	-	-	3
		Credits	3	-	-	3

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal Assessment			End Sem Exam				
		IA 1	IA 2	Average					
IL 477	**Cooking and Nutrition**	40	40	40	60	-	-	--	100

Course Objectives:

The course is aimed to:

1. To understand nutrition and of health problems related to diet and various factors affect diet
2. To various statistical tools required to analyze the experimental data in nutrition and community research
3. Gain information about various food constituents, and changes that occur in them during food processing.
4. To gain food-related knowledge and skills so that they can organise and manage family resources effectively according to the needs and lifestyles of family members
5. To be able to make informed judgements and choices about the use of food available.
6. To create interest in the creative side and enjoyment of food and the skills necessary for food preparation and food preservation. And to be aware of relevant mandatory and other necessary safety and hygiene requirements

Course Outcomes:

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

1. To understand the importance and mechanisms of the food components taking place during food processing,

2. To understand nutrition and of health problems related to diet and various factors affect diet
3. To aware how eating patterns and dietary needs depend on age and social group
4. Ability to assess the effectiveness and validity of claims made by advertisers
5. To enhance aesthetic and social sensitivity to dietary patterns and to develop an interest in the creative aspect and enjoyment of food
6. To develop skills necessary for food preparation and food preservation and knowledge of safety and hygiene requirements

Detailed Theory Syllabus:

Module No	Module	Detailed Contents of Module	Hrs.
1	Nutritional terms	**Nutritional terms**: proteins (high biological and low biological value), carbohydrates (monosaccharide, disaccharide and polysaccharide), fats, vitamins (A, C, D, E, K, B group – thiamin, riboflavin, nicotinic acid and cobalamin), mineral elements (calcium, iron, phosphorous, potassium, sodium, iodide) water Sources and uses of food energy. Sources and functions of dietary fibre.	3
2	Kitchen equipment & Kitchen planning	**Kitchen equipment & Kitchen planning:** Selection, Use and care of: modern cookers, thermostatic control and automatic time-controlled ovens, microwave ovens, slow electric cook pots, refrigerators and freezers, small kitchen equipment, e.g. knives, pans, small electrical kitchen equipment, e.g. food processors, electric kettles, Advantages and disadvantages of microwave ovens, Organisation of cooking area and equipment for efficient work., Selection, Use and care of: work surfaces, flooring, walls and wall coverings, lighting, ventilation	4

3	Meal planning and guidelines	**Meal planning and guidelines:** Factors affecting food requirements, Planning and serving of family meals, Meals for different ages, occupations, cultures and religions, Special needs of: people with food allergies and intolerances, people with medical conditions linked to diet, such as diabetes, convalescents, vegetarians, including vegans and lacto-vegetarians, Meals for special occasions, festivals, packed meals, snacks, beverages, Use of herbs, spices and garnishes, Attractive presentation of food, Terminology describing recommended dietary intakes, e.g. Dietary Reference Value (DRV) and Reference Daily Intake (RDI).	6
4	Strategic cooking	**Strategic cooking**: Transfer of heat by conduction, convection and radiation. Principles involved in the different methods of cooking, baking, boiling, braising, cooking in a microwave oven, frying, grilling, poaching, pressure cooking, roasting, simmering, steaming, stewing, use of a slow cooker. Reasons for cooking food, Sensory properties of food (flavour, taste, texture), Effect of dry and moist heat on proteins, fats and oils, sugars and starches, and vitamins to include: caramelisation, coagulation dextrinization, enzymic and non-enzymic browning, gelatinisation, rancidity, smoking point, Preparation and cooking of food to preserve nutritive value, Economical use of food, equipment, fuel and labour.	6
5	Convenience foods and Basic proportions	**Convenience foods and Basic proportions:** Foods partly or totally prepared by a food manufacturer – dehydrated, tinned, frozen, ready-to-eat, Intelligent use of these foods, Advantages and disadvantages, Food additives – types and function, Packaging – types, materials used, Labelling – information found on labels, Importance of maintaining proportions, maintaining proportions for : Bakery products, melting, rubbing-in and whisking methods, Pastries – shortcrust, flaky and rough puff, Sauces – pouring and coating, roux and blended methods, Batters – thin (pouring) and coating, Sweet and savoury yeast products	5

6	Food preservation & Kitchen safety and first aid	**Food preservation & Kitchen safety and first aid**: Food preservation & Kitchen safety and first aid: Reasons for preserving food, Methods of preservation and an understanding of the principles involved: heating – canning, bottling; removal of moisture – dehydrating; reduction in temperature – freezing; chemical preservation – sugar, salt, vinegar; modified atmosphere packaging; irradiation; Awareness of potential danger areas in the kitchen. Safety precautions. First aid for burns and scalds, cuts, electric shock, fainting, shock.	5

Theory Assessment:

A. Internal Assessment (IA): Two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class test when an additional 35% syllabus is completed. Duration of each test shall be one hour.

B. End Semester Theory Examination: In question, paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. Question paper will consist of 3 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total three questions need to be solved.

5. Books and References:

1. Fundamentals of Food and Nutrition by Tejmeet Rekhi, Heena Yadav
2. Food Process Engineering And Technology by Akash Pare, B L Mandhyan

Back to scheme

Subject Code	Subject Name	Total (Credits)
ET 491	Major Project B	4

Lab Objectives:

1. The Project work enables the students to develop the required skills and knowledge gained during the programme by applying them for the analysis of a specific problem or issue, via a substantial piece of work which is carried out over an extended period.

2. It enables the students to demonstrate proficiency in the design of a research project, application of appropriate research methods, collection and analysis of data and presentation of results.

3. To improve the team building, communication and management skills of the students.

4. To introduce students to the vast array of literature available of the various research challenges in the field of Electronics & telecommunication engineering.

5. To create awareness among the students of the characteristics of several domain areas where Electronics & telecommunication engineering can be effectively used.

Course Outcomes: Upon successful completion of this course, the learner will be able to

1. Discover potential research areas in the field of Electronics & telecommunication engineering.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Compare and contrast the several existing solutions for research challenges.
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified.
6. To report and present the findings of the study conducted in the preferred domain

Guidelines:

1. Project Topic:

- To proceed with the project work it is very important to select a right topic. Project can be undertaken on any domain of electronics and telecommunication programmes. Research and development projects on problems of practical and theoretical interest should be encouraged.
- Project work must be carried out by the group of at least two students and maximum four and

must be original.

- Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements.

- The project work can be undertaken in a research institute or organization/company/any business establishment.
- Students must consult an internal guide along with external guide (if any) in selection of topic.
- Head of department and senior staff in the department will take decisions regarding selection of projects.
- Students has to submit a weekly progress report to the internal guide whereas internal guide has to keep track on the progress of the project and also has to maintain attendance report. This progress report can be used for awarding the term work marks.
- In case of industry projects, visit by an internal guide will be preferred.

2. Project Report Format:

At the end of semester a project report should preferably contain at least following details:-

- Abstract
- Introduction
- Literature Survey
    a) Survey Existing system
    b) Limitation of the Existing system or research gap
    c) Problem Statement and Objective
    d) Scope
- Proposed System

a) Analysis/Framework/ Algorithm

b) Details of Hardware & Software

c) Design details

d) Methodology (your approach to solve the problem)

- Implementation Plan for next semester
- Conclusion
- References

3. Term Work:

Distribution of marks for term work shall be as follows:

a) Weekly Attendance on Project Day

b) Contribution in the Project work

c) Project Report (Spiral Bound)

d) Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects

4. Oral Exam:

Oral examination of Project-I should be conducted by Internal and External Examiners. Students have to give a presentation and demonstration on the Project- I

Back to scheme

Course Code	Course Name	Credits
ET 421	Block chain for Communication	04

Prerequisite:

Java and scripting , Database and Management , Computer Communication and Network

Objectives:

1. To understand basics of Blockchain technology
2. To understand concept of cryptocurrency and Bitcoin
3. To understand concepts of Ethereum Blockchain
4. To learn the concepts of Hyperledger
5. To understand solidity programming language and concepts of smart contracts
6. To learn and develop various applications of Blockchain

Outcomes: Learner will be able to…

1. Understand working knowledge of the emerging block chain technology.
2. Discuss concept of cryptocurrency and Bitcoin
3. Apply the knowledge of Ethereum Blockchain
4. Understand and analyze the working of Hyperledger
5. Explore basics of solidity programming language and smart contracts
6. Develop various applications of Blockchain

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Blockchain	What is Blockchain, Blockchain Technology Mechanism Networks, Blockchain Origins, Objective of Blockchain, Blockchain challenges, Transsactions and Blocks,P2P systems, Keys as Identity, Digital signatures, hashing and public key cryptosystems, private vs public blockchain	4	CO1
II	Bitcoin and Cryptocurrency	What is Bitcoin,The Bitcoin Network,The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of	8	CO2

		Blockchain Technology on Cryptocurrency		
III	Introduction to Ethereum Blockchain	What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether's What's a Transaction?, Smart Contracts.	7	CO3
IV	Introduction to Hyperledger	What is Hyperledger? , Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer.	5	CO4
V	Solidity Programming Language	Solidity -Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)	8	CO5
VI	Blockchain Applications	Blockchain Applications: Internet of Things, Medical Record Management System, Do-main Name Service and future of Blockchain	4	CO6

Lab Syllabus

Lab Prerequisite: Cryptography, DataStructure, Networking, OOP

Sr. No.	**Level** 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	**Detailed Lab Description**	**Hours**
1	Basic	Understanding the concept of Hash in Blockchain	02
2	Advanced	Working of Bitcoin mining and how blocks are added in the Blockchain.	02
3	Advanced	Setting up bitcoin wallet	02
4	Basic	Creating and Building Up Crypto Token	02
5	Advanced	Setting up Metamask and MIST Wallet	02
6	L3	Set up Hyperledger Fabric Blockchain using Hyperledger Composer locally	02
7	L1	Advanced Storage smart contract with function to add elements to array,function to read individual elements of	02

		array , function to read all elements of array and function to return length of array.	
8	L1 , L3	Create a smart contract for Hotel Room	02
9	L1 , L3	Create a smart contract that implements the simplest form of a cryptocurrency.The contract allows only its creator to create new coins (different issuance schemes are possible). Anyone can send coins to each other without a need for registering with a username and password, all you need is an Ethereum keypair	02
10	L1 , L3	Simple Open Auction Smart Contract The general idea of the following simple auction contract is that everyone can send their bids during a bidding period. The bids already include sending money / Ether in order to bind the bidders to their bid. If the highest bid is raised, the previous highest bidder gets their money back. After the end of the bidding period, the contract has to be called manually for the beneficiary to receive their money - contracts cannot activate themselves.	02
11	L4	Practical use cases of Blockchain - Case study	02

Software Requirements: Remix Browser - online compiler

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 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 Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. ArshdeepBahga, Vijay Madisetti, Blockchain Applications: A Hands-On Approach Paperback, VPT; 1st edition (31 January 2017)
3. Baset, Salman A., Blockchain Development with Hyperledger,Packt, 2019
4. Parikshit Jain, A Practical Guide To Blockchain And Its Applications, Bloomsbury India,1st Edition,February 2019

Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

Course Code	Course Name	Credits
ET 422	AIML in Communication	04

Prerequisite:

Fundamentals of Mathematics, Communication systems, Artificial Neural Networks.

Course Objectives:

1. To understand the concept of data cleaning and data transformation.
2. To understand and apply the basic methods of feature extraction and feature evaluation.
3. To understand and apply both supervised and unsupervised machine learning algorithms to improve performance of equalizers.
4. To develop routing algorithms using machine learning to resolve real-world problems in Network design.
5. To become familiar with various Neural Networks methods for controlling ATM calls.
6. To understand fault management techniques in Communication systems.

Course Outcomes: Learner will be able to…

1. Able to Understand the fundamentals of pattern recognition and machine learning.
2. Able to Understand the issue of dimensionality and apply suitable feature extraction methods considering the characteristics of a given problem..
3. Able to apply Self organizing maps and distribution Learning methods for the adaptive equalization.
4. Able to create solutions to real-world problems of Network design and Management using reinforcement learning and Hopfield optimization techniques.
5. Understand and apply Network control methods for performance enhancement of communication systems.
6. Analyze the performance of communications systems by estimating various faults in the systems.

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction	Basic definitions; Hypothesis space and inductive bias; Data cleaning; Data transformation; Evaluation;Model visualization; Cross-validation; Linear Regression	04	CO1

II	Data Interpretation & feature extraction	Curse of dimensionality; Principal component analysis; Fisher linear discriminant, Feature extraction from multivariate data, image data; Feature evaluation. Text recognition for Conversion of Telephone, Speech recognition.	04	CO2
III	Equalisers	Adaptive equalization and channel equalization by distribution Learning, Equalization of varying channels using RBFNN, Adaptive signal recovery, Self organizing maps in nonlinear multipath channels.	08	CO3
IV	Network design and Management	Adaptive Routing, Distributed reinforcement learning scheme for network routing. Optimal traffic routing using Self organization principle, Hopfield optimization techniques for routing in computer networks, Q-routing approach to adaptive traffic control. NN for network topology design.	06	CO4
V	Network Control	ATM call control by Neural Network. ATM Multimedia traffic prediction. Optimization for switching. Control ATM call traffic by reinforcement learning	04	CO5
VI	Fault Management	Learning index rules and adaption functions for a communication network, Identify faults in switching systems using Distributed neural network.	08	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 study various steps to clean the data.	02
2	Basic	Minimizing the error function and fitting the best line or hyperplane using linear regression.	02
3	Design	Write a program to reduce the dimensionality of the data set.	02
4	Design	Design an Algorithm to extract features from multivariate data.	02
5	Design	Write a program for equalization of varying channels using RBFNN	02

6	Advanced	Design adaptive routing algorithm using reinforcement learning	02
7	Advanced	Design optimal traffic routing algorithm using the Self organizing Maps.	02
8	Advanced	Write a algorithm to control ATM call traffic by using reinforcement learning	02
9	Project	Design an algorithm to identify faults in switching systems using Distributed neural network	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:

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. T. Mitchell, Machine Learning, McGraw Hill.
2. M. Gopal, Applied Machine Learning, McGraw Hill.

References:

1. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India.
2. Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill.
3. A. Ethem, Introduction to Machine Learning, PHI Learning Pvt. Ltd.
4. S N Sivanandam, Introduction to Neural Networks,McGraw-Hill edu. Pvt. Ltd.

Course Code	Course Name	Credits
ET 423	MIMO Systems for 5G	04

Prerequisite:

Wireless and mobile communication, Antenna and Digital Communication.

Course Objectives:

1. To get familiar with the basics of the diversity schemes involved in the MIMO system.
2. To understand planning and design of the capacity of deterministic and random MIMO channels and fading channels.
3. To inculcate the design considerations of MIMO antenna system
4. To study various space time coding techniques.
5. To explore various algorithms used to detect the received signal in MIMO systems.
6. To study the advances in MIMO Communication Systems.

Course Outcomes: Learner will be able to…

1. Classify and explain the diversity schemes involved in MIMO with advantages, applications, channel models and power allocation.
2. Calculate the capacity of deterministic and random MIMO channels and fading channels.
3. Classify and compare SISO antenna with MIMO antenna
4. Explain the different space time coding techniques like STBCs, STTCs and Space time turbo codes.
5. Describe various algorithms used to detect the received signal in MIMO systems like Maximum likelihood, MMSE, ZFE.
6. Discuss the advances in MIMO Communication Systems.

Theory Syllabus

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to MIMO channel models	Diversity-multiplexing trade-off, transmit diversity schemes, advantages and applications of MIMO systems, Fading Channel Models: Uncorrelated - fully correlated - separately correlated - keyhole MIMO fading models, parallel decomposition of MIMO channel, Power allocation in MIMO: Uniform - adaptive - near optimal power allocation	07	CO 1

II	MIMO channel capacity	Indoor RF communication and its Propagation models, Capacity for deterministic MIMO Channels: SISO – SIMO – MISO – MIMO, Capacity of random MIMO channels: SISO – SIMO – MISO - MIMO(Unity Channel Matrix, Identity Channel Matrix), Capacity of independent identically distributed channels, Capacity of separately correlated Rayleigh fading MIMO channels, Capacity of keyhole Rayleigh fading MIMO channel,	05	CO2
III	MIMO Antenna	Introduction to MIMO antenna, Massive MIMO antenna system and its applications, Performance Parameters of MIMO antenna system (Return loss, Isolation/mutual coupling between antenna elements, Envelope correlation coefficient, Total active reflection coefficient and Channel capacity loss etc.), Mutual coupling reduction techniques in MIMO antenna	04	CO3
III	Space-time codes	Advantages, code design criteria, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels, Space-time block codes, Space-time trellis codes, Performance analysis of Space time codes over separately correlated MIMO channel, Space-time turbo codes, BLAST Architectures: VBLAST – HBLAST – SCBLAST - DBLAST	08	CO4
IV	MIMO detection techniques	Maximum Likelihood, Zero Forcing, Minimum Mean Square Error, Zero Forcing Equalization with Successive Interference Cancellation, Minimum Mean Square Error Successive Interference Cancellation, Lattice Reduction based detection	08	CO5
V	Advances in MIMO systems	Spatial modulation, MIMO based cooperative communication and cognitive radio, multiuser MIMO, cognitive-femtocells and large MIMO systems for 5G wireless, MIMO Applications in RADAR, Satellite Communication, Wi-Fi	07	CO6

Lab Syllabus

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

1	Design	Performance analysis of 2 x 2 MIMO systems using different modulation techniques with ML detection algorithm.	02
2	Design	Performance analysis of 2 x 2 MIMO systems using different modulation techniques with ML detection algorithm in correlated and uncorrelated channel conditions.	02
3	Design	Performance analysis of 2 x 2 MIMO systems using different modulation techniques with VB last detection algorithm.	02
4	Design	Performance analysis of 2 x 2 MIMO systems using different space time coding techniques with ML detection algorithm.	02
5	Design	Performance analysis of 2 x 2 MIMO systems using different space time coding techniques with V-Blast detection algorithm.	02
6	Design	Performance analysis of a Multi-user MIMO system using BPSK modulation technique with SIC and V-Blast detection algorithm.	02
7	Design	To design a 2 element MIMO antenna system and to study the effect of spacing between antenna elements on the radiation characteristics of MIMO antenna.	02
8	Design	To design a 2 element MIMO antenna system, using various diversity techniques.	02
9	Design	To design Massive MIMO antenna system and to analyze the effect of number of antenna elements and operating frequency on the performance of MIMO system	02
10	Study	Deployment of access points for indoor (in-house, basement, tunnel) RF communication.	LO6

Software Requirements:

1. Ns-2: http://www.isi.edu/nsnam/ns/
2. Virtual Lab : http://vlab.amrita.edu/index.php?sub=78&brch=256
3. Scilab Experiments Book: https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjgwcelodTTAhVJrI8KHTQUC9AQFggqMAA&url=http%3A%2F%2Fscilab.in%2Ftextbook_companion%2Fenerate_book%2F3446&usg=AFQjCNGDs2a6AHGKL93l3_j8Ra1UN-5SQQ&sig2=yT9ep5_ZlhfRDVsv-GmsWw&cad=rja

Online Repository Sites:

1. http://nptel.ac.in/courses/117105132

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

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 attempts 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.

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

Text Books:

1. TolgaM.Duman and Ali Ghrayeb, "Coding for MIMO Communication Systems", John Wiley & Sons Ltd.,2007.
2. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications", Cambridge University Press, 2017.
3. T. L. Marzetta, E. G. Larsson, H. Yang and H. Q. Ngo, Fundamentals of Massive MIMO, Cambridge University Press, 2016.
4. B. Kumbhani and R. S. Kshetrimayum, "MIMO Wireless Communications over Generalized Fading Channels", CRC Press, 2017.

References:

1. A. Chockalingam and B. S. Rajan, *Large MIMO systems*, Cambridge University Press, 2014.
2. EzioBiglieri, Robert Calderbank and Anthony Constantinides. "MIMO Wireless Communications".
3. Single and Multi Carrier MIMO Transmission for Broadband Wireless Systems by R.Prasad, Rahman and S.S. Das.
4. Mohammad Sharawi "Printed MIMO antenna

Course Code	Course Name	Credits
ET 424	Cloud Computing	04

Prerequisite: Computer Network, Operating System

Course Objectives:

1. Basics of cloud computing.
2. Key concepts of virtualization.
3. Different Cloud Computing services
4. Cloud Implementation, Programming and Mobile cloud computing
5. Key components of Amazon Web Services
6. Resources Management In Cloud Computing

Course Outcomes:

1. Define Cloud Computing and memorize the different Cloud service and deployment models
2. Describe the importance of virtualization along with their technologies.
3. Use and Examine different cloud computing services
4. Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing
5. Describe the key components of Amazon web Service
6. Design and develop resources management In Cloud Computing

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Cloud Computing	Introduction to Cloud Computing, Cloud Characteristics, Cloud Computing Components, Comparing of Cloud Computing with Peer to Peer architecture, Client Server , Distributed, Grid, Cloud Deployment model (Cloud types- Public, Private, Community, Hybrid), Service Models-(IaaS,PaaS,SaaS)	04	CO1
II	Virtualization	Introduction & benefit of Virtualization – Implementation Levels of Virtualization- VMM Design Requirements and Providers– Virtualization at OS level – Middleware support for Virtualization– Virtualization structure/tools and mechanisms: Hypervisor and Xen Architecture,	07	CO2

		Binary Translation with full Virtualization, Para Virtualization with Compiler Support - CPU Virtualization – Memory Virtualization and I/O Virtualization – Virtualization in Multicore processors		
III	Cloud Computing Services	Compute Services - Amazon Elastic Compute Cloud, Google Compute Engine, Windows Azure Virtual Machines Storage Services - Amazon Simple Storage Service, Database Services - Amazon Relational Data Store, Amazon DynamoDB, Application Services - Application Runtimes & Frameworks, Queuing Services, Email Services, Notification Services, Media Services ,Content Delivery Services - Amazon CloudFront, Windows Azure Content Delivery Network Analytics Services - Amazon Elastic MapReduce, Deployment & Management Services - Amazon Elastic Beanstalk, Amazon CloudFormation Identity & Access Management Services - Amazon Identity & Access Management, Open Source Private Cloud Software - CloudStack, Eucalyptus, OpenStack	10	
IV	Cloud Application Design	Design Considerations for Cloud Applications - Scalability, Reliability & Availability, Security, Maintenance & Upgradation, Performance Cloud Application Design Methodologies - Service Oriented Architecture, Cloud Component Model, IaaS, PaaS and SaaS services for cloud applications, Model View Controller, RESTful Web Services, Data Storage Approaches - Relational (SQL) Approach, Non-Relational (No-SQL) Approach	06	
V	Cloud Security	AAA Administration for Clouds -AAA model – SSO for Clouds – Authentication management and Authorization management in clouds – Accounting for Clouds	06	
VI	Cloud Computing Applications	Cloud Computing for Health care, Education, Transportation, Manufacturing Industry, Energy System, Mobile Computing Multimedia Cloud - Introduction, Streaming Protocols - RTMP Streaming, HTTP Live Streaming, HTTP Dynamic Streaming Case Studies - Live Video Streaming	06	

		App , Video Transcoding App, Edge Computing, FOG Computing		

Detailed Lab Syllabus

Lab Prerequisite:

Software Requirements: XEN/ VmwaresEXSi, Open Stack,GoogleappEngine/ Windows Azure, Amazon Web Service

Sr. No.	Level 1. Basic 2. Design 3. Advanced 4. Project/Case Study/Seminar	Detailed Lab/Tutorial Description	Hours
1	Basic	Study of NIST model of cloud computing.	02
2	Basic	Understand different types of virtualizations, Host and bare metal hypervisors and implement horizontal scalability.	02
3	Basic	Install Google App Engine. Create a hello world app and other simple web applications using python/java.	02
4	Design	Use GAE launcher to launch the web applications.	02
5	Design	Working and Installation of Microsoft Azure	02
6	Design	Simulate identity management in a private cloud.	02
7	Design	Explore Storage as a Service for remote file access using web interface	02
8	Advanced	Deploy web applications on commercial cloud	02
9	Advanced	To create and access VM instances and demonstrate various components such as EC2, S3	02
10	Advanced	To demonstrate components SimpleDB, DynamoDB.	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 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/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.

Course Code	Course Name	Credits
IL 480	Digital Business Management and Digital Marketing	3

Syllabus under preparation

Course Code	Course Name	Credits
IL 481	Medical Image Processing	3

Objectives:

1. To introduce the learners to the basic theory of digital image processing.
2. To expose learners to various available techniques and possibilities of this field.
3. To prepare learners to formulate solutions to general image processing problems.

Outcomes: Learner will be able to…

1. Record, extract and analyse key information about teeth, muscles, bones etc
2. Acquire the fundamental concepts of a digital image processing
3. Analyze images in the spatial and frequency domain.

Theory Syllabus

Module	Detailed Contents	Hrs
1	**Medical Imaging Systems:** Properties, advantages and disadvantages of X-rays based imaging systems, Magnetic Resonance Imaging (MRI) imaging, Gamma-rays based imaging systems, Positron emission tomography (PET), Single-photon emission computerized tomography (SPECT) scan, Computed Tomography (CT) scan, Ultrasound (sonography), Endoscopy, and Thermography based imaging systems. Difference between different medical imaging systems. Nature of Biomedical images, Objectives of biomedical image analysis, Difficulties in biomedical image acquisition and analysis.	7
2	**Medical Imaging Toolkits:** ImageJ (and/or FIJI), ITK-Snap, SimpleITK, MITK, FreeSurfer, SLICER, OsiriX. Image Formats: dicom (.dcm), Nifti (.nii), Minc (.mnc), Analyze (img/hdr), Raw (.raw), MHD (.mhd) and MHA (.mha)	5
3	**Medical Image Detection and Recognition:** Medical image parsing, Deep Learning for Medical Image Recognition, Automatic Interpretation of Carotid Intima–Media Using Convolutional Neural Networks, Deep Cascaded Networks for Sparsely Distributed Object Detection, Deep Voting and Structured Regression for Microscopy Image Analysis.	6

4	**Medical Image Registration:** Intensity-based methods, Cost functions - correlation, least squares, mutual information, robust estimators. Optimization techniques - fixed-point iteration, gradient descent, Nelder-Mead simplex method. MRI motion compensation, Convolutional Neural Network for Robust and Real-Time 2-D Registration..	6
5	**Medical Image Segmentation Networks:** Comparative study and analysis of U-Net family of segmentation: U-Net, V-Net, 3D U-Net, H-DenseUNet, GP-Unet, UNet++, MDU-Net, DUNet, RA-UNet, nnU-Net, SUNet, IVD-Net, LADDERNET, Attention U-Net, R2U-Net, MultiResUNet, U-NetPlus, CE-Net, CIA-Net, U2-Net, ScleraSegNet, AHCNet, MFP-Unet, ResUNet-a, RAUNet, 3D U2-Net, SegNAS3D, U^2-Net, UNET 3+.	9
6	**Deep Learning for Healthcare:** Deep learning for different healthcare applications: Diabetic Retinopathy, Knee Osteoarthritis, Histological and Microscopic Elements Detection, Gastrointestinal Diseases Detection, Cardiac Imaging. Lesion detection: Brain tumor detection, prostate lesion detection, Lung nodule detection.	6

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.

References:

1. W. Birkfellner, Applied Medical Image Processing: A Basic Course, CRC Press , Second Edition, 2014
2. Bankman, Handbook of Medical Image Processing and Analysis, Academic Press Second Edition, 2008
3. Rangaraj M. Rangayyan, “Biomedical Image Analysis”, CRC Press, 2000.
4. Zhou et al “Deep learning for Medical image analysis” Elsevier 2018.
5. R. C. Gonzalez, Digital Image Processing, Pearson Education India , Third Edition, 2013
6. S. Jayaraman, T. Veerakumar, S. Esakkirajan, Digital Image Processing, McGraw Hill Education , 2017
7. A K Jain, “Fundamental of Digital Image Processing”, Prentice Hall, 2002.

Course Code	Course Name	Credits
IL 482	Technologies for Rural Development	3

Objectives:

1. To understand the nature and characteristics of rural resources and its importance in Rural Development.
2. To understand various technologies required for Rural Development

Outcomes: Learner will be able to…

1. Understand various natural resources and their importance in rural development.
2. Get exposure to various challenges and problems with regard to availability and use of natural resources.
3. Develop and implement various technologies for rural development
4. Explore various schemes for rural development

Theory Syllabus

Module	Detailed Contents	Hours
1	**Nature and Characteristics of Rural Resources: Land Resources. water Resources, Living Resources, Human Resources** Definition and meaning of Resources, Types of Rural Resources, Natural and Man-made, Characteristics of Resources, Importance of different resources in Rural Development.	8
2	**Concept of Information and Communication Technologies (ICT's)** Evolution of ICT's, Communication Functions of ICT's, Nature and Scope of ICT's, Information Haves and Information Have Nots in the Rural Areas, Strengths and Weaknesses of ICT's in Rural India, Application of ICT's for Rural Development in India, Management Information System for Rural Development in India, Success Stories relating to ICT for Rural Development (Andhra Pradesh, Tamil Nadu, Kerala and Karnataka Experiments), Satellite Communication support for Rural Development, Telecommunication support for Rural Development, Computer Communication support for Rural Development	10
3	**Crop production technology /Processing Plants**	8

	for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc.; Major varieties, sowing time, method of sowing, spacing, inter culturing, fertilizer and water requirement, time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc. Rural Energy system Technologies for Water treatment	
4	**The Role of Rural Technology** – Need & importance of rural Technology, appropriate rural Technology, Technology for Rural Women, difficulties in adoption of rural technology.	6
5	**Globalisation of Rural Economy-** Globalisation and aims and objectives; Impact of Globalisation on rural economy, Contract farming, corporate farming, SEZ's and Agriculture. Agricultural value chain	6
6	Government Schemes, initiatives and participation of various Stake holders for development and Protection of Rural resources	4

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.

References:

1. Rural Development: Principles, Policies and Management, Katar Singh, Sage Publications India Pvt. Ltd., 2009
2. Development of Land Resources – Ebook on Activities Department of Land Resources, Ministry of Rural Development, Government of India, Dec. 2014,
3. Http://dolr.nic.in/downloads/PDFs/DoLR%20Activities.pdf
4. S.S. Singh., Principles and Practices of Agronomy. 1985. Kalyani Publishers, Ludhiana
5. Indian Economy by Datt, Rudra &Sundharam, New Delhi: S. Chand, 2008.
6. W.T.O and Indian Economy by Deogirikar, A. B. Jaipur: Shri Niwas Publications, 2004

Course Code	Course Name	Credits
IL 483	Economics	3

Objectives:

1. Provide a good grounding in the basic concepts of Micro and Macroeconomics.
2. Familiarize learners with concepts of demand, supply, price, income and equilibrium.
3. Teach students to represent the Indifference curve in regular as well as in exceptional cases with respect to consumer behaviour, consumer preferences and Risk Aversion.
4. To inculcate the skills required to understand the concept of Production function with single and two variable inputs.
5. To create an awareness of the different market structures and its impact on the price and output of a product.
6. To prepare the learners in understanding the Keynesian System of Money, Interest and Income and its impact in society with respect to Inflation.

Outcomes: Learner will be able to…

1. Acquire conceptual and theoretical knowledge of Micro and Macroeconomics and learn to think critically about issues and topics of the subject.
2. Demonstrate the understanding of the concepts of demand, supply, price, income and equilibrium and relate it to the existing scenario in the society.
3. Perform successfully in representing the Indifference curve in relation to the prevalent consumer behaviour and consumer preferences.
4. Illustrate the skills required for maximising output and minimising cost for effective production.
5. Determine the importance of the existence of different market structures and its impact in society.
6. Develop an understanding of the Keynesian System of Money, Interest and Income and formulate anti- inflationary policies.

Theory Syllabus

Module	Detailed Contents	Hours
1	Introduction to Micro and Macro Economics	5
2	Demand & Supply: Concept of demand & supply functions, Price, Income & Cross elasticities of demand, Elasticity of Supply, Market demand functions, Concept of equilibrium, Impact of changes in demand & supply on equilibrium	7

3	Theory of Consumer Behaviour: Concept of cardinal and ordinal utility, consumer's equilibrium, Consumer's preferences, Risk Aversion and Indifference Curve Analysis, & its properties, Shapes of Indifference Curves in exceptional cases	7
4	The Theory of Production: Concept of Production function, Production with a single variable input, Production with two variable inputs, Optimal input combination, Constrained output maximization, Cost minimization, Elasticity of substitution	6
5	Theory of Cost: Different concept of cost, Short-run and Long- run cost analysis, modern concept. Market Structures a. Perfect Competition Short-run and long-run equilibrium of the firm and Industry, Stability of equilibrium, Concept of imperfect competition; short run and long run price and output decisions of a monopoly firm; concept of a supply curve under monopoly; comparison of perfect competition and monopoly	4
6	The Keynesian System: Money, Interest and Income Money in the Keynesian theory, Interest Rate Determination (Liquidity Preference Theory), Money Market, Bond market and Commodity Market, Monetary policies and fiscal policies, Inflation and Unemployment Inflation, Role and Effects of inflation, Anti- inflationary policies	7

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.

References:

1. Dr.Samwel Nyagucha Ores. (2019). Micro and Macro Economics: Understanding the Basics of Economics. New Generation Publishing.
2. Daron Acemoglu and James A. Robinson. (2013). Why Nations Fail: The Origins of Power, Prosperity and Poverty. Profile BooK

Course Code	Course Name	Credits
IL 484	**GIS and Remote Sensing**	**3**

Objectives:

1. To gain basic understanding of GIS and remote sensing techniques
2. To understand basic software such as QGIS used for GIS analysis
3. To understand various GIS data sources, their processing and interpretation

Outcomes: Learner will be able to…

1. Know and apply GIS and remote sensing concepts to real world problems
2. Learner will become proficient in using Python and QGIS to conduct geospatial analysis

Prerequisites: Knowledge of Python or other software programming language

Module	Detailed Contents	Hrs
1	Introduction to GIS Mapping. GIS Data models and modelling, Maps and Databases, GIS data types (vector, raster etc), Geographic coordinate systems,	10
2	Introduction to QGIS software, GIS data sources, Digitizing data, Georeferencing.	10
3	Spatial Analysis techniques vector and raster analysis and tools.	20
4	Satellite images, electromagnetic energy and remote sensing, satellites and sensors, arial cameras, surveys using drones, multispectral scanners, LIDAR.	10
5	Applications of GIS in industry, governments, NGOs etc	10

Assessment Scheme:

Internal Assessment: Course will have 6 take home assignments worth 10% of the final grade

End Semester Examination: Will have a final exam worth 40% of the final grade

References:

Principles of Remote Sensing: An Introductory Textbook (https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesremotesen sing.pdf)
Principles of GIS (https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesgis.pdf)

Course Code	Course Name	Credits
IL 485	Physical Education, Fitness & Sports	**3**

Objectives:

1. To understand the components of Physical Fitness.
2. To understand the modern development and social aspects of physical education
3. To understand general troop games, recreational games and the importance of playing to achieve health & wellness.
4. To acquaint students with principles of nutrition and the application of human energy.
5. To understand the role of food in physical performance.
6. To understand the need for wellness & weight management.
7. To understand common sports injuries, first aid & their treatment.
8. To understand the application of Yoga in physical education & sports.
9. To enable the student to understand the basic structure & function of the human body and the effect of exercise on the body as a whole.

Outcomes: Learner will be able to…

1. Maintain a health-enhancing level of fitness throughout the program as well as be able to collect and analyse personal fitness data.
2. Gain knowledge regarding the application of yoga to Physical Education and Sports
3. Understand the anatomy and Physiology of Asanas and Pranayamas.
4. Acquire the knowledge regarding the effect of exercise on the body as a whole
5. Develop an understanding of the concept of personality, factors affecting personality development
6. To understand proportional body weights and their management
7. To understand nutrition and balance diet

Module	Detailed Contents	Hrs
1	**Physical Fitness** 1. Concept, definition and meaning of Physical fitness, activity and exercise 2. Component of Physical fitness, Benefit of Physical fitness & exercise. 3. Principles of physical fitness 4. Definition and concept of wellness and factors affecting Physical fitness & wellness 5. Concept and importance of physical conditioning, warming up and cooling down of all age groups	8
2	**Nutrition and Dietary Requirement** 1. Nutrition components and balanced diet 2. Meaning and definition of doping and ergogenic aids 3. Prevention and first-aid of common injuries during Physical training 4. Need of Energy, Carbohydrate and Protein 5. Concept training nutrition and competition nutrition	6
3	**Wellness, Weight management and Holistic health** 1. Meaning, concept and components of Wellness 2. Manipulation of energy balance to induce weight loss and weight gain 3. Methods of weight management 4. Concept, types and cause of obesity and its management. 5. Waist hip ratio, larger heart, BMI, calculation of Training Heart Rate	6
4	**Human body system, function and effect of exercise** 1. Meaning and Importance of the study of Human anatomy in physical education & sports 2. Classification and functions of bones and joints 3. Movements of various joints 4. Structural classification of muscle, types of muscle and effect of exercise on the musculoskeletal system. 5. Structure and Effect of exercise on the cardiorespiratory system 6. Digestion and effect of exercise on the digestive system 7. Nervous system and effect of exercise on the nervous system.	6

5	**Yoga and meditation** 1. Concept of Yoga and misconception about Yoga 2. Comparison of Physical Education exercise and Yogic exercise. 3. Meaning, Types and principles of Meditation 4. Principlesgoverning various exercises in Yoga(Asana, Pranayam, Bandha, Mudra, Kriya) 5. Yoga for stress management and emotional stability 6. Application of Yoga in sports & physical education and effect of Yogic exercise on different systems of the human body.	8
6	**General & recreational troop games and its method of skill training** 1. The game soccer and its rules and regulation 2. The game Volleyball, Basketball and its rules and regulations 3. The Indoor games and their rules and regulations 4. Method of sports skill developing training 6.5Recreational games and their importance in day to day life	6

Assessment Scheme:

Term Papers(40 Marks):

Two theory papers will be conducted for 40 marks each with average marks of both papers as the final score. One hour theory paper as per the pattern of the semester-end examination will be conducted.

Projects/Assignments(30 Marks):

Project on Nutrition (10 Marks): The learner will be given one project on the calculation of Basel metabolic rate. He /she will submit the report of the same in a prescribed format based on which the learner will be evaluated for 10 marks by the concerned teacher/s

Projects/Assignment on Yoga education (10 Marks): The learner will be given an assignment on yoga education such as gathering/compiling the information about the various aspects of asanas and asking to prepare and submit the report of the same based on which the concerned subject teacher will give marks out of 10.

Assignments on Sports Injuries (10 Marks): The learner will be given two assignments on the specific sports injuries and their remedial aspects based on the report submitted in the prescribed format by him/her as well as observations, the concerned teacher/s will give marks out of 10.

Physical Activities(25 Marks):

To perform 8 Asanas in a group (10)
To perform one Pranayama and one Kriyas(5)
To perform any five exercises of Motor Fitness. (5)
To perform any five exercises of HRPF(5)

4. Trekking/ Hiking (05 Marks)- The learner should be provided experience of participating in the organization and the actual conduct of the co-curricular activities viz. Hiking/Trekking and the assessment of 05 marks should be done based on learners actual participation and involvement in the same.

References:

1. Padmakshan Padmanabhan 'Handbook of Health & Fitness', Indus Source; First edition, Indus Source Books, Wadala Mumbai. 2014.
2. Adams, William.C. 'Foundation of Physical Education Exercises and Sports Sciences', Lea and Febigor, Philadelphia, 1991.
3. Dr. Kamlesh M.L. 'Principles and History of Physical Education and Sports', Friends Publication (India) New Delhi, 2004
4. Bates M.'Health Fitness Management (2nd Ed.) USA : Human Kinetics.2008
5. Fink, H.H., Burgoon,L.A., & Mikesky. Practical Applications in Sports Nutrition. Canada : Jones and Bartlett Publishers. 2006.
6. Worthington, Vivian. History of Yoga. London : Routledge and Kegan Paul Ltd. 1982.
7. Rajan, M. Yoga Stretching and Relaxation for Sportsman. Delhi : Allied publishers. 1985.
8. Crouch James E. – Essential Human Anatomy A Text – Lea & Febriger , Philladalphia
9. Murgesh N. – Anatomy, Physiology and Health Education, Sathya, Chinnalapatti, 1990
10. Giam, C.K. Sport Medicine Exercise and Fitness. Singapore : P.G. Medical Book.

Course Code	Course Name	Credits
IL 486	**Environmental Management**	3

Objectives:

1. To promote the safety, health, and welfare of people and the environment through engineering professionals.
2. To encourage students to be productive and contributing members of the environmental profession as practitioners, entrepreneurs, researchers, or teachers.
3. To develop environmental awareness among students that meet specified engineering needs with consideration of public health, safety, and welfare, as well as global, environmental, and legal factors.

Outcomes:

On successful completion of the course learner/student will be able to:

1. Understand core concepts and methods from ecological sciences and their application in environmental problem-solving.
2. Recognize different types of toxic substances and analyze toxicological information
3. Acquire and apply environmental knowledge to the engineering field as needed.
4. Assist industries and projects in obtaining environmental clearance and compliance with other environmental laws.
5. Interpret appropriate environment-related legislation.
6. Develop a thorough understanding of practice and procedure followed by various enforcing agencies/bodies/countries.

Module	Detailed Contents	Hrs
1	**Fundamentals of Environmental Sciences** Definition, Principles, and Scope of Environmental Science. Structure and composition of the atmosphere, hydrosphere, lithosphere, and biosphere. Concept of Ecology- Ecosystem, Food chain, Food web, Ecological pyramid, Ecological succession, limiting factor, and carrying capacity. Global Environmental Concerns (Global warming, Loss in Bio-diversity, Ozone depletion, E-waste management) and Renewable Energy Resources (Solar Energy, Wind Energy, Hydrothermal Energy, etc.)	8
2	**Environmental Chemistry** Toxic chemicals: Pesticides and their classification and effects. Biochemical aspects of heavy metals (Hg, Cd, Pb, Cr) and metalloids (As, Se), Sewage treatment, Concept of DO, BOD, and COD. Composition of air-chemical processes in the formation of inorganic and organic particulate matter, Thermochemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry. Photochemical smog, Air Quality Index	8
3	**Fundamentals of Environmental Management** Concept of Environmental Management, Need & Objective of Environmental Management, Role of Engineers in Environmental Management, Career Opportunities. The need for sustainable development, Sustainable Development Goals	5
4	**Scope of Environmental Management** Role and functions of Government as a planning and regulatory agency. Environment Quality Management and Corporate Environmental Responsibility. Total quality Environmental management: ISO 14000, EMS Certification. Environmental Management System Standards (ISO-14000 series). Environment and Social Management Plan	7

5	**Overview of Environmental Laws in India** Constitutional provisions in India (Articles 48A and 51A). Wildlife Protection Act, 1972 Indian Forest Act, Water (Prevention and Control of Pollution) Act, Air (Prevention and Control of Pollution) Act, Environmental (Protection) Act, 1986, The e-waste (Management) Rules 2016,	5
6	**Environmental Conventions and Agreements** Stockholm Conference on Human Environment 1972, Montreal Protocol, 1987, Earth Summit at Rio de Janeiro, 1992, Agenda-21, Convention on Biodiversity (1992), UNFCCC, Kyoto Protocol, 1997, Copenhagen Summit, Paris Agreement, CITES.	6

Assessment Scheme:

Internal Assessment:

Assessment consists of two class tests of 40 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and the second class when 80% syllabus over.

End Semester Examination:

In the question paper weightage of each module will be proportional to the number of respective lecture hours as mentioned in the syllabus.

1. The question paper will comprise 5 questions, each carrying 15 marks.
2. Question number 1 will be compulsory and based on the maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. A total of four questions need to be solved.

References:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G.Oakwell, Edward Elgar Publishing
3. Environmental Management, V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India,2000

Subject Code	Subject Name	Credits
ET 492	Major Project C	04

Course Objectives:

1. The primary objective is to meet the milestones formed in the overall project plan decided in Major Project B.
2. The idea presented Major Project B in should be implemented in Major Project C with results, conclusion and future work.
3. The project will culminate in the production of a thesis by each individual student.

Course Outcomes: Upon successful completion of this course, the learner will be able to

1. Discover potential research areas in the field of Electronics & telecommunication engineering.
2. Conduct a survey of several available literature in the preferred field of study.
3. Compare and contrast the several existing solutions for research challenges.
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified.
6. To report and present the findings of the study conducted in the preferred domain.

Guidelines:

Project Report Format:

At the end of the semester the student needs to prepare a project report which should be prepared as per the guidelines issued by the department. Along with the project report a CD containing: project documentation, Implementation code, required utilities, Software‘s and user Manuals need to be attached.

Term Work:

Students have to submit a weekly progress report to the internal guide and the internal guide has to keep a track on the progress of the project and also has to maintain the attendance report. This progress report can be used for awarding the term work marks. In case of industry projects, visits by internal guides will be preferred to get the status of the project. Distribution of marks for term work shall be as follows:

a. Weekly Attendance on Project Day
b. Project work contributions as per objective
c. Project Report (Hard Bound)
d. Term End Presentation (Internal)

The final certification and acceptance of TW ensures the satisfactory performance on the above aspects.

Oral Exam:

Oral examination of Major Project C should be conducted by Internal and External Examiners. Students have to give a presentation and demonstration on Major Project C.