SYLLABUS

DR VISHWANATH KARAD

MIT - WORLD PEACE UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING–ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

BATCH: 2021 - 25

PROGRAMME STRUCTURE

Preamble:

In the past three decades, we have seen the drastic growth in electronics, communication and computing, giving birth to ICT Technologies. The electronic devices and hardware are getting smaller and more intelligent with the help of advances in network and software technologies. Modern communication needs have made the internet truly pervasive by means of Internet of Things. The role of qualified Electronics and Communication Engineers has become critical in automation, control, core manufacturing, transport, water, environment, pharmaceutical, food processing, disaster management, smart cities and many others. Broadband and ICT technologies have a unique potential to meet the United Nation's sustainable development goals, SDGs, by 2030.

Along with these opportunities, there are many challenges to study and carry out research on electronic materials, devices and circuits, micro-controllers and their interfacing devices, communication technologies and related signal processing, and development of efficient software tools to drive them. Hence, in order to tackle these challenges and leverage the opportunities in the fastest growing electronics, networking and communication industry, MIT-World Peace University (MIT-WPU) has designed a unique Bachelor of Technology (B. Tech.) Program in Electronics and Communication Engineering(Artificial Intelligence& Machine Learning) with emphasis on life skills development and world peace. This Four-year full-time degree provides comprehensive theoretical, practical and real-life knowledge of electronics and communication to match the current and future needs of the Industry.

Dr. Prasad Khandekar Chairman, BoSfor School of Electronics and Communication Engineering and Dean FoET,MIT-WPU	**Dr. Vinaya Gohokar** Professor and Head, School of Electronics and Communication Engineering

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Vision and Mission of the Programme

VISION

To be a recognized leader in Electronics and Communication Engineering education and research with emphasis on social and ethical values

MISSION

To produce quality Electronics and Communication Engineering graduates by providing them education with applied approach and professional values

Programme Educational Objectives

The Electronics and Communication Engineering Graduate will:

- Be widely employed across a range of disciplines in electronics and communication engineering.
- Have ability to tackle interdisciplinary engineering problems.
- Have quest for excellence, leadership qualities, lifelong learning.
- Contribute for the betterment of the society through technology.

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Programme Outcomes (POs)

Electronics and Communication Engineering Graduates will be able to:

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **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.

PO3 **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.

PO4 **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.

PO5 **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.

PO6 **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.

PO7 **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.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **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.

PO11 **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.

PO12 **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.

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Programme Specific Outcomes (PSOs)

Engineering Graduates will be able to:

PSO1 Design variety of modules and systems for applications that includes embedded control and automation

PSO2 Utilize modern modeling and computational techniques, and tools for analyzing and solving trans disciplinary and intra disciplinary systems

PSO3 Demonstrate skills for designing of communication systems and network

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Programme Structure:

(a) Programme duration : Four Years

(b) System followed : Trimester

(c) Credits System:

The outcome-based education, trimester-based credit and grading system is introduced to ensure quality of engineering education. Trimester based credit and grading system enables a much-required shift in focus from teacher centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education.

(i) Per term or per year : Credits are given per trimester
(ii) Total in the programme : 168 Credits

(d) Credits for activities other than academics:

In the curriculum, some credits are given to other activities such as Industry internship/project.

(e) Internship:

The program has rural immersion module as a part of social internship in the first year of study. The student would also have to undergo one full trimester Internship in Industry along with their project work during the final year. These credit-based internships are mandatory for all the students.

(f) Assessment Criteria:

There will be continuous as well as end trimester assessment of a student's performance and grades will be awarded by the Subject Teacher. Various assessment tools such as tests, quizzes, assignments, project, group activities, presentations, etc would be used to evaluate the performance of the students.

(g) Branches or Specializations:

There are B. Tech. (Electronics and Communication) Program has the below specialization tracks:

- Signal Processing
- Communication engineering
- Applied Electronics
- Artificial Intelligence and Machine Learning
- VLSI and Embedded Systems

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(h) Mandatory Attendance to appear for examination:

As per the Examination Ordinance, 2020 of MIT-WPU, the student should have minimum 75% attendance in a trimester considering all concessions such as attendance concession given for sport, sick leave etc. to appear for external examination for that trimester.

(j) Medium of Instruction & Examination: *English*

As per Section 14(a), Academic Ordinance: 2018 of MIT-WPU, in all the Academic Programs, the medium of instruction and examination shall be English.

(k) Eligibility criteria for admission to the programme:

As per Para 4, Academic Ordinance: 2017 of MIT-WPU, the eligibility criteria for First Year B. Tech. admission is as below:

1. Passed HSC or its equivalent examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry or Biotechnology or Biology or Technical Vocational subjects, and obtained at least 50 % marks (at least 45 % marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only) in the above subjects taken together **OR**
2. Passed Diploma in Engineering and Technology and obtained at least 50 % marks (at least 45 % marks, in case of Backward class categories and Persons with Disability candidates belonging to Maharashtra State only)
3. Obtained score in MHT-CET conducted by the Competent Authority. **OR** Obtained score in JEE (Main) conducted by the Competent Authority.

Eligibility Criteria for B.Tech. (Lateral Entry)

1. The candidate should have passed in First Class / First Class with condonation, post SSC Or post HSC diploma course in Engineering / Technology of the Maharashtra State Board of Technical Education (MSBTE) **OR**
2. Any other recognized Diploma equivalent to the Diploma awarded by the Maharashtra State Board of Technical Education (MSBTE) with English as a medium of instruction at Diploma level. **OR**
3. Any other state / Territory Diploma equivalent to MSBTE, approved by AICTE, English as a medium of instruction out of state.

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B. Tech Courses in Electronics and Communication Engineering(AI & ML)

2020-24

A. Definition of Credit:

1 Credit (Theory/Tutorial)	15 Hrs
1 Credit (Laboratory/Project or similar activity)	30 rs

B. Credits:

Total number of credits for four - year B.Tech. Electronics and Communication Engineering Programme would be 168.

B. Structure of Credits for Undergraduate B.Tech. Electronics and Communication Engineering(AI & ML):

S. No.	Category	Suggested Breakup of Credits (Total 168)
1	Humanities and Social Sciences and Peace Programmes including Management courses	19
2	Basic Science courses	31
3	Engineering Science courses including workshop, drawing, Basics of electrical/mechanical/computer etc.	24
4	Professional core courses	58
5	Professional Elective courses relevant to chosen specialization/branch	12
6	Open subjects–Electives from other technical and/or emerging subjects	8
7	Project work, seminar and internship in industry or elsewhere	16
	Total	**168**

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D.CourseCode and Definition:

Coursecode	*Definitions*
L	Lecture
T	Tutorial
ES	Engineering Science Courses
WPC	Humanities and Social Sciences and Peace Programs including Management courses
MEE	Mechanical Engineering Courses
ECE	Electronics and Communication
EEE	Electrical Engineering
CHE	Chemical Engineering
CET	Computer Science and Engineering
POE	Polymer Engineering
CVE	Civil Engineering
PEL	Petroleum Engineering

E.Grading Scheme:

According to Para 12.1 of Academic Ordinances 2017, University shall use trimester /semester / annual as per need of a program. The credit-based system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice-based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning. The University shall follow a 10-point grading system with the following letter grades as given below:

Marks Out of 100	**Grade**	**Grade Point**
80-100	O: Outstanding	10
70-79	A+: Excellent	9
60-69	A: Very Good	8
55-59	B+: Good	7
50-54	B: Above Average	6
45-49	C: Average	5
40-44	Pass	4
0-39	Fail	0
Ab	Absent	NA

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B. Tech. (First Year) (Batch 2020 - 24)
Trimester – I

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1	SCI101B	Linear Algebra and Differential Calculus	BS	30	15		3	-	100	-	50	**150**
2	SCI102B	Physics	BS	30	15	30	3	1	100	50	50	**200**
3	CVE101B	Mechanics	BS	45	-	30	3	1	100	50	50	**200**
4	MEE101B	Workshop Practices	ES	-	-	30	-	1	-	50	-	**50**
5	FET101B	Effective Communication	HSS	15	-	30	1	1	50	50	-	**100**
6	WPC101A	World Famous Philosophers, Sages/Saints and Great Kings	WP	30	-	-	2	-	70	-	30	**100**
7	WPC001A	Yoga - for Winning Personality	WP	-	-	-	-	-	-	-	-	-
		Total:		**150**	**30**	**120**	**12**	**4**	**420**	**200**	**180**	**800**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 300 Hours

Total Credits First Year B. Tech Trimester - I: 16

***** CCA: Class Continuous Assessment

***** LCA: Laboratory Continuous Assessment

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Trimester – II

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1	SCI103B	Integral Calculus	BS	30	15	-	3	-	100	-	50	**150**
2	SCI104B	Chemistry	BS	30	-	30	2	1	50	50	50	**150**
3	MEE102B	Material Science	BS	30	-	-	2	-	50	-	50	**100**
4	MEE103B	Engineering Graphics	ES	30	-	30	2	1	50	50	50	**150**
5	CET101B	Programming and Problem Solving	ES	30	-	30	2	1	50	50	50	**150**
6		Rural Immersion	HSS	-	-	-	-	-	-	-	-	-
7	WPC001A	Yoga - for Winning Personality	WP	-	-	-	-	-	-	-	-	-
		Total:		**150**	**15**	**90**	**11**	**3**	**300**	**150**	**250**	**700**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 255 Hours
Total Credits First Year B. Tech Trimester - I: 14

***** CCA: Class Continuous Assessment
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B. Tech. (First Year) (Batch 2020-24)
Trimester – III

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1	SCI105B	Biology for Engineers	BS	30	-	-	2	-	50	-	50	**100**
2	MEE104B	Design Thinking Laboratory	ES	-	-	30	-	1	-	50	-	**50**
3	ECE101B	Basics of Electrical and Electronics Engineering	ES	45	-	30	3	1	100	50	50	**200**
4	MEE105B	Basics of Mechanical Engineering	ES	30	-	30	2	1	50	50	50	**150**
5	CVE102B	Basics of Civil Engineering	ES	30	-	30	2	1	50	50	50	**150**
6	WPC302A	Study of Languages, Peace in Communications and Human Dynamics	WP	30	-	-	2	-	70	-	30	**100**
7	WPC001A	Yoga - for Winning Personality	WP	-	-	-	-	-	-	-	-	-
		Total:		**165**	-	**120**	**11**	**4**	**320**	**200**	**230**	**750**

Trimester Teaching Hours: 285 Hours

Total Credits First Year B. Tech Trimester - I: 15

Total FY BTech Credits: 16 + 14 + 15 = 45

****Assessment Marks are valid only if Attendance**

* CCA: Class Continuous Assessment

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Trimester – IV

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Signals and Systems	BS	30	15	-	3	-	100	-	50	**150**
2		Electronic Devices and Circuits	ES	30	-	30	2	1	50	50	50	**150**
3		Digital Electronics	ES	30	-	30	2	1	50	50	50	**150**
4		Data Structures and Algorithms	PC	30	-	30	2	1	50	50	50	**150**
5		Sensors and Actuators	PC	-	-	30	-	1	-	50	-	**50**
6		Indian Constitution	HSS	15	-	-	1	-	50	-	-	**50**
		Total:		**135**	**15**	**120**	**10**	**4**	**300**	**200**	**200**	**700**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 270 Hours
Total Credits Second Year B. Tech Trimester - IV: 14

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Trimester – V

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Probability and Statistics	BS	30	15	-	3	-	100	-	50	**150**
2		Integrated Circuits and Applications	PC	30	-	30	2	1	50	50	50	**150**
3		Power Devices and Machines	PC	30	-	30	2	1	50	50	50	**150**
4		Object Oriented Programming	PC	15	-	60	1	2	50	100	-	**150**
5		Environmental Science	BS	15	-	-	1	-	50	-	-	**50**
6		Philosophy of Science and Religion/Spirituality	WP	30	-	-	2	-	70	-	30	**100**
7		National Study Tour										
		Total:		**150**	**15**	**120**	**11**	**4**	**370**	**200**	**180**	**750**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 285 Hours
Total Credits Second Year B. Tech Trimester - V: 15

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Trimester – VI

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Transform Technique and Vector Calculus	BS	30	15	-	3	-	100	-	50	**150**
2		Communication Systems	PC	30	-	30	2	1	50	50	50	**150**
3		Microcontroller and Applications	PC	30	-	30	2	1	50	50	50	**150**
4		Control Systems	PC	30	-	30	2	1	50	50	50	**150**
5		Linux Based Python Laboratory	PC	-	-	30	-	1	-	50	-	**50**
6		Finance and Costing	HSS	30	-	-	2	-	50	-	50	**100**
7		Employment Skills Development - I	AC	-	-	-	-	-	-	-	-	-
		Total:		**150**	**15**	**120**	**11**	**4**	**300**	**200**	**250**	**750**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 285 Hours
Total Credits Second Year B. Tech Trimester - VI: 15
Total SY BTech Credits: 14 + 15 + 15 = 44

***** CCA: Class Continuous Assessment
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B. Tech. (Electronics and Communication Engineering- AI & ML) (Third Year) (Batch 2020-24)

Trimester – VII

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Digital Signal Processing	PC	30	-	30	2	1	50	50	50	**150**
2		Digital Communication	PC	45	-	30	3	1	100	50	50	**200**
3		Machine Learning Algorithm	PC	30	-	-	2	-	50	50	-	**100**
4		Artificial Intelligence	PC	30	-	30	2	1	50	50	50	**150**
5		OE – I[@]	OE	30	-	-	2	-	50	-	50	**100**
6		Indian Tradition, Culture and Heritage	WP	30	-	-	2	-	70	-	30	**100**
7		Employment Skills Development - I	AC	-	-	-	-	-	-	-	-	-
		Total:		**195**	**-**	**90**	**13**	**3**	**370**	**150**	**280**	**800**

****Assessment Marks are valid only if Attendance criteria are met Trimester Teaching Hours: 285 Hours**

***** CCA: Class Continuous Assessment

Total Credits Third Year B. Tech Trimester - VII: 16

***** LCA: Laboratory Continuous Assessment

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Trimester – VIII

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Image Processing and Computer Vision	PC	30	-	30	2	1	50	50	50	**150**
2		Data Science for Engineers	PC	30	-	30	2	1	50	50	50	**150**
3		IoT Architectures and Protocols	PC	45	-	30	3	1	100	50	50	**200**
4		PE – I	PE	30	-	30	2	1	50	50	50	**150**
5		Humanities - Ethical, Moral and Social Sciences	WP	30	-	-	2	-	50	-	50	**100**
		Total:		**165**	**-**	**120**	**11**	**4**	**300**	**200**	**250**	**750**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 285 Hours

Total Credits First Year B. Tech Trimester - VIII: 15

***** CCA: Class Continuous Assessment

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Trimester – IX

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		VLSI Design	PC	30	-	30	2	1	50	50	50	**150**
2		Artificial Neural Network	PC	45	-	30	3	1	100	50	50	**200**
3		PE-II	PE	30	-	30	2	1	50	50	50	**150**
4		OE-II[@]	OE	30	-	-	2	-	50	-	50	**100**
5		Scientific Studies of Mind, Matter, Spirit and Consciousness	WP	30	-	-	2	-	50	-	50	**100**
		Total:		**165**	**-**	**90**	**11**	**3**	**300**	**150**	**250**	**700**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 255 Hours

Total Credits Third Year B. Tech Trimester - IX: 14

Total TY BTech Credits: 16 + 15 + 14 = 45

***** CCA: Class Continuous Assessment

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Trimester – X

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Deep Learning	PC	30	-	30	2	1	50	50	50	**150**
2		Advanced SQL	PC	30	-	30	2	1	50	50	50	**150**
3		PE – III	PE	30	-	30	2	1	50	50	50	**150**
4		PE – IV	PE	30	-	30	2	1	50	50	50	**150**
5		Innovation and Entrepreneurship	HSS	30	-	-	2	-	50	-	50	**100**
		Total:		**150**	**-**	**120**	**10**	**4**	**250**	**200**	**250**	**700**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 270 Hours

Total Credits Final Year B. Tech Trimester - X: 14

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***** LCA: Laboratory Continuous Assessment

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Trimester – XI

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Internship or Capstone Project	PR	-	-	240	-	8	-	400	-	**400**
2		OPE – I/MOOC	OP	30	-	-	2	-	100	-	-	**100**
		Total:		**30**	**-**	**240**	**2**	**8**	**100**	**400**	**-**	**500**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 270 Hours
Total Credits Final Year B. Tech Trimester - XI: 10

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For Capstone Project 100 marks out of 400 are for external review at the end of term.

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B. Tech. (Electronics and Communication Engineering- AI & ML) (Final Year) (Batch 2020-24)
Trimester – XII

Sr. No.	Course Code	Name of Course	Type	Total Hrs.			Credits		Assessment Marks**			
				Theory	Tutorial	Lab	Theory	Lab	CCA*	LCA*	ETT	Total
1		Internship or Capstone Project	PR	-	-	240	-	8	-	400	-	**400**
2		OPE – II/MOOC	OP	30	-	-	2	-	100	-	-	**100**
		Total:		**30**	**-**	**240**	**2**	**8**	**100**	**400**	**-**	**500**

****Assessment Marks are valid only if Attendance criteria are met**

Trimester Teaching Hours: 270 Hours
Total Credits Final Year B. Tech Trimester - XII: 10

***** CCA: Class Continuous Assessment
***** LCA: Laboratory Continuous Assessment

Total Final Year BTech Credits: 14 + 10 + 10 = 34

Total credits of all four years: 45 + 44 + 45 + 34 = 168

For Capstone Project 100 marks out of 400 are for external review at the end of term.

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List of Professional Electives offered by School of ECE

Course Code	PE – I	Course Code	PE – II	Course Code	PE – III	Course Code	PE – IV
	Mechatronics		Microwave and Optical Communication		Network Security		Satellite Communication
	Automotive Electronics		Big Data Analytics		Augmented and Virtual Reality		Test and Testability
	Software Defined Radio		Pattern Recognition		AI Computing Platform		Agriculture Electronics
	Embedded System and RTOS		Robotics and Automation		Industrial IoT		AI in Healthcare
	Natural Language Processing						

List of Open Professional Electives offered by School of ECE

Course Code	OPE – I	Course Code	OPE – II
	Optimization Techniques		Edge Intelligence
	Wireless Sensor Networks		Multimedia Techniques
	Electric Vehicles		Cloud Computing
	Advanced VLSI		Advanced Digital Signal Processing

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Course Code				
Course Category	Basic Science			
Course Title	**Signals and Systems**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**15**	**--**	**2+1+0**

Pre-requisites: Exposure toBasic knowledge of integration, differentiation and complex numbers.

CourseObjectives:

1. Knowledge:
(i)To characterize signals/functions and do manipulations on them.
(ii) To illustrate and analyze the system in time domain.
(iii) To understand frequency domain representation using Fourier transform and Laplace transform.

2. Skills:
(i)To represent the signals and systems in time domain as well as frequency domain.

3. Attitude:
(i) To interpret the signal manipulations and analyze the system response in time domain as well as frequency domain.

CourseOutcomes: After completion of this course students will be able to

1. Understand basic definitions, characteristics of signals and perform time transformations.(CL-III)
2. Analyze LTI system in time domain. (CL-III)
3. Obtain and interpret the signal spectrum using Fourier transform (CL-III)
4. Apply Laplace transform for frequency domain analysis of signals and systems. (CL-III)

CourseContents

Time domain analysis of signals/functions: Classification of signals, elementary signals, operations on signals, sampling theorem. [7 hrs]

Characterization and Time domain Analysis of System: Classification and interconnection of systems, impulse response of Linear time invariant (LTI) systems, convolutional integral, convolution sum, properties of the convolution integral. [8 hrs]

Continuous Time Fourier Transform: Review of Fourier series. Continuous Time Fourier Transform (CTFT), Inverse Fourier Transform, properties of CTFT, correlation, spectral analysis. [8 hrs]

Laplace Transform and its application in stability analysis: Unilateral & Bilateral Laplace Transform, Inverse Laplace Transform, properties of Laplace Transform, Solution of differential equations, characteristic equation, poles and zeros. LTIC system stability analysis using Laplace Transform. [7 hrs]

Tutorials: The tutorials will consist of questions based on following topics

1. Elementary signals
2. Classification of signals
3. Transformation of signals
4. Properties of systems
5. Continuous time convolution
6. Fourier transform
7. Correlation
8. Laplace transform

Learning Resources:

Text Books:

1. Mrinal Mandal and Amir Asaf, *Continuous and Discrete Time Signals and Sys*tems, 1st Edition, New York: Cambridge University Press, 2007
2. B. P Lathi, *Linear Systems and Signals*, 2nd Edition, Oxford University Press, 2005.

Reference Books:

1. Gordon E. Carlson, *Signal and Linear System Analysis.* Wiley, 2nd Edition, 1998
2. Mahmood Nahvi, *Signal and Systems.* McGgraw Hill Education, 1st Edition, 2015.
3. H P Hsu, *Signals and Systems. New Delhi:* Tata McGraw-Hill, 2nd Edition, Schaum"s Outlines

Web Resources:

MOOCs:
https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011

Pedagogy:

- **Power point presentation, videos**

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- **Group activity**

AssessmentScheme:

Class Continuous Assessment (CCA): (100 Marks) (67%)

Mid-term Exam	Active Learning Tool	PBL/ Case Study/Group Activity (Either or both)	MCQ test/Open Book Test	Tutorial
30 (30%)	20 (20%)	15 (15%)	15 (15%)	20 (20%)

Term End Examination: 50 marks (33%)

The term end exam of 50 marks will be based on entire syllabus.

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Time domain analysis of signals/functions:** Classification of signals, elementary signals, operations on signals, sampling theorem	8 hrs		
2	**Characterization and Time domain Analysis of System:** Classification and interconnection of systems, impulse response of Linear time invariant (LTI) systems, convolutional integral, convolution sum, properties of the convolution integral.	8 hrs		
3	**Continuous Time Fourier Transform:** Review of Fourier series. Continuous Time Fourier Transform (CTFT), Inverse Fourier Transform, properties of CTFT, correlation, spectral analysis.	7 hrs		
4	**Laplace Transform and its application in stability analysis:** Unilateral & Bilateral Laplace Transform, Inverse Laplace Transform, properties of Laplace Transform, Solution of differential equations, characteristic equation, poles and zeros. LTIC system stability analysis using Laplace Transform. (7 hours)	7 hrs		

Course Code				
Course Category	**Professional Core**			
Course Title	**Data Structures and Algorithms**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**0**	**30**	**2+0+1**

Pre-requisites: Exposure to Programming and Problem Solving

Course Objectives:

1. Understand the concept of Data Structures using C.
2. Create and manipulate linear data structures like arrays, linked list, stack, and queue.
3. Create and manipulate nonlinear data structures like graphs and tress.
4. Develop the ability to write program in C for problem solving using suitable data structure.

Course Outcomes: After completion of this course students will be able to

1. Develop skills of writing and analyzing algorithms to solve problem. (CL-III)
2. Identify and apply the concept of Linear Data Structures for problem solving and its applications. (CL-III)
3. Demonstrate the usage and applications of stacks and queues. (CL-II)
4. Apply concept of Nonlinear data structure for problem solving and its applications (CL-III)

Course Contents:

Introduction to Data Structures: Data, Data Objects, and Data Structure, Classification of data structure (Primitive and Non-primitive, Linear and Non-linear, Static and dynamic), Arrays, Representation of Polynomials using arrays, addition and evaluation of Polynomials, Analysis of Algorithm.
Searching: Linear Search, Binary Search, Hashing.
Sorting: Bubble Sort, Insertion Sort, Selection Sort, Comparison and analysis of sorting methods. [7 hrs]

Linked List: Introduction to Linked Lists, Dynamic memory allocation, Operations on Singly Linked List, Introduction to Doubly Linked List, Circular Linked List, Polynomial addition using linked list, Case study: Garbage collection. [8 hrs]

StacksandQueues: Stack: Representation of Stack using Array and Linked List, Stack Applications: Reversing List, Arithmetic expressions conversion and evaluation.
Queues: Representation of Queue using Array and Linked List, Circular Queue, Application-Job scheduling in Operating System. [8 hrs]

Non-Linear Data Structure: BinaryTree**:** Basic Terminologies, Properties of Binary Trees,

Representation of Binary Trees, Binary Tree Traversal, Binary Search Trees (BST) and its operations, Reconstruction of Binary Tree, Application of Tree.
Graph: Graph Terminologies, Sequential and Linked Representation of Graph, Creation and Traversal of Graph, Spanning Tree, Minimum Spanning Tree-Kruskal's Algorithm, Prim's Algorithm. [7 hrs]

Laboratory Exercises / Practical:

1. Write a C program to search a number from given list of numbers stored in an array using linear search and binary search.
2. Write a C program to create student database using array of structures and apply sorting techniques.
3. Write a C program to perform following operations on singly linked list: (a) Create (b) Delete (c) Insert (d) Display (e) Search.
4. Write a C program to implement stack using array and evaluate the postfix expression.
5. Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write a C program to simulate the system with simple queue using array. Implement the same system using Circular Queue.
6. Write a C program to perform following operations on Binary Search Tree: (a) Create (b) Search (c) Traverse (in-order, pre-order, post-order recursive)
7. Write a C program to create graph using adjacency matrix and traverse using BFS and DFS method.
8. Mini project.

Extra (Optional):

1. Write a C program for sparse matrix realization and operations on it- Transpose, Fast Transpose.
2. Implement following polynomial operations using Singly Linked List/Circular Linked List: Create, Display, Addition and Evaluation.
3. Implement Stack for infix to postfix conversion.

Learning Resources:

Text books:

1. Horowitz, S. Sahani, S. Anderson-Freed, *Fundamentals of Data Structures in* C, 2nd Edition, Universities Press, 2008.

Reference Books:

1. E. Balgurusamy, *Programming in ANSI.*, New Delhi: Tata McGraw-Hill, 3rd Edition.
2. ISRD Group, *Data Structures Using C.* New Delhi: Tata McGraw Hill, 2nd Edition, 2012.
3. YedidyahLangsam, Moshe J Augenstein, and Aaron M Tenenbaum, *Data structures using C and C++*.New Delhi: 2nd Edition, PHI Publications.

Supplementary Reading:

1. Peter van der Linden, *Experts C Programming*, 1st Edition, Pearson Education
2. Seymour Lipschutz, *Data Structure with C*, 2nd Edition, New Delhi: Tata McGraw-Hill, Schaum's Outlines.

Web Resources:

https://leetcode.com/
www.hackerrank.com/domains/algorithms/warmup

Web links:

www.tutorialspoint.com/data_structures_algorithms/
www.programiz.com/dsa

MOOCs:

www.edx.org/course/foundations-data-structures-iitbombayx-cs213-1x-0

Pedagogy:

- White board
- Group Activities
- Power Point Presentations, Videos
- Co-teaching
- Mini project

Assessment Scheme:

Class Continuous Assessment (CCA)(50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment (LCA) (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: (50 Marks) (33%)

Term end exam of 50 Marks will be based on entire syllabus.

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Course Code				
Course Category	Engineering Sciences			
Course Title	Electronic Devices and Circuits			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	-	30	2+0+1

Pre-requisites: Exposure toBasic Electronics and Electrical Engineering, Engineering Physics

CourseObjectives:

1. Knowledge:

(i) About the construction, working and characteristics of Field Effect Transistors.

(ii) Understand feedback concept and its application in Amplifiers and Oscillators.

2. Skills:

(i) To design MOSFET Amplifier.

(ii)To demonstrate the applications of semiconductor devices.

3. Attitude:

(i) To design and verify circuits using hardware and simulation tools.

(ii)To analyse semiconductor device behaviour using small signal low and high frequency models.

CourseOutcomes: After completion of this course students will be able to

1. Understand basics of Field Effect transistor. (CL-II)
2. Analyse and Design MOSFET amplifier at Low and High Frequencies (CL-IV)
3. Build and Test circuits using semiconductor devices (CL-II)
4. Apply knowledge of feedback for various applications (CL-III)

CourseContents:

Field Effect Transistor: Why FET over BJT, Introduction to JFET, N-Channel Enhancement mode MOSFET construction and working, Ideal and Non-Ideal characteristics, Comparison of NMOS-PMOS, DC Analysis, Constant resistance operation of MOSFET. [6 hrs]

AC Analysis of MOSFET Amplifier: Comparison of CS, CD, CG Amplifier, AC Analysis of CS amplifier, Small Signal Equivalent Model, High Frequency Model, Frequency Response of CS Amplifier. [8 hrs]

MOSFET Applications and Special Semiconductor Devices: MOSFET Scaling, MOSFET capacitances, DC Analysis of CMOS inverter, Bi-CMOS Technology: Bi-CMOS inverter, Recent trends in semiconductor devices. [8 hrs]

Feedback Amplifiers and Oscillators: Classification of amplifier, Feedback topologies, Analysis of

feedback amplifiers, Oscillators (RC, LC, Crystal). [8 hrs]

Laboratory Exercises / Practicals:

1. Verification of Ideal and Non-Ideal Characteristics of MOSFET.
2. Design, Simulate and Build MOSFET as an Amplifier.
3. Build and Test MOSFET as a Switch and CMOS Inverter.
4. To plot characteristics of Photo diode/ Solar Cell/ Opto-Coupler.
5. Application based on special semiconductor devices (Photo diode/ Solar Cell/ Opto-Coupler/Graphene).
6. Simulate, Build and Test Voltage-Series Feedback Amplifier.
7. Simulate, Build and Test Current Series Feedback Amplifier.
8. Design, Simulate or Build RC/LC/Crystal Oscillator.
9. **Project Based Learning (PBL)**

Project based preferably on following topics using discrete components.

Simple inverter (Standard), Electronic load bank design up to 1A, Solar PV panel inverter, Battery inverter, Opto-couplers for revolution measurement or Counting, Obstruction detection (Counting conveyor objects), Light dependent Switches, Audio Amplifiers class D using MOSFET, Push Pull Amplifier types, coupled amplifiers, Audio tune generation using audio oscillator, Bio-FET, Chem-FET as sensors, Simple SMPS using MOSFET and ICs with different voltages and duty cycle up to1A load, Application of MOSFET as driver, PL493, Regulating PWM using LM3524.

LearningResources:

Text books:

1. D. Neamen, Electronic Circuits Analysis and Design. New Delhi: Tata McGraw Hill Education Private Limited, 3rd Edition, 2007.
2. S. Kang and Y. Leblebici, CMOS Digital Integrated Circuits Analysis and Design. USA: McGraw Hill Higher Education, 4th Edition, 2014.
3. T. Floyd, Electronic Devices, USA: Prentice Hall, 9th Edition, 2012.

Reference Books:

1. D. Neamen, *Microelectronics: Circuit Analysis and Design,* Tata McGraw Hill Education Private Limited, 4th Edition, 2009.
2. J. Millman, C. Halkias, and C. Parikh, *Integrated Electronics,* McGraw Hill Education, 2nd Edition, 2013.
3. Irving M. Gottlieb, *Regulated Power Supplies*, 4th Edition, Tab Books Tata McGraw Hill.
4. Abraham I. Pressman, *Switch Mode Power Supply Design,* 3rd Edition, Tata McGraw Hill Education Private Limited.

Supplementary Reading:

Texas, Signetics, Silicon Labs, ON Semiconductors Datasheets.

Web Resources:

Web Links:
https://www.thierry-lequeu.fr/data/SMPSRM.pdf
https://www.electronics-tutorials.ws/transistor/tran_6.html
https://www.alldatasheet.com/

MOOCs:
https://nptel.ac.in/courses/117/106/108106105/

Pedagogy:

- Project Based Learning
- Power Point Presentations, Videos
- Virtual Labs

AssessmentScheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)

Term end exam of 50 Marks will be based on entire syllabus.

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Field Effect Transistor:** Why FET over BJT, Introduction to JFET, N-Channel Enhancement mode MOSFET construction and working, Ideal and Non-Ideal characteristics, Comparison of NMOS-PMOS, DC Analysis, Constant resistance operation of MOSFET	6	4	
2	**AC Analysis of MOSFET Amplifier:** Comparison of CS, CD, CG Amplifier, AC Analysis of CS amplifier, Small Signal Equivalent Model, High Frequency Model, Frequency Response of CS Amplifier.	8	4	
3	**MOSFET Applications and Special Semiconductor Devices:** MOSFET Scaling, MOSFET capacitances, DC Analysis of CMOS inverter, Bi-CMOS Technology: Bi-CMOS inverter, Recent trends in semiconductor devices.	8	11	
4	**Feedback Amplifiers and Oscillators:** Classification of amplifier, Feedback topologies, Analysis of feedback amplifiers, Oscillators (RC, LC, Crystal).	8	11	

Course Code				
Course Category	Engineering Sciences			
Course Title	Digital Electronics			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	-	30	2+0+1

Pre-requisites: Exposure to Basics of Electrical and Electronics Engineering.

Course Objectives:

1. **Knowledge**
   - (i) To introduce the concepts of digital logic families.
   - (ii) To introduce Boolean expression reduction techniques.
   - (iii) To acquainting students with microprocessor architecture and software tools for coding.
2. **Skills**
   - (i) To design and analyze the combinational & sequential logic circuits
   - (ii) To design and analyze finite state machines
   - (iii) To develop assembly level programming skills
3. **Attitude**
   - (i) Apply the knowledge gained in the design of Counters, Registers and A/D & D/A converters.

Course Outcomes: After completion of this course students will be able to

1. Understand the concepts of digital logic families and reduction techniques. (CL-II).
2. Design and analyze combinational & sequential logic circuits (CL-III).
3. Develop state machines for various applications (CL-III)
4. Write efficient codes in assembly language, and debug using software tools (CL-III)

Course Contents:

Combinational Logic Design: Introduction to digital logic families, Minimization of logic functions using K map, Design examples: Arithmetic circuits, Comparator, Code converters, Parity generators and checkers, BCD to 7 segment decoder, Multiplexers, De-multiplexers**. [8 Hrs]**

Sequential Logic Design: 1-bit Memory Cell, Flip flops, Conversion of flip flops, Shift registers, Applications of Shift registers (ring and twisted ring counters), Pulse train generator, Design of ripple counters and synchronous counters, Lock out condition. [8 Hrs]

Finite State Machines: Synchronous sequential circuits,Concept of Moore and Mealy machines, Basic design steps, Finite state machine design, Sequence detector. [6 Hrs]

Introduction to Microprocessor: Introduction to 8086, Microprocessor architecture, Memory segmentation, Programmer's model, addressing modes, Instruction set, Assembly language programming. [8 Hrs]

Laboratory Exercises / Practicals:

1. Design and Implement Code Converters using basic logic gates
2. Design and Implement Combinational Logic Design using MUX/Decoder ICs
3. Design and Implement MOD-N asynchronous counter using JK- Flip flop
4. Design and implement Synchronous Counter
5. Design and implement Sequence Detector
6. Design and implement finite state machine (Simulation)
7. Assembly language program for addition & subtraction of two 2-digit numbers
8. Assembly language program for multiplication/Division of two 2- digit numbers
9. Design and implement Digital Electronics Application. (PBL)
10. Design and implement project for providing real time solutions using Microcontrollers Boards. (PBL)

Learning Resources:

Text Books:

1. Thomas L. Floyd, *Digital Fundamentals,* Pearson Education, 11th Edition, 2015
2. R.P. Jain, *Modern Digital Electronics,* New Delhi: Tata McGraw-Hill, 4th Edition, 2009
3. Hall, D. V., *Microprocessors and Interfacing,* New Delhi: Tata McGraw Hill, 2nd Edition, 2006

Reference Books:

1. J. F. Wakerly, *Digital Design: Principles and Practices*, Pearson Education, 3rd Edition
2. Anand Kumar, *Fundamentals of Digital Circuits,* PHI Publication, 4th Edition, 2016

Web Resources:

http://tlc.iith.ac.in/arduino.html
https://nptel.ac.in/courses/108/105/108105132/

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Leaning Methods
- Project Based Learning

AssessmentScheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)
Term end exam of 50 Marks will be based on entire syllabus

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Combinational Logic Design:** Introduction to digital logic families, Minimization of logic functions using K map, Design examples: Arithmetic circuits, Comparator, Code converters, Parity generators and checkers, BCD to 7 segment decoder, Multiplexers, De-multiplexers.	8	9	
2	**Sequential Logic Design:** 1-bit Memory Cell, Flip flops, Conversion of flip flops, Shift registers, Applications of Shift registers (ring and twisted ring counters), Pulse train generator, Design of ripple counters and synchronous counters, Lock out condition.	8	9	
3	**Finite State Machines:** Synchronous sequential circuits,Concept of Moore and Mealy machines, Basic design steps, Finite state machine design, Sequence detector.	6	6	
4	**Introduction to Microprocessor:** Introduction to 8086, Microprocessor architecture, Memory segmentation, Programmer's model, addressing modes, Instruction set, Assembly language programming.	8	6	

Course Code	
Course Category	**Professional Core**
Course Title	**Sensors and Actuators**

Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	-	-	30	0+0+1

Pre-requisites: Exposure to basics of Electrical and Electronics Engineering

CourseObjectives:

1. Knowledge:

(i) To measure various physical parameters using sensors and interpret the data acquired and measured results

(ii) To understand use of various actuators for real world applications

2. Skills:

(i) Make use ofArduino IDE to interface Sensors and Actuators

3. Attitude:

(i) To select the appropriate sensor and actuator for given application

CourseOutcomes: After completion of this course students will be able to

1. Analyze and select the most appropriate sensors or actuator for an application. (CL-II)
2. Design and construct the appropriate interface circuits for the sensors and actuators. (CL-IV)
3. Make use of Arduino to interface sensors and actuators. (CL-II)
4. Take part in team work and be able to learn technical communication skills. (CL-IV)

Laboratory Exercises / Practicals:

1. **Study and performance analysis of Sensors required for measuring various physical parameters.**
   Case study for temperature measurement: study and comparative analysis of Thermistor, Thermocouple and LM35 for temperature measurement.
2. **Study and performance analysis of actuators required for controlling devices.**
   Case study for Relay: study and comparison of different types of Relay and understanding selection for the given application.
3. **Introduction to Arduino as open-source hardware:** Understanding Arduino programming basics through IDE and LED interfacing.
4. **Understanding digital input and digital output:** Interfacing digital sensors (minimum two sensors) and LCD display with Arduino.
5. **Understanding analog input of Arduino:** Interfacing analog sensors (minimum two sensors) and plotting output on serial monitor.
6. **Understanding UART (Universal Asynchronous Reception and Transmission):** Connecting two Arduino boards and establish communication serially.
7. **Interfacing and speed control of DC motor with Arduino:** Generate PWM with varying duty cycle using Arduino, observe the waveform on DSO and use it for speed control of

DC Motor.

8. **Introduction to RFID and interfacing with Arduino for simple application development.**
9. **Comparative study of sensors for measuring physical parameters:** (Group of 2/3 students can be assigned a physical parameter and find possible sensors for measurement and present the comparative analysis).
10. **PBL:** Project as a group activity based on Sensors and Actuators using Arduino or similar hardware platform. Write comprehensive Report on the project.

LearningResources:

Text Book:

1. Patranabis D., *Sensor and Actuators*, 2nd Edition., Prentice Hall of India (Pvt) Ltd.
Monk, Simon. *Programming Arduino: getting started with sketches*. McGraw-Hill Education, 2016.

Web Resources:

Datasheet:https://www.alldatasheet.com/datasheetpdf/pdf/241077/ATMEL/ATMEGA328P.html
https://www.digikey.in/en/blog/investigating-a-relay-experiment-7

Coursera:
https://www.coursera.org/learn/interface-with-arduino

Pedagogy:

- Power Point Presentations, Videos
- Hands on practices
- Group Activities

AssessmentScheme:

Laboratory Continuous Assessment: (50 Marks) (100%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Course Code	
Course Category	**Basic Sciences**

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Course Title	Probability and Statistics			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	15	--	2+1+0

Pre-requisites: permutation and combination, set theory.

Course Objectives:

1. To understand the concepts of statistical summary measures.
2. To learn discrete and continuous probability distributions models.
3. To learn about parametric tests used in hypothesis testing.

Course Outcomes:

After completion of this course students will be able to

1. Use statistical methodology and tools in the engineering problem-solving process. (CL III)
2. Use knowledge of basic probability theory in related engineering problems. (CL III)
3. Analyse the given probabilistic model of the problem. (CL IV)
4. Use statistical tests in testing hypothesis on data construct confidence intervals on parameters for a single sample. (CL III)

Course Contents:

Descriptive Statistics: Measures of central tendency, measures of dispersion, moments, skewness and kurtosis, correlation, least square approximation-fitting of straight line and second- degree parabola, Linear regression. [8 hrs]

Introduction to Probability and random variables: Basic probability, conditional probability, independent events, Bayes' theorem, random variables, distribution function for discrete and continuous random variables, cumulative distribution function, joint distribution and joint density function, mathematical expectation and variance. [8 hrs]

Probability distributions: Standard discrete distributions- Binomial distribution, Poisson distribution, exponential distribution and Geometric distribution. Standard continuous distribution- Normal distribution. [7 hrs]

Estimation and Testing of Hypothesis: Sampling and estimation of parameters, Standard error, Statistical hypothesis, testing a hypothesis, one and two tailed tests of Hypothesis, Type I and Type II errors, level of significance, Chi - Square test, Students t- test, F-test. [7 hrs]

Tutorial Exercises:

1. Measures of central tendency and dispersion, Coefficient of variation
2. Moments, skewness and kurtosis
3. correlation

4. Least square approximation, regression.
5. Conditional probability, Baye's rule
6. Probability distribution functions
7. Expectation and variance, joint distribution and joint probability distribution
8. Binomial, Poisson
9. Geometric distribution and Exponential distributions
10. Normal distribution
11. Chi square test
12. Students t test
13. F- test

Two tutorials will be conducted using Mathematical Software. Tutorial shall be engaged in four batches (batch size of 15 students) per division.

Learning Resources:

Reference Books:

1. Ross Sheldon M., *Introduction to Probability and Statistics for Engineers and Scientists*, 5th Edition, 2014.
2. Gupta S. C. and Kapoor V. K., *Fundamentals of Applied Statistics*, 3rd Edition, S. Chand and Sons, New Delhi, 1987.
3. De Groot Morris H. and Schervish Mark J., *Probability and Statistics*, 4th Edition, Pearson New International Edition, 2010

Web Resources:

Web links:

https://nptel.ac.in/courses/111/105/111105041/#
https://nptel.ac.in/courses/111/102/111102098/

MOOCs: NPTEL, MIT OPEN COURSEWARE

Pedagogy:

- Team Teaching
- Tutorials and class tests
- Video technique

Assessment Scheme:

Class Continuous Assessment (CCA): 100 marks (67%)

Assignment / short term Question answers Tests	Tutorial	Mid Term Test	Presentations	Case study	MCQ	Oral	Total
20 Marks (20%)	50 Marks (50%)	30 Marks (30%)	--	--	--	--	100 Marks

Laboratory Continuous Assessment (LCA):NA

Regularity and punctuality	Understanding of objective	Understanding of procedure	Experimental skills	Ethics

Term End Examination: 50 Marks (33%)

Module No.	Contents	Workload in Hrs		
		Theory	Tutorial	Assess
1	**Descriptive Statistics:** Measures of central tendency, measures of dispersion, moments, skewness and kurtosis, correlation, least square approximation-fitting of straight line and second-degree parabola, Linear regression.	8	4	-
2	**Introduction to Probability and random variables:** Basic probability, conditional probability, independent events, Bayes' theorem, random variables, distribution function for discrete and continuous random variables, cumulative distribution function, joint distribution and joint density function, mathematical expectation and variance	8	3	--
3	**Probability distributions:** Standard discrete distribution- Binomial distribution, Poisson distribution, exponential distribution and Geometric distribution. Standard continuous distribution- Normal distribution.	8	3	-

4	**Estimation and Testing of Hypothesis:** Sampling and estimation of parameters, Standard error, Statistical hypothesis, testing a hypothesis, one and two tailed tests of Hypothesis, Type I and Type II errors, level of significance, Chi - Square test, Students t- test, F-test.	8	3	-

Prepared By	**Checked By**	**Approved By**
Prof. Vaishali M. Joshi School of Mathematics & Statistics, MITWPU, Pune	Dr Prashant Malavadkar HOS, Mathematics and Statistics MITWPU, Pune	Prof. (Dr.) Shubhalaxmi Joshi Associate Dean, Faculty of Science, MITWPU, Pune

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Course Code				
Course Category	Professional Core			
Course Title	Integrated Circuits and Application			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	-	30	2+0+1

Pre-requisites: Exposure to Electronic Devices and Circuits, Digital Electronics

CourseObjectives:

1. **Knowledge:**
   (i)To introduce basics of the Op- amp and its parameters.
   (ii) To design and test various linear op-amp applications
   (iii) To design and test various non-linear Op- amp applications
   (iv) Study, design and test convertors and various active filters.

2. **Skills:**
(i) Able to classify op-amp based on specifications as per the need from datasheet.
(ii)To design linear and non -linear op-amp applications.

3. **Attitude:**
   (i)Should be able to design and validate the performance using hardware components or simulation.

CourseOutcomes: After completion of this course students will be able to

1. Classify Op-amps, identify parameters for a particular application. (CL-II)
2. Design and test linear applications of Op-amp. (CL-VI)
3. Design and test non-linear applications of Op-amp. (CL-VI)
4. Design, build and test convertors and various types of active filters for given specifications. (CL-VI)

CourseContents:

Op-amp Fundamentals: Basic building blocks of Op-amp, fundamentals of differential amplifier and their types, DC and AC analysis and study of Op- amp parameters. [7 hrs]

Linear Applications: Different Op-amps Configurations, Integrator, Differentiator, Instrumentation Amplifiers, Bridge Amplifiers. [8 hrs]

Non-Linear Applications: Comparators, Schmitt trigger, Precision rectifiers, square wave, and triangular wave generators. [7 hrs]

Convertors and Active filters: V to F and / F to V converters using IC LM331, V to I, I to V, DAC, ADC, Classification of filters based on order, alignment, and function, Sallen and Key topology and study of Phase Locked Loop (PLL), Introduction to Mixed signal processing Integrated Circuit like MAX 31855/MAX31865/ ADUX1020 or equivalent.[8 hrs]

Laboratory Exercises / Practicals:

1. Measurement of Op-amp parameters: Input offset voltage, input offset current and bias current, Slew rate. External Offset Nulling. (OP-07C, LF 356, LM741C)
2. Design and build Summing amplifier/Averaging/ Integrator for given specifications.
3. Design and build Instrumentation amplifier (3 Op-amp based) for given specifications and validate performance using IC AD620 or equivalent.
4. Design and build inverting Schmitt trigger (Symmetric and Asymmetric) for given specifications and study performance of comparators IC's like LM311/LM339.
5. Design and build various configurations of Precision rectifier. Use Schottky diodes. Application in Piezo generators. (HWR and FWR).
6. Design and build Square wave and triangular wave generator for given specifications with variable duty cycle and voltage limiters. Study of Waveform generator IC 8038.
7. Design and build Active LPF/ HPF for given specification for 1st and 2nd order filters.
8. Design a 2-bit R-2R DAC and simulate 2-bit flash ADC. Verify performance using ICs for eg. MC1408(DAC) or equivalent, ADC0808 or equivalent.
9. **Project based on following topics using Analog ICs.**
   Pulse/ RPM measurement using combination of opto-coupler, Schmitt trigger and F to V, Constant Current source for temperature measurement using RTD, DPM (7109 Intersil), Application of op-amp for measurement of temperature using RTD.

LearningResources:

Text Books:

1. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*. New Delhi: PHI, 4th Edition, 2015

Reference Books:

1. S. Salivahanan and V. S. Kanchana Bhaaskaran, *Linear Integrated Circuits*, New Delhi: McGraw Hill Education Pvt. Ltd, 2nd Edition, 2014
2. Sergio Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, 4th Edition, Tata McGraw Hill.

Web Resources:

Weblinks:
https://nptel.ac.in/courses/122/106/122106025/

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MOOCs:

https://onlinecourses.nptel.ac.in/noc21_ee31

Pedagogy:

- Power Point Presentations, Videos
- Project Based Learning

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)

Term end exam of 50 Marks will be based on entire syllabus

Module No.	Contents	Workload in Hours		
		Theory	Lab	Assess
1	**Op-amp Basics:** Block diagram of Op-Amp, Differential Amplifier configurations, DC and AC analysis, Level shifter, current mirror, Op-amp parameters, effect of temperature on parameters, frequency response of Op-amp	7	3	
2	**Linear Applications:** Inverting and Non-inverting amplifier, voltage follower. Summing, averaging scaling amplifier, difference amplifier, Integrator ideal and practical, differentiator ideal and practical,	8	6	

	Instrumentation Amplifier, Bridge Amplifiers.			
3	**Non-Linear Applications**: Voltage comparators, Schmitt trigger, Precision rectifiers, square wave and triangular wave generators.	7	9	
4	**Convertors and Active Filters**: V to F, F to V using IC LM331, V to I, I to V, DAC and ADC basics. Need of active filters, classification based on order, alignment and function, Sallen and Key topology, LPF, HPF, BPF, BRF and All pass filter, first order and second order, Phase Locked Loop using IC 565.Introduction to Mixed signal processing Integrated Circuits like MAX 31855/MAX31865/ ADUX1020 or equivalent.	8	6	
5	**Project Based Learning**	-	6	

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Course Code				
Course Category				
Course Title	**Power Devices & Machines**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**-**	**30**	**2+0+1**

Pre-requisites: Primary knowledge of Electronics and Electrical

Course Objectives:

1. **Knowledge**:
   (i)To learn construction, principle & applications of important electrical machines.
   (ii) To learn the basics of switch used in Power electronics
   (iii) To gain knowledge of various power conversion systems and their applications.

2. **Skills:**
   (i) To be able to use electric motors for different applications.
   (ii) To be able to select appropriate power device for a particular application.
   (iii) To develop competency in various power conversion circuits

3. **Attitude**:
   (i)To develop attitude to analyse various motors.
   (ii)To develop attitude to apply required power conversion effectively.

Course Outcomes: After completion of this course students will be able to

1. Demonstrate and explains various features power switches. (CL-I)
2. Understand, design and analyse various power conversion circuits (CL-II)
3. Illustrate the basic structure, characteristics of important electrical motors (CL-II)
4. Apply suitable motor for particular application (CL-III)

Course Contents:

DC & AC Motors: Construction, principle, working, characteristics, speed control and applications of D.C. motors and Three -phase induction motor, Regenerative breaking used for hybrid vehicles, Basic concept of four quadrant drive used for e-Vehicles. [8 hrs]

Power devices: Study of SCR, MOSFET and TRIAC with reference to Construction, Operation, Static characteristics, Switching characteristics and specifications. [7 hrs]

AC to DC & DC to AC converters: Introduction to Phase controlled Rectifiers: Concept of line & forced commutation, Single phase Full converters for R & R-L loads, Effect of freewheeling diode.
Introduction to DC- AC converters: Inverter Working principle of single phase, Bridge inverter for R & R-L load. [8 hrs]

DC - DC converters & AC Voltage controller: DC Chopper, working principle of step-down chopper, control strategies, Step down chopper for R-L load, Step- up chopper, Working of UPS- On line and off line.
Single phase AC voltage controller for R load. [7 hrs]

Laboratory Exercises:

1. DC motor: -Speed control of DC motor using armature voltage and field control method.
2. DC motor: -Load test on DC motor using direct loading method.
3. Three phase induction motor: - To plot speed-torque characteristic of three phase induction motor.
4. V/F Speed control of Induction Motor
5. Study of Characteristics of SCR / MOSFET
6. SCR Firing Circuits
7. Full Control Bridge Rectifier Circuit
8. Inverter circuit: To study the operation of a single-phase square wave inverter
9. AC regulator: AC phase control of SCR- Observe load voltage waveform, Measurement of firing angle, average voltage across load, verification of theoretical values with practically measured values
10. DC chopper: To measure effect of duty cycle on average load voltage for DC chopper.

Learning Resources:

Text Books:

1. D P Kothari and I J Nagrath, *Electrical Machines*, Tata McGraw Hill, 3rd Edition
2. Guru, Hiziroglu, *Electric Machinery & Transformer,* 3rd Edition, The Oxford Series in Electrical and Computer Engineering
3. M. D. Singh & K B Khanchandani, *Power Electronics*, 2nd Edition, TMH, New Delhi.

Supplementary Reading:

1. Edward Hughes, John Hiley, Ian McKenzie-Smith, Keith Brown, Hughes *Electrical and Electronic Technology*, Pearson Education, 12th Edition, 2016.
2. M. H. Rashid, *Power Electronics circuits devices and applications*, PHI 3rd Edition, 2004, New Delhi.
3. P.C. Sen, *Modern Power Electronics*, 2nd Edition, S Chand & Co New Delhi.

Web Resources:

Electrical machines- https://nptel.ac.in/courses/108/105/108105159/

Weblinks:
https://www.coursera.org/specializations/power-electronics
https://www.mooc-list.com/tags/power-electronics

Pedagogy:

- Power Point Presentations, Videos
- Group Activities

Assessment Scheme:

Class Continuous Assessment (CCA):(50 Marks) (33%)

Assignments	Test	Presentations	Case study	MCQ	Oral	Initiative
20 Marks (40%)	15 Marks (30%)	--	--	10 Marks (20%)	--	05 (10%)

Laboratory Continuous Assessment (LCA):(50 Marks) (33%)

Practical Experiments	Oral based on practical	Site Visit	Mini Project	Problem based Learning	Any other
20 Marks (40%)	15 Marks (30%)	--	--	15 Marks (30%)	--

Term End Examination: 50 Marks (33%)
Term end exam of 50 Marks will be based on entire syllabus.

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Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**DC & AC Motors:** Construction, principle, working, characteristics, speed control and applications of D.C. motors and Three -phase induction motor, Regenerative breaking used for hybrid vehicles, Basic concept of four quadrant drive used for e-Vehicles.	8	12	
2	**Power devices:** Study of SCR, MOSFET and TRIAC with reference to Construction, Operation, Static characteristics, Switching characteristics and specifications.	7	6	
3	**AC to DC & DC to AC converters**: Introduction to Phase controlled Rectifiers: Concept of line & forced commutation, Single phase Full converters for R & R-L loads, Effect of freewheeling diode. Introduction to DC- AC converters: Inverter Working principle of single phase, Bridge inverter for R & R-L load.	8	6	
4	**DC - DC converters & AC Voltage controller**: DC Chopper, working principle of step-down chopper, control strategies, Step down chopper for R-L load, step-up chopper, Working of UPS- On line and off line. Single phase AC voltage controller for R load.	7	6	

Prepared By
Prof. Dr.SaketYeolekar
Prof. Anjali Purohit

Checked By

Approved By
Prof. Dr. Bharat Chaudhari
Head, School of Electrical Engineering.

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Course Code				
Course Category	Professional Core			
Course Title	Object Oriented Programming			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	15	0	60	1+0+2

Pre-requisites: Exposure to Data Structures and Algorithms

Course Objectives:

1. Knowledge:

(i) Concept of object-oriented programming through C++

(ii) Concept of object-oriented programming through JAVA

(iii) Understand the concept of SQL Programming language and apply in DBMS

2. Skills:

(i) To write program in C++ for problem solving and simple applications.

(ii) To write program in C++ and Java for problem solving and simple applications.

(iii)To write program in SQL for DBMS application

3. Attitude:

(i)To develop programs in C++ and JAVA by making effective use of OOP principles.

(ii) To write effectively SQL programs for handling and managing database.

Course Outcomes: After completion of this course students will be able to

1. Demonstrate the principles of object-oriented programming in C++ and JAVA. (CL-II)
2. Apply the concept of Polymorphism and Inheritance in C++ for problem solving. (CL-III)
3. Apply the concept of Inheritance, Package and Multithreading in JAVA for problem solving. (CL-III)
4. Demonstrate Database Relational Model and apply SQL concepts for database programming. (CL-II)

Course Contents:

Concepts of OOP using C++: Design Principles of OOP, Reference Variables, Functions, Arrays, String, Class, Objects Array of Objects, Objects as Function Arguments. Friendly Functions Constructors and Destructors. [4hrs]

Polymorphism and Inheritance in C++: Concept of Operator overloading, Function Overloading, Inheritance, Types of Inheritance, Constructors in Derived Classes. [3 hrs]

Java Programming: Java overview**,** Classes, Objects, Constructors, Method Overloading, Static variables, static methods, final, Arrays, Strings, Inheritance: Types, Using Super, Constructors in derived class, Method overriding, InterfacesPackages, Multithreading [4hrs]

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SQL Programming: Introduction to DBMS and Data Modeling, Introduction to SQL, SQL Data Types, DDL Commands, DCL Commands. SQL Queries: DML PL/SQL Concepts: PL/SQL Functions and Procedures[4hrs]

Laboratory Exercises / Practical:

1. Write a program in C++
   A. To sort the numbers in an array using functions. Write swap function using call by reference.
   B. To implement operations on matrix using class.
2. Write a program in C++
   A. To perform arithmetic operations on complex numbers using class concept. Use constructor and destructor.
   B. To implement string class and perform string operations.
3. Write a program in C++ to implement concept of
   A. Operator overloading.
   B. Function overloading.
4. Write a program in C++ to implement different types of inheritance.
5. Write a program in Java
   A. To implement simple arithmetic operations such as add, subtract, multiply, divide, factorial using methods.
   B. To sort i) List of integers ii) List of names.
6. Write a Java program to create database using the concept of Inheritance
7. Write a program in JAVA
   A. To create and import user defined package
   B. To implement multiple threading.
8. SQL- DDL commands (Create, Alter, Drop, Truncate Rename, Describe), DCL (Grant, Revoke)
9. SQL- DML (Insert, Update, Delete), SQL Select- Logical IN, Negation, NULL, Comparison Operators. Where Clause, Between AND, Exists, ALL, LIKE
10. SQL Queries on: Functions-Single Row, Aggregate Functions, Data Sorting, Subquery, Joins (Inner, Outer, Natural, Self), Group by-Having, Set Operations, View. TCL Commands (Rollback, Commit, Savepoint)
11. Mini project based on C++
12. Mini project based on JAVA
13. Mini project based on SQL

Learning Resources:

Text Books:

1. E Balagurusamy, *Object OrientedProgramming with C++*. New Delhi: Tata McGraw Hill, 3rd Edition.
2. Herbert Schildt, *Java: The complete reference*. New Delhi: Tata McGraw Hill, 7th Edition.
3. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, *Database System Concepts* 6th Edition, McGraw Hill, 2010.

Reference Books:

1. Robert Lafore, *Object Oriented Programming in C++*.Sams Publishing, 4th Edition.
2. T. Budd, *Understanding OOP with Java*, updated Edition, Pearson Education.
3. Ramakrishnan, R. and Gherke, J., *Database Management Systems*, 3rd Edition, McGraw-Hill.
4. Connally T, Begg C., *Database Systems*, 6th Edition, Pearson Education

Web Resources:

https://www.geeksforgeeks.org/java/
https://www.geeksforgeeks.org/c-plus-plus/
https://www.tutorialspoint.com/java/
https://www.tutorialspoint.com/cplusplus/index.htm
https://www.khanacademy.org/
https://nptel.ac.in/
https://www.studytonight.com/cpp/cpp-and-oops-concepts.php

Pedagogy:

- Power Point Presentations
- Videos
- Co-teaching
- Group Activities
- Mini project

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

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Laboratory Continuous Assessment (LCA): 100 Marks (67%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation*
30 (30%)	30 (30%)	40 (40%)

*PBL – to be evaluated

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Concepts of OOP using C++:** Design Principles of OOP, Reference Variables, Functions, Arrays, String, Class, Objects Array of Objects, Objects as Function Arguments. Friendly Functions Constructors and Destructors	4	6	
2	**Polymorphism and Inheritance in C++:** Concept of Operator overloading, Function Overloading, Inheritance, Types of Inheritance, Constructors in Derived Classes.	3	8	
3	**Java Programming:** Java overview**,** Classes, Objects, Constructors, Method Overloading, Static variables, static methods, final, Arrays, Strings, Inheritance: Types, Using Super, Constructors in derived class, Method overriding, InterfacesPackages, Multithreading	4	8	
4	**SQL Programming:** Introduction to DBMS and Data Modeling, Introduction to SQL, SQL Data Types, DDL Commands, DCL Commands. SQL Queries: DML PL/SQL Concepts: PL/SQL Functions and Procedures	4	8	

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Course Code				
Course Category	**Basic Sciences**			
Course Title	**Transform Technique & Vector Calculus**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**15**	**--**	**2+1+0**

Pre-requisites: Linear Algebra and Differential Calculus, Integral Calculus (F. Y. B. Tech)

Course Objectives:

- To understand integral transform techniques and their applications.
- To learn vectors calculus for applications in engineering field.

Course Outcomes: After completion of this course students will be able to

- solve problems related to Fourier Transforms (CLIII)
- solve problems using Z transforms (CL III)
- apply the knowledge of vector calculus for solving engineering problems. (CL III)

Course Contents:

Fourier Transform: Fourier Integral theorem, Fourier Sine and Cosine Transforms, Inverse Fourier Transform. Finite Fourier Transform & Discrete Fourier Transforms. [8 hrs]

Z-Transform: Definition, Properties, Z- transform of standard sequences and their inverse, solution of difference equations. [7 hrs]

Vector Differential Calculus: Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Vector identities. [8 hrs]

Vector Integral Calculus: Line, Surface and Volume Integration, Work done, Green's Lemma, Stoke's and Divergence Theorem. Applications in Engineering field (branch Specific) [7 hrs]

Tutorial Exercises:

1. General Fourier Transform
2. Fourier Sine and Cosine Transforms.
3. Finite Fourier Transform
4. Discrete Fourier Transform
5. Z-Transform
6. Inverse Z-Transform.

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7. Solution of Difference Equation
8. Vector differentiation- problems on tangential & normal component, velocity, acceleration.
9. Gradient, divergence
10. Curl
11. Work done, Green's Lemma
12. Stoke's Theorem
13. Divergence Theorem.

Two tutorials will be conducted using Mathematical Software. Tutorial shall be engaged in four batches (batch size of 15 students) per division.

Learning Resources:

Reference Books

1. KreyszigErwin, *Advanced Engineering Mathematics*, 10th Edition, Wiley Eastern Limited 2015.
2. O' Neil Peter, *Advanced Engineering Mathem*atics ,8th Edition, Cengage Learning 2015.
3. Greenberg Michael D, *Advanced Engineering Mathematics*, 2nd Edition, Pearson, 2009.
4. Grewal B.S., *Higher Engineering Mathematics*, 43rd Edition Khanna Publishers 2014

Supplementary Reading:

1. Weber H.J. and Arfken G.B. *Mathematical Methods for Physicists*, 6th Edition, Academic Press 2011.

Web Resources:

http://nptel.ac.in/courses/111105035/6
https://nptel.ac.in/courses/111/105/111105090/

MOOCs:

https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/

Pedagogy:

- Co-teaching
- Audio- video techniques
- Tutorials and class tests

Assessment Scheme:

Class Continuous Assessment (CCA): 100 marks (67%)

Assignment / short term Question answers Tests	Tutorial	Mid Term Test	Presentations	Case study	MCQ	Oral	Total
20 Marks (20%)	50 Marks (50%)	30 Marks (30%)	--	--	--	--	100 Marks

Laboratory Continuous Assessment (LCA): NA

Regularity and punctuality	Understanding of objective	Understanding of procedure	Experimental skills	Ethics

Term End Examination: 50 marks (33%)

Module No.	Contents	Workload in Hrs		
		Theory	Tutorial	Assess
1	**Fourier Transform**: Fourier Integral theorem, Fourier Sine and Cosine Transforms, Inverse Fourier Transform. Finite Fourier Transform, Discrete Fourier Transform.	8	4	--
2	**Z-Transform:** Definition, Properties, Z- transform of standard sequences and their inverse, solution of difference equations.	8	3	--
3	**Vector Differential calculus:** Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Vector identities.	8	3	--
4	**Vector integral Calculus**: Line, Surface and Volume integration, Work done, Green's Lemma, Stoke's and Divergence Theorem. Applications in Engineering field (branch specific)	8	3	---

Prepared By	**Checked By** **Checked**	**Approved By**
Prof.RamaaSandu	Dr. Prashant Malavadkar	Dr. Shubhalaxmi Joshi

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Course Code				
Course Category	Professional Core			
Course Title	Communication Systems			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	0	30	2+0+1

Pre-requisites: Exposure of Signals and Systems

Course Objectives:

1. Knowledge:

(i) The need of modulation.

(ii) Concept of analog communication systems and digital communication system with pulse modulation.

(iii) Noise, noise parameters and random processes.

2. Skills:

(i) Hands on to explore the generation and reception of different analog and digital pulse modulation techniques.

3. Attitude:

(i) To explain and demonstrate the methods of generation and reception of different analog and digital communication systems.

Course Contents:

Amplitude Modulation: Elements of communication system, need of modulation, baseband and carrier communication, Amplitude Modulation (AM), modulation index, spectrum of AM wave, power, transmission efficiency and bandwidth, generation of AM and its variants such as DSB-SC, SSB, ISB, VSB, RF wave propagation. [7 hrs]

Angle Modulation and Radio Receivers: Concept of angle modulation, mathematical analysis of FM and PM, frequency spectrum, NBFM and WBFM, FM generation methods, TRF receiver, superheterodyne receiver for AM and FM, performance characteristics of receiver, AM and FM detectors, FM stereo receiver. [8 hrs]

Noise and Random Processes:

Sources of noise, types of noise, noise figure, noise factor, noise resistance, noise temperature, bandwidth, SNR, Friis's formula, noise calculations.

Introduction to random process, Stationary processes, Mean, Correlation & Covariance functions, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process. [8 hrs]

Digitization of Analog Signal: Sampling Theorem, sampling techniques, analog pulse modulation methods: PAM, PWM and PPM, Digital Communication system block diagram, Digital pulse modulation methods: PCM, Non-uniform Quantization and Companding, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation. [7 hrs]

Laboratory Exercises / Practical:

1. Generation, detection and spectral analysis of AM.
2. Generation, detection and spectral analysis of DSB-SC.
3. Generation, detection and spectral analysis of SSB.
4. Generation, detection and spectral analysis of FM.
5. Measurement of performance characteristics of Receiver: Sensitivity, Selectivity, Fidelity.
6. Verification of Sampling Theorem and sampling techniques.
7. Study of linear PCM and Companded PCM system.
8. Study of Delta Modulation Technique.
9. Study of Adaptive Delta Modulation Technique.
10. PBL - Software/Hardware

LearningResources:

Text Books:

1. P. Lathi, *Modern Digital and Analog Communication Systems*. Oxford University Press, 3rd Edition.
2. Simon Haykin, *Communication Systems,* John Wiley & Sons, 4th Edition

Reference Books:

1. Taub, Herbert, and Donald L. Schilling. *Principles of communication systems*. McGraw-Hill Higher Education, 3rd Edition.
2. Kennedy George, Brendan Davis, *Electronic communication systems.* Tata McGraw-Hill Publishing Co. Ltd., 4th Edition.

Web Resources:
https://nptel.ac.in/courses/108/102/108102120/

Pedagogy:

- Power Point Presentations, Videos
- PBL, Group activity.

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

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Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)
Term end exam of 50 Marks will be based on entire syllabus

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Amplitude Modulation:** Elements of communication system, need of modulation, baseband and carrier communication, Amplitude Modulation (AM), modulation index, spectrum of AM wave, power, transmission efficiency and bandwidth, generation of AM and its variants such as DSB-SC, SSB, ISB, VSB, RF wave propagation.	6	9	
2	**Angle Modulation and Radio Receivers**: Concept of angle modulation, mathematical analysis of FM and PM, frequency spectrum, NBFM and WBFM, FM generation methods, TRF receiver, superheterodyne receiver for AM and FM, performance characteristics of receiver, AM and FM detectors, FM stereo receiver.	9	6	
3	**Noise and Random Processes:** Sources of noise, types of noise, noise figure, noise factor, noise resistance, noise temperature, bandwidth, SNR, Friis's formula, noise calculations. Introduction to random process, Stationary processes, Mean, Correlation & Covariance functions, Ergodic	8	3	

	processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process.			
4	**Digitization of Analog Signal:** Sampling Theorem, sampling techniques, analog pulse modulation methods: PAM, PWM and PPM, Digital Communication system block diagram, Digital pulse modulation methods: PCM, Non-uniform Quantization and Companding, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation.	7	12	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Microcontroller and Applications**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**-**	**30**	**2+0+1**

Pre-requisites: Exposure of Digital Electronics

Course Objectives:

1. Knowledge:

(i) Basics of Microcontroller architecture and features
(ii) Integrated Development Environment (IDE) for developing microcontroller-based applications.
(iii) Interfacing of microcontroller with various peripherals.

2. Skills:

(i) To write assembly language and embedded C programs.
(ii) To apply the knowledge for the development of multidisciplinary projects

3. Attitude:

(i) To develop real world application using particular microcontroller
(ii) To select the appropriate microcontroller for the desired application

CourseOutcomes: After completion of this course students will be able to

1. Explain the architecture of the microcontroller (CL-II)
2. Make use of Integrated Development Environment (IDE) for programming and debugging. (CL-III)
3. Apply knowledge of microcontroller interfacing with various peripherals for developing real-world applications. (CL-III)
4. Compare various microcontrollers and select the appropriate microcontroller for the desired application. (CL-IV)

CourseContents:

Introduction to Microcontroller: Microprocessor and Microcontroller comparison, Role of microcontroller in Embedded System, Introduction to CIP-51 architecture and block diagram, Memory organization, Instruction set, and Assembly language programming. [7 hrs]

CIP-51 Architecture: Reset sources, Oscillator options, Port structure, Timers, Timer

programming in Embedded C, Interrupt handler, Power management modes. [8 hrs]

Peripheral Interfacing and Programming-I: Interfacing of LED, Relay, Buzzer, Switch, 7-segment display, LCD, Keypad, and DAC (All programs in Embedded C). [8 hrs]

Peripheral Interfacing and Programming-II: ADC, Programmable Counter Array (PCA), DC motor control using PWM of PCA, Serial Communication protocols - UART, I2C, and SPI (All programs in Embedded C), Comparative study of various emerging microcontrollers. [7 hrs]

Laboratory Exercises / Practicals:

1. Simple assembly language programming.
2. Complex assembly language programming.
3. Interfacing LED, Relay, Buzzer, and switch with C8051F340.
4. Interfacing LCD with C8051F340.
5. Interfacing DAC with C8051F340.
6. Interfacing ADC with C8051F340.
7. Interfacing DC motor and control its speed using PWM with C8051F340.
8. Interfacing UART with C8051F340.
9. Interfacing EEPROM using SPI with C8051F340.
10. Design and implement a microcontroller-based project.

LearningResources:

Text Books:
https://www.silabs.com/documents/public/data-sheets/C8051F34x.pdf

Reference Books:

1. Muhammad Mazidi, Janice Mazidi and Rolin McKinlay, "*The 8051 Microcontroller and Embedded Systems using Assembly and C"*, Pearson Education, 2nd edition

Web Resources:

https://www.academia.edu/31736611/The_8051_Microcontroller_and_Embedded_Systems_Mazidi_pdf
https://www.silabs.com/community/software/simplicitystudio/tutorials.resource.html/content/siliconlabs/en/community/resources/en/resource_1511907620908

Weblinks:

https://www.keil.com/support/man/docs/is51/is51_xch.htm
https://www.electronicshub.org/basics-of-embedded-c-program/

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Pedagogy:

- PowerPoint Presentations, Videos
- Project Based Learning

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)
Term end exam of 50 Marks will be based on entire syllabus

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Module No.	Contents	Workload in Hrs.		
		Theory	Lab	Assess
1	**Introduction to Microcontroller:** Microprocessor and Microcontroller comparison, Role of microcontroller in Embedded System, Introduction to CIP-51 architecture and block diagram, Memory organization, Instruction set, and Assembly language programming.	7	6	
2	**CIP-51 Architecture:** Reset sources, Oscillator options, Port structure, Timers, Timer programming in Embedded C, Interrupt handler, Power management modes.	7	3	
3	**Peripheral Interfacing and Programming-I:** Interfacing of LED, Relay, Buzzer, Switch, 7-segment display, LCD, Keypad, and DAC (All programs in Embedded C).	7	9	
4	**Peripheral Interfacing and Programming-II:** ADC, Programmable Counter Array (PCA), DC motor control using PWM of PCA, Serial Communication protocols - UART, I2C, and SPI (All programs in Embedded C), Comparative study of various emerging microcontrollers.	9	12	

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Course Code	EEE			
Course Category	Professional Core			
Course Title	Control Systems			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	0	30	2+0+1

Pre-requisites: Knowledge of electrical and electronic circuits

CourseObjectives:

1. To impart knowledge of the elements of control system and their modeling using various Techniques.
2. To understand relationship among the parameters of control system and specifications of control system in time domain and frequency domain.
3. To identify various methods to determine the stability of control system.
4. To learn various the controllers

CourseOutcomes: After completion of this course students will be able to

1. Identify the system using mathematical model (CLIII).
2. Explain the relationship among the parameters of control system and specifications of control system in time domain and frequency domain (CLII).
3. Analyzecontrol system using different methods to determine stability of system (CLIII).
4. Understand PLC ladder and Tune PID controller (CLII).

CourseContents:

- **Control System Modeling**: Basic elements of control system, open loop and closed loop systems, differential equations and transfer function. Modeling of electric systems, translational mechanical systems. Block diagram reduction techniques. Signal flow graph.
- **Time Response Analysis**: Standard input signals. Time response analysis of first order systems. Time response analysis of second order systems, steady state errors and error constants, design specifications for second order systems.
- **Stability Analysis:** Concept of stability, Routh-Hurwitz Criterion, relative stability. Root locus technique, gain margin, phase margin from root locus technique, stability of the system from root locus.
- **Frequency Response Analysis**: Frequency domain versus time domain analysis and its correlation. Bode Plots. Frequency domain specifications from the plots. Stability analysis from plots.
- **State Variable representation and controllers:** State space advantages and representation. Transfer function from state space, physical variable form, phase variable forms: controllable canonical form, observable canonical form. Controllers and digital control systems introduction to PLC: P, PI, PD and PID.

Laboratory Exercises / Practical:

1. To obtain pole, zeros, and gain value of given transfer function.
2. To obtain transient response of second order system.
3. To plot the root locus for a given transfer function of the system using MATLAB.
4. Determination of Bode plot using MATLAB for second order system.
4. To obtain frequency response of given lag/lead network.

5. Determination of Nyquist plot using MATLAB.
6. To obtain the state space model from the given transfer function using MATLAB.
7. Implement basic logic gates using Programmable Logic Controller.
8. Study of controllability of the system using MATLAB.
9. Study of Observability of the system using MATLAB.
10. To control the closed loop system using PID controller.

LearningResources:

Reference Books:

1. N. J. Nagrath and M. Gopal, *Control System Engineering*. New Delhi: New Age International Publishers, 5th Edition, 2012
2. C. D. Johnson, Process Control and *Instrumentation*. Pearson Publication ,5th Edition

Supplementary Reading:

Schaum's Outline Series, *Feedback and Control Systems*, Tata McGraw-Hill, 2013

Web Resources:

Weblinks: https://nptel.ac.in/courses/108101037/

MOOCs: https://www.mooc-list.com/tags/control-system

Pedagogy:

- Power Point Presentations
- Videos
- Group Activities
- Project based learning

AssessmentScheme:

Class Continuous Assessment (CCA) (50 Marks)

Assignments(I & II)	Test	Class participations	MCQ
20 (40%)	15 (30%)	05 (10%)	10 (20%)

Laboratory Continuous Assessment (LCA) (50 Marks)

Understanding the Objective	Understanding of procedure	Experiment Skills	Oral
5 (10%)	10 (10%)	10 (10%)	25 (50%)

Term End Examination:

Term end exam of 50 Marks will be based on entire syllabus.

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Module	Contents	Workload in Hrs

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		Theory	*Lab*	*Assess*
1	**Control System Modeling**: Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational mechanical systems, Block diagram reduction Techniques, Signal flow graph	**6**	**3**	
2	**Time Response Analysis**: Standard input signals, Time response analysis of First Order Systems, Time response analysis of second order systems, Steady state errors and error constants, design specifications for second order systems.	**6**	**3**	
3	**Stability Analysis:** Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, gain margin, phase margin from root locus technique, stability of the system from root locus.	**6**	**3**	
4	**Frequency Response Analysis**: Frequency domain Versus Time domain analysis and its correlation, Bode Plots. Frequency Domain specifications from the plots, Stability analysis from plots.	**6**	**9**	
5	**State Variable Analysis**: State space advantages and representation, Transfer function from State space, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method only. **Controllers And Digital Control Systems:** Introduction to PLC: Introduction to PID controller: P, PI, PD and PID	**6**	**12**	

Course Code				
Course Category	PC			
Course Title	**Linux Based Python Laboratory**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	--	**--**	**30**	**0+0+1**

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Pre-requisites

- Basic knowledge of operating system
- Basic knowledge of programming concepts

Course Objectives:

1. To learn basic concepts of Linux operating system
2. To study fundamentals of Python programming
3. To use Python for data analytics of real-life applications.

Course Outcomes:

After completion of this course, students will be able to:

1. Identify features and use of Linux environment
2. Apply Python programming to real life problems
3. Perform data analytics using Python on real-life applications

Course Contents:

1. Linux operating system: Installation and Basics
2. Fundamentals of Python Programming
3. Introduction to Basic data structures of Python
4. Introduction to Advanced Data Structures of Python
5. File Handling Concepts
6. Exploratory Data Analysis

Laboratory Exercises / Practical:

Sr. No.	Contents	Workload in Hrs
1	Installation of Linux Operating System	2 Hrs
2	Execution of Basic Commands	2 Hrs
3	Introduction to Fundamentals of Python	2 Hrs
4	Introduction to Basic Data Structures of Python (Attempt any three) a) Write a python program to check if a number is a perfect number. b) Write a python program to count the occurrences of each word in a given string sentence. c) Write a python program to print numbers between 1 to 50 which are divisible by 6 & 4. d) Write a python program to get numbers divisible by 2 from a list.	4 Hrs

	e) Write a python program to create set of n numbers. Print max of set elements. f) Write a python program to check even numbers from a set of numbers from 1 to 50.	
5	Introduction to Advanced Data Structures of Python (Any two) a) Write a python program to create a sorted merged list of two unsorted lists. b) Write a python program to create dictionary of vehicles (mode_lno, manufacturer, year). Write a function to search a key into it c) Write a python program to create dictionary of customer (id, name, ph_no). Write a function to search a key into it d) Write a python program to create dictionary of mobiles (brand, color, memory). Write a function to search a key into it e) Write a python program to create dictionary of bank (name, account_no, balance). Write a function to search a key into it	4 Hrs
6	File Handling Concepts (Attempt any one) a) Write a python program to perform following file handling operations: Create, Open, Append, Read, Write b) Write a python program to count occurrences of characters, numbers, newlines, special characters, spaces from a file and write it in a new file c) Create a database of (Bank/library/students) using lists and write it in a file. Perform different operations like read, write, search, update, delete.	4 Hrs
7	Exploratory Data Analysis using Pandas, Numpyand Matplotlib. Student can choose any two of the problem statements from the Problem Statements Repository for exploratory data analysis. They can download required datasets from Kaggle for analysis. (https://www.kaggle.com)	6 Hrs

Course Coordinators of respective schools can create their own problem statements if they want and give them to students for solving, in that case students need not select problem statements from Repository.

Problem Statements Repository:

1. Download the 3D printer dataset from Kaggle and perform following operations on the data.

- Read the csv file in python notebook
- Display top records of the dataset
- Display size of the dataset (no of records)
- Check if null value is present
- Plot correlation matrix of the data

2.Download Mechanical Tools Classification dataset and perform following operations on the data.

a. Importing Image data into numpy arrays
b. Plotting numpy arrays as Images
c. Applying pseudocolor schemes to image plots
d. Examining a specific data range using histogram

3. Download Gear box Fault Diagnosis dataset and perform following operations on the data.

- Plot Time series of vibration data
- Plot Time series of the 4 accelerometers
- Histogram of the four vibration signals
- Plots of probability density functions of vibration signals

4.Download cnc-milling-machine-tool-wear-detection dataset and perform following operations on the data.

- Mean value of velocity, voltage, feedrate(x,y,z)
- Distribution of feedrate, clamp_ pressure
- Correlation of each features

5. Building a Motion-Activated Alarm System (Assignment

	with Raspberry Pi kit) ● Set up a new Raspberry Pi ● Run Python on the Raspberry Pi using the Mu editor or remotely over SSH ● Read input from physical sensors connected to the Raspberry Pi ● Send output to external components using Python 6. Build button-controlled "music box" (Assignment with Raspberry Pi kit) ● Play sounds in Python with pygame ● Use the Python gpiozero library to connect button presses to function calls ● Use the dictionary data structure in Python 7. Face Tracking using OpenCV and Ardiuno ● Facial detection identifies and localizes human faces and ignores any background objects such as curtain, windows, trees, etc. OpenCV uses Harr cascade of classifiers where each frame of the video is passed through stages of classifiers and if the frame passes through all the classifiers, the face is present. ● These coordinates are passed to the Arduino UNO using the pyserial library. 8. Smart Phone Controlled Mouse: ● The assignment involves a smartphone application that sends the data, scroll status, left and right click status using bluetooth to the Arduino Uno connected to the HC-05 bluetooth module. On receiving this data, the Arduino makes changes in the current cursor's position to obtain a new position. The resulting data along with scroll and button status is then printed as the output that is recognized to be read by the Python sketch. The Python sketch is made to execute mouse actions using the mouse module. 9. Download Stock market data and perform exploratory data analysis on Financial Data. ● Calculate the stocks daily returns and obtain	

correlations
- Perform interactive data visualization using Plotly Express
- Use matplotlib finance API for plotting financial Data

10. Download Chemical Engineering dataset and perform following operations on data.

- Investigating chemical counts
- Plot no of products containing chemicals
- Find chemicals in Baby Products

11.Read the Chemicals in Cosmetics dataset and perform following operations on data.

- Import data to pandas dataframe and clean the data, including standardizing the ProductName, CompanyName, and ChemicalName columns
- What is the most frequently reported chemical? Create plot for visualization.
- Which are highest chemicals reported? Is Titanium Dioxide very harmful? Group the data by the product ID and primary category, and plot out a chart and find the answers.
- Plot the Histogram of products containing very harmful chemical to total products reported.

12. Read the data and explore different features provided in the data and give a brief chemical background of each feature. Also visualize the distributions of these features in the dataset.

- Load training data and get list of molecule types
- Visualize distribution of scalar coupling coefficient

13. Download dipole moment data and perform following operations on the data.

- Visualize the distribution of dipole moments in X, Y and Z directions
- Visualize the distribution of dipole moments in all directions for each molecule type

Learning Resources:

Text Books:

1. Sumitabha Das, Unix concepts and applications, 4th Edition, TMH
2. A Hands-On, Project-Based Introduction to Programming, 2nd Edition: Python Crash Course, Eric Matthas

Reference Books:

1. William Shotts, *The Linux Command Line: A Complete Introduction*, 2nd Edition
2. David Beazley, Brian K. J, Oreilly, *Python Cookbook: Recipes for Mastering Python* 3, 3rd Edition

Supplementary Reading:

Web Resources:

https://nptel.ac.in

Weblinks:

https://www.python.org

https://www.tutorialspoint.com

MOOCs:

Introduction to Python Programming (Coursera, udemy etc.)

Pedagogy:

- PPT presentation
- Smart board teaching
- Video lecturers (ex. nptel)
- Hands-on experiments

Assessment Scheme:

Laboratory Continuous Assessment (LCA) (50 Marks)

Practical	Oral based on practical	Site Visit	Mini Project	Active Learning	Attendance	Any other

(40 Marks)				(10 Marks)		

Course Coordinator

Prof. Shilpa Sonawani
Prof. Preeti Kale
Prof. Manisha Thakkar

Course Advisor

Dr. Sharmista Desai

Head of School

Dr. Vrushali Kulkarni
HOS, School of CET

Dr. Prasad Khandekar
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Course Code				
Course Category	Professional Core			
Course Title	Basic IoT Laboratory			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	--	--	60	0+0+2

Pre-requisites: Exposure of Programming and Problem Solving

CourseObjectives:

1. Knowledge:

(i) To understand IoT prototyping platforms

(ii)To know basic architecture and protocols of Internet of Things

2. Skills:

(i) To comprehend sensor and actuators interfacing with development boards

(ii) To relate web and cloud technologies to empower IoT applications

3. Attitude:

(i)To illustrate integration and deployment issues through IoT based project specific to domain application.

CourseOutcomes: By the end of the course, students will be able to

1. Choose IoT development platforms as per requirement (CL-II)
2. Demonstrate use of sensors and actuators with hardware platforms (CL-III)
3. Experiment with hardware platform and cloud for data analysis and visualization (CL-III)
4. Develop an IoT system for real life application (CL-V)

Laboratory Exercises / Practical:

1.To introduce various hardware platforms for IoT based design. (Example platforms are Arduino Uno /Node MCU/ Raspberry Pi/ ESP8266 / Beagle board/ Tiva / MSP430 /Jetson Nano/ Intel Galileo)

2.Understanding Arduino IDE and Interfacing Basic Sensors with hardware platforms.

3. Interfacing stepper motor and relay with hardware platforms.

4. Understanding Node MCU as development platform and connecting to Wi-Fi network through Arduino IDE.

5. Exploring cloud infrastructure for connecting IoT devices and sending and visualizing sensor data to open-source cloud via Arduino IDE.

6. Understanding Raspberry-Pi as single board Computer and exploring GPIO.

7. Sensor and Actuator interfacing with Raspberry-Pi and development of simple application.

8. Data Analysis for IoT. Upload and retrieve sensor data using Thing Speak or similar Platform.

9. Study and interfacing of domain specific sensors and actuators with hardware platform.

10. Project based on real life IoT applications and report submission.

LearningResources:

Text Books:

1. HakimaChaouchi, *The Internet of Things: Connecting Objects to the Web*, ISTE Ltd and John Wiley & Sons, Inc., 2010.
2. Michael Margolis, *Arduino Cookbook*, 2nd Edition,O'Reilly Media, Inc, 2011.
3. Alex Bradbury & Ben Everard, *Learning Python with Raspberry Pi*, 1st Edition, John Wiley & Sons, Feb 2014.

Reference Book:

1. Charles Bell, *Beginning Sensor Networks with Arduino and Raspberry Pi*, 1st Edition, Apress, 2014.

Web Resources:

https://www.iot-experiments.com/

Weblinks:

https://www.tutorialspoint.com/internet_of_things/
https://www.arduino.cc/en/Tutorial/HomePage?from=Main.Tutorials
https://lastminuteengineers.com/esp8266-nodemcu-arduino-tutorial/
https://core-electronics.com.au/tutorials/raspberry-pi-workshop-for-beginners.html

MOOCs:

https://www.coursera.org/learn/raspberry-pi-platform
https://www.coursera.org/learn/arduino-platform
https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English
https://www.udemy.com/course/nodemcu-esp8266-dev-board-tutorial/

Pedagogy:

- Power-point Presentation
- Videos
- Group Activity
- Project Based Learning

AssessmentScheme:

Laboratory Continuous Assessment (LCA) (100%)

Assessment as per Rubric	Mid-term evaluation	End-term evaluation*
30 (30%)	30 (30%)	40 (40%)

*PBL – to be evaluated

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Course Title	Analog and Digital Electronics			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	-	30	2+0+1

Pre-requisites: Exposure ofBasics of Electrical and Electronics Engineering

Course Objectives:

1. **Knowledge:**
   (i) To acquire knowledge of JFET and MOSFET
   (ii) To understand the concepts in combinational and sequential logic circuits
   (iii) To study various oscillators and wave shaping circuits.
2. **Skills:**
   (i) To learn design and implementation of applications of MOSFET like switch and amplifier.
   (ii) To design and implement combinational and sequential logic circuits.
3. **Attitude:**
   (i) Apply the knowledge gained in the design of analog and digital applications

Course Outcomes: After completion of this course students will be able to

1. Analyse and Design MOSFET amplifier at Low Frequencies (CL-IV).
2. Explain different type of Oscillators & Wave Shaping Circuits (CL-II)
3. Model different combinational logic circuits (CL-III).
4. Design various sequential logic circuits (CL-III)
5. Apply the knowledge gained in the design of various real time applications. (CL-III)

Course Contents:

Field Effect Transistor: Why FET over BJT, Introduction to JFET, E-MOSFET Construction and characteristics, Ideal and non-ideal characteristics, Small signal model - CS and CD amplifiers, MOSFET switches and complementary MOSFET (CMOS) switches[8 Hrs]

Oscillators & Wave Shaping Circuits: Condition for sustained oscillation, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, High pass and low pass filters using R-C Circuits; R-L, R-L-C circuits, Attenuators, Clipping and clamping circuits [7 Hrs]

Combinational Logic Circuits: Review of Basic Logic gates, minimization of logical functions using K map, design examples: arithmetic circuits, comparator, code converters, Parity Generator and detector, Multiplexers, Demultiplexers. [8 Hrs]

Sequential Logic Circuits: 1-bit Memory Cell, Flip flops, Shift registers, Applications of shift registers, Pulse train generator, Design of asynchronous and synchronous counters, lock out condition [7 Hrs]

Laboratory Exercises / Practicals:

1. Verification of Ideal and Non-ideal Characteristics of MOSFET.
2. Design, Build and Simulate MOSFET amplifier in common source/common drain configuration
3. Design, Build and Simulate Hartley/Colpitt oscillator using MOSFET and observe the sinusoidal output waveform.
4. Design and Implement Code Converters using basic logic gates
5. Implementation of Combinational Logic Design using MUX/Decoder ICs
6. Design and Implement application of Shift Registers (Ring and Twisted ring counter)
7. Design and Implement MOD-N asynchronous counters.
8. Design and implementation of synchronous Counter.
9. Design and implement Analog Electronics Application. (Hardware/Simulation) (PBL)
10. Design and implement Digital Electronics Application. (Hardware/Simulation) (PBL)

Learning Resources:

Text Books:

1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, Pearson Education, 11th Edition, 2015
2. Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 11th Edition, 2015

Reference Books:

1. J. Millman, C. Halkias, and C. Parikh, *Integrated Electronics*, McGraw Hill Education, 2nd Edition, 2013
2. R.P. Jain, *Modern Digital Electronics*, New Delhi: Tata McGraw-Hill, 4th Edition, 2009
3. Anand Kumar, *Fundamentals of Digital Circuits*, PHI Publication, 4th Edition, 2016

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Active Learning Methods
- Project Based Learning

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)

Term end exam of 50 Marks will be based on entire syllabus

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Field Effect Transistor:** Why FET over BJT, Introduction to JFET, E-MOSFET Construction and characteristics, Ideal and non-ideal characteristics, Small signal model - CS and CD amplifiers, MOSFET switches and complementary MOSFET (CMOS) switches	8	9	
2	**Oscillators & Wave Shaping Circuits:** Condition for sustained oscillation, R-C phase shift, Hartley, Colpitts, Crystal and Wien Bridge Oscillators, High pass and low pass filters using R-C Circuits; R-L, R-L-C circuits, Attenuators, Clipping and clamping circuits	7	3	
3	**Combinational Logic Circuits:** Review of Basic Logic gates, minimization of logical functions using K map, design examples: arithmetic circuits, comparator, code converters, Parity Generator and detector, Multiplexers, Demultiplexers.	8	9	

	4	**Sequential Logic Circuits:** 1-bit Memory Cell, Flip flops, Shift registers, Applications of shift registers, Pulse train generator, Design of asynchronous and synchronous counters, lock out condition	7	9		

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Course Code				
Course Category	Professional Core			
Course Title	Analog and Digital Integrated Circuits			
Total Teaching Hrs and Credits	L	T	Laboratory	Credits
	30	-	30	2+0+1

Pre-requisites: Exposure ofBasics of Electrical and Electronics Engineering, Analog and Digital Electronics

CourseObjectives:

1. **Knowledge:**
   (i) To introduce basics of the Op- amp and its parameters.
   (ii) To design and test various linear op-amp applications.
   (iii) To design and test various non-linear Op- amp applications.
   (iv) Study, design and test convertors and various active filters.

2. **Skills:**
(i)Able to classify op-amp based on specifications as per the need from datasheet
   (ii) To design linear and non -linear op-amp applications.

3. **Attitude**:
   (i)Should be able to design and validate the performance using hardware components or simulation.

CourseOutcomes: After completion of this course students will be able to

1. Classify Op-amps, identify parameters for a particular application. (CL-II)
2. Design and test linear applications of Op-amp. (CL-VI)
3. Design and test non-linear applications of Op-amp. (CL-VI)
4. Develop state machines for various applications (CL-III)

Course Contents:

Basics of Operational Amplifiers: Fundamentals Introduction to Differential amplifier, Block diagram of Op-amp Basics of an Op-amp, Op-amp parameters, Frequency response. [8 hrs]

Linear Applications: Different Op-amps Configurations, Integrator, Differentiator, Instrumentation Amplifiers. [7 hrs]

Non-Linear Applications: Schmitt trigger, Precision rectifiers, square wave and triangular wave

generators. [7 hrs]

Digital Integrated Circuit Technology & A/D -D/A Convertors: Introduction to Logic families. Logic Gates using CMOS. Design of Synchronous sequential circuits,Concept of Moore and Mealy machines, Finite state machine design, Sequence detectors.
D/A converter specifications, weighted resistor type, R-2 Ladder type, A/D Converters specifications, Flash type, Successive Approximation type, ICs like MC1408(DAC), ADC0808
[8 hrs]

Laboratory Exercises / Practical's:

1. Measurement of Op-amp parameters: Input offset voltage, input offset current and bias current, Slew rate (OP-07C, LF 356, LM741C)
2. Design and build Summing amplifier/Averaging/ Integrator for given specifications.
3. Design and build Instrumentation amplifier (3 Op-amp based) for given specifications and validate performance using IC AD620 or equivalent.
4. Design and build inverting Schmitt trigger (Symmetric and Asymmetric) for given specifications and study performance of comparators IC's like LM311/LM339.
5. Design and build Square wave and triangular wave generator for given specifications with variable duty cycle and voltage limiters.
6. Design a 2- bit R-2R DAC/2-bit ADC. Verify performance using ICs like MC1408(DAC), or equivalent DAC/ADC0808.
7. Design and implement sequence detector using JK Flip flops.
8. Implementation of logic gates using TTL/CMOS
9. **Project based learning:**
   Any Application circuit to validate using op-amp.
   Using basic logic gates implement any application in real world.

LearningResources:

Text Books:

1. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*. New Delhi, PHI, 4th Edition, 2015
2. S. Salivahanan and V. S. Kanchana Bhaaskaran, *Linear Integrated Circuit* New Delhi, McGraw Hill Education Pvt. Ltd, 2nd Edition, 2014
3. Sergio Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, 4th Edition, Tata McGraw Hill
4. Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, 11th Edition

Reference Books:

1. Morris M. Mano, *Digital Design*, 3rd Edition, Prentice Hall International – 1984.

2. Donald D. Givone, *Digital Principles and Designs*, 1st Edition,Tata McGraw Hill
3. R. P. Jain, Modern, *Digital Electronics*, 4th Edition, McGraw Hill

Web Resources:

Weblinks:
https://nptel.ac.in/courses/122/106/122106025/

MOOCs:
https://onlinecourses.nptel.ac.in/noc21_ee31
https://onlinecourses.nptel.ac.in/noc21_ee75

Pedagogy:

- Power Point Presentations,
- Videos
- Project Based Learning

Assessment Scheme:

Class Continuous Assessment (CCA): (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment: (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: 50 Marks (33%)

Term end exam of 50 Marks will be based on entire syllabus

Module No.	Contents	Workload in Hours		
		Theory	Lab	Assess
1	**Op-amp Basics:** Block diagram of Op-Amp, Differential Amplifier configurations, DC and AC analysis, Level shifter, current mirror, Op-amp parameters, effect of temperature on parameters, frequency response of Op-amp	8	3	
2	**Linear Applications**: Inverting and Non-inverting amplifier, voltage follower. Summing, averaging scaling amplifier, difference amplifier, Integrator ideal and practical, differentiator ideal and practical, Instrumentation Amplifier.	7	6	
3	**Non-Linear Applications**: Voltage comparators, Schmitt trigger, Precision rectifiers, square wave and triangular wave generators.	7	6	
4	**Digital Integrated Circuit Technology & Convertors**: Introduction to Logic families. Logic Gates using CMOS. Design of Synchronous sequential circuits,Concept of Moore and Mealy machines, Finite state machine design, Sequence detectors. D/A converter specifications, weighted resistor type, R-2 Ladder type, A/D Converters specifications, Flash type, Successive Approximation type, ICs like MC1408(DAC), ADC0808	8	9	
5	**Project Based Learning**	-	6	

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Course Code				
Course Category	**Core Engineering**			
Course Title	**Basics of Control Systems**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**-**	**30**	**2+0+1**

Pre-requisites: Exposure of Basics of Electrical and Electronics Engineering

Course Objectives:

1. **Knowledge:**
   (i) To impart knowledge of the elements of control system and their modelling using various techniques.

2. **Skills:**

(i)To understand relationship among the parameters of control system and specifications of control system in time domain and frequency domain.

(ii) To identify various methods to determine the stability of control system.

3. **Attitude:**

(i)To apply concepts of controllers for practical scenario.

Course Outcomes: After successfully completing this course, students will be able to:

1. Identify the system using mathematical model. (CL-III)
2. Explain the relationship among the parameters of control system and specifications of control system in time domain and frequency domain. (CL-II)
3. Analyze control system using different methods to determine stability of system. (CL-III)
4. Understand PLC ladder and Tune PID controller. (CL-II)

Course Contents:

Control System Modeling: Dynamic system, Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational mechanical systems, Block diagram reduction Techniques, Introduction to PLC: Block schematic, Simulation software introduction for different control modeling. [6 hrs]

Time Response Analysis: Standard input signals, Time response analysis of First Order Systems, Time response analysis of second order systems, Steady state errors and error constants, design specifications for second order systems, Applications and Advantages /Disadvantages of Time

Response Analysis. [6 hrs]

Stability Analysis: Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, gain margin, phase margin from root locus technique, stability of the system from root locus. [6 hrs]

Frequency Response Analysis: Frequency domain Versus Time domain analysis and its correlation, Bode Plots, Polar Plots. Frequency Domain specifications from the plots, Stability analysis from plots [6 hrs]

Controllers and Digital Control Systems: Servomechanism, Regulator and Process Control, Introduction to PID controller: P, PI, PD and PID, Case Study: Applications of PID Controller in E-Vehicle Controller. [6 hrs]

Laboratory Exercises / Practicals:

1. Familiarization with simulation and control system modeling software.
2. To obtain step and ramp response of first order system.
3. To obtain transient response of second order system.
4. To plot the root locus for a given transfer function of the system.
5. To check stability of system using bode plot.
6. To obtain frequency response of given lag/lead network.
7. Implement basic logic gates using Programmable Logic Controller.
8. To control the closed loop system using PID controller and compare with open loop system.
9. Project Based Learning

Learning Resources:

Reference Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited; 5th Edition.
2. C. D. Johnson, Process Control and *Instrumentation*. Pearson Publication ,5th Edition

Text Books:

1. N. J. Nagrath and M. Gopal, *Control System Engineering*. New Delhi: New Age International Publishers, 5th Edition, 2012
2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition.

Supplementary Reading:

Schaum's Outline Series, *Feedback and Control Systems*, Tata McGraw-Hill, 2013

Web Resources:

Weblinks:
https://nptel.ac.in/courses/108101037/

MOOCs:
https://www.mooc-list.com/tags/control-system

Pedagogy:

- PPT/Animation/Video.
- Demonstrations of Circuits using trainer kits/simulation software.
- Group Activities.
- Assignments/quizzes

AssessmentScheme:

Class Continuous Assessment (CCA) (50 Marks) (33%)

Mid-term Exam	Assignment/Active Learning Tool/Quiz (Max 2)	PBL/ Case Study/Group Activity (Either or both)
15 (30%)	15 (30%)	20 (40%)

Laboratory Continuous Assessment (LCA) (50 Marks) (33%)

Assessment as per rubrics	Mid-term evaluation	End-term evaluation
15 (30%)	15 (30%)	20 (40%)

Term End Examination: (50 Marks) (33%)

Term end exam of 50 Marks will be based on entire syllabus.

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Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1.	**Control System Modeling**: Dynamic system, Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational mechanical systems, Block diagram reduction Techniques, Introduction to PLC: Block schematic, MATLAB Simulink introduction for different control modeling.	8	3	
2.	**Time Response Analysis**: Standard input signals, Time response analysis of First Order Systems, Time response analysis of second order systems, Steady state errors and error constants, design specifications for second order systems, Applications and Advantages /Disadvantages of Time Response Analysis.	6	6	
3.	**Stability Analysis:** Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, gain margin, phase margin from root locus technique, stability of the system from root locus.	5	3	
4.	**Frequency Response Analysis**: Frequency domain Versus Time domain analysis and its correlation, Bode Plots, Polar Plots. Frequency Domain specifications from the plots, Stability analysis from plots,	6	6	
5.	**Controllers and Digital Control Systems:** Servomechanism, Regulator and Process Control, Introduction to PID controller: P, PI, PD and PID, Case Study: Applications of PID Controller in E-Vehicle Controller	5	6	
6.	**Project Based Learning**	-	6	

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Course Code				
Course Category	**Professional Core**			
Course Title	**Sensor Technology**			
Total Teaching Hrs and Credits	**L**	**T**	**Laboratory**	**Credits**
	30	**0**	**30**	**2+0+1**

Pre-requisites: Exposure of Basics of Electrical and Electronics Engineering

CourseObjectives: To make students familiar with

1. **Knowledge**

(i) To introduce the functionality of various sensors and actuators.

(ii) To learn principle of operation of different sensors and actuators

(iii) To analyse a variety of sensor circuit

2. **Skills**:

(i) To apply knowledge of smart sensors in IOT.

(ii) To develop various applications using sensors and actuators.

3. **Attitude:**

(i) To develop attitude to use sensors and actuators, smart sensors for automation.
(ii) To develop attitude to design, build and troubleshoot various sensor circuit.

CourseOutcomes: After completion of this course students will be able to

1. Use sensor for a particular application. (CL-III)
2. Design signal conditioning circuitry for a sensor. (CL-VI)
3. Understand architecture and applications of smart sensor. (CL-II)
4. Identify actuators for various practical applications. (CL-I)

CourseContents:

Sensor Fundamental: Types of sensors, Active and passive sensors, Characteristics, Sensor Signal Conditioning, Conditioning Bridge Circuits, Amplifiers for Signal Conditioning, Sensor calibration, Introduction to Data-Acquisition Systems, ADC & DAC. [6 Hrs]

Thermal, Optical and Radiation Sensor: Mechanical & Electrical temperature sensors, IR temperature sensor, Photo sensors, Thermal Detectors, Phototransistor, Opto-couplers, Pyroelectric Detector, Thermopile, Bolometer, Introduction to Nanotechnology: Bio Sensors. [6 Hrs]

Displacement, Pressure, Position and Load Sensors: Transduction principle & sensors, Level Sensors, Ultrasonic transducer, Piezoelectric sensors, Accelerometers, Quartz Sensors, Strain Gage

Sensors, Load Cells, Proximity sensors, Optical Sensor, Hall effect sensors. **[**6 Hrs**]**

Smart Sensors: Components of Smart Sensors, Architecture of Smart Sensors, Evolution of Smart Sensors, Features, Data Communications: IEEE488, RS232, Zig-bee module, RF transmitter, HART, Standards for Smart Sensor Interface, Application area of Smart Sensors. **[**6 Hrs**]**

Actuators: Pneumatic and Hydraulic Actuators, PCV, DCV, Rotary actuators, Electro-mechanical, electro-thermal, electro-optical and electrochemical actuators, Piezoelectric and Piezo-resistive actuators, micro-pumps and micro actuators, relays, motors, heaters. [6 Hrs]

Laboratory Exercises / Practical's (Any 8):

1. Design of instrumentation amplifier

   Details of Instrumentation amplifier using op-amp circuit & its derivation. Input from Wheatstone bridge & implemented on bread board.
2. Measurement of temperature using thermistor (Wheatstone Bridge)

   Details about NTC & PTC types, Implementation using bread board & other electronic components along with temperature.
3. Measurement and Analysis of temperature using various sensors.

   Measurement using LM 35, RTD & Thermocouples & its detail study.
4. Measurement of Displacement using LVDT.

   Study of variable inductance type transducers & working principle. Performed using PLC & TIA software & LVDT sensor.
5. Measurement and Analysis of Displacement using various sensors.

   Compare output from different displacement sensors, performed using Siemens PLC, TIA software & Linear sensor.
6. Measurement of load using strain gauge.

   Detailed study of strain gages (SG), metal SG, and Semiconductor SG. Performed using Force sensor & load sensor using in TIA software & Siemen's PLC.
7. Study of photo sensors

   Explanation of different types of photo sensor, photo transistor. Implementation using PLC & TIA software.
8. Study of Hydraulics & Pneumatics Systems

   Theory of hydraulic & Pneumatic will be covered. Demonstration of working of PLC based Hydraulics & Pneumatics Systems
9. Interfacing of data with DAQ

   Detailed study of DAQ & their types. Inputs from different sensor will be given.
10. PBL - Project as a group activity based on Sensors and Actuators using any hardware

platform. Write comprehensive Report on the project & Preparation of presentation

LearningResources:

Text Books:

1. C S Rangan, G R Sarma, V S V Mani, *Instrumentation Devices & Systems*, 2nd Edition, Tata McGraw Hill
2. K P Ramachandra, *Mechatronics: Integrated Mechanical electronics System*, 1st Edition, Wiley
3. D. Patranabis, *Sensors and Actuators*, 2nd Edition, PHI, 2013

Reference Books:

1. John Wilson: Sensor Technology Handbook, 1st Edition, Elsevier
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, 6th Edition, Prentice Hall International Edition, ISBN: 0-13-978-200

Supplementary Reading:

Web Resources:

Sensors & actuator: https://nptel.ac.in/courses/108108147/#
Nanotechnology: https://nptel.ac.in/courses/118102003/

Pedagogy:

- Power Point Presentations, Videos
- Group Activities
- Chalk and talk
- Laboratory Experiments

AssessmentScheme:

Class Continuous Assessment (CCA) (50Marks) (50%)

Mid Term Test	Assignment/ Active Learning Tool/Quiz	PBL/Case study/Group Activity
15 (30%)	15 (30%)	20 40%

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Laboratory Continuous Assessment (LCA)(50 Marks) (33%)

Assessment as per Rubrics	Mid-term Evaluation	End Term Skills
15 (30%)	15 (30%)	20 (40%)

Term End Examination: (50 marks) (33%)
Term end exam of 50 Marks will be based on entire syllabus.

Module No.	Contents	Workload in Hrs		
		Theory	Lab	Assess
1	**Sensor Fundamental**: Types of sensors, Active and passive sensors, Characteristics, Sensor Signal Conditioning, Conditioning Bridge Circuits, Amplifiers for Signal Conditioning, Sensor calibration, Introduction to Data-Acquisition Systems, ADC & DAC	6	6	
2	**Thermal, Optical, Radiation Sensor**: Mechanical & Electrical temperature sensors, IR temperature sensor, Photo sensors, Thermal Detectors, Phototransistor, Opto-couplers, Pyroelectric Detector, Thermopile, Bolometer, Introduction to Nanotechnology: Bio Sensors	6	9	
3	**Displacement, Pressure, Position and Load Sensors:** Transduction principle & sensors**,** Level Sensors, Ultrasonic transducer, Piezoelectric sensors, Accelerometers, Quartz Sensors, Strain Gage Sensors, Load Cells, Proximity sensors, Optical Sensor, Hall effect sensors	6	9	
4	**Smart Sensors:** Components of Smart Sensors, Architecture of Smart Sensors, Evolution of Smart Sensors, Features, Data Communications: IEEE488, RS232, Zig-bee module, RF transmitter, HART, Standards for Smart Sensor Interface, Application area of Smart Sensors	6	3	
5	**Actuators:** Pneumatic and Hydraulic Actuators, PCV, DCV, Rotary actuators, Electro-mechanical,	6	3	

	electro-thermal, electro-optical and electrochemical actuators, Piezoelectric and Piezo-resistive actuators, micro-pumps and micro actuators, relays, motors, heaters			

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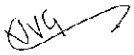

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