KANNUR UNIVERSITY
കണ്ണൂർ സർവകലാശാല

(Abstract)

FYUG Electronics Programme in Affiliated Colleges -Fifth to Eighth semester Syllabus -Approved and implemented with effect from 2024 Admission-- Orders issued

---

ACADEMIC C SECTION

ACAD C/ACAD C1/21843/2024 Dated: 15.03.2026

Read:-1. U O No. ACAD C/ACAD C1/21843/2024 dated 26.11.2024

2. U.O. No .ACAD C/ACAD C1/21843/2024 dated 13.08.2025
3. E mail dated 17.02.2026 from Dr. Rohit K. Raj, Associate Professor & Head, Department of Electronics, Government College, Mananthavady.
4. E. mail dated 18.02.2026 from the Dean, Faculty of Science
5. Orders of Vice-Chancellor in the file of even No. dated 20.02.2026
6. Minutes of the meeting of Standing Committee of Academic Council held on 21.02.2026
7. Orders of the Vice Chancellor in file of even No dated 15.03.2026

ORDER

1. As per the paper read as (1) above, the Scheme (full) and Syllabus (First and Second Semesters) of the FYUG Electronics Programme in affiliated colleges were implemented with effect from the 2024 admission.
2. As per the paper read as (2) above, the Third and Fourth Semester syllabus of the FYUG Electronics Programme in affiliated colleges under Kannur University were implemented with effect from the 2024 admission.
3. Dr. Rohit K. Raj, Associate Professor & Head, Department of Electronics, Government College, Mananthavady, who has resigned from the Chairmanship of the Board of Studies in Electronics (Cd), submitted (vide paper read as (3) above) the Fifth to Eighth Semester syllabus of the FYUG Electronics Programme for approval and implementation with effect from the 2024 admission.
4. Subsequently, the Fifth to Eighth Semester syllabus of the FYUG Electronics Programme was forwarded to the Dean, Faculty of Science, for verification.
5. The Dean, Faculty of Science, vide paper read as (4) above, recommended approval of the Fifth to Eighth Semester syllabus of the FYUG Electronics Programme.
6. Considering the matter, the Vice Chancellor ordered to place the Fifth to Eighth Semester syllabus of the B.Sc. Electronics Programme before the Standing Committee of the Academic Council for consideration.
7. The Standing Committee of the Academic Council, held on 21.02.2026, vide paper read as (6) above, considered the Fifth to Eighth Semester syllabus of the B.Sc. Electronics

Programme and recommended approval of the same.

8. The Vice Chancellor, after considering the recommendation of the Dean, Faculty of Science, and in exercise of the powers of the Academic Council conferred under Section 11(1), Chapter III of the Kannur University Act, 1996, and all other enabling provisions read together, **approved the Fifth to Eighth Semester syllabus of the B.Sc. Electronics Programme in affiliated colleges under Kannur University and accorded sanction to implement the same with effect from the 2024 admission,** subject to reporting to the Academic Council.

9. The Fifth to Eighth Semester syllabus of the B.Sc. Electronics Programme in affiliated colleges under Kannur University, with effect from the 2024 admission, is appended herewith and uploaded on the University Website

Orders are issued accordingly.

Sd/-
Bindu K P G
DEPUTY REGISTRAR (ACADEMIC)
For REGISTRAR

To:
1. The Controller of Examination (Through PA to CE)
2. Dr. Rohit K. Raj, Associate Professor & Head, Department of Electronics, Government College, Mananthavady.
3. The Principals of all affiliated colleges.

Copy To:
1. The Examination Branch (through PA to CE)
2. JR (Exam)
3. DR/AR (Academic)
4. Computer Programmer
5. The Web Manager I (For uploading in the website)
6. SF/DF/FC

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
Pin-670 002
THAVAKKARA

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY

Four Year Undergraduate Programme

ELECTRONICS

(OBE – Outcome Based Education)

2024 Admission onwards

(Semesters: V,VI,VII & VIII)

List of Courses (Category wise)

Discipline Specific Core Courses (DSC) - Major pathway

Sl. No.	Semester	Course Code	Course Title	MARKS			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	1	KU1DSCELE101	Fundamentals of Electrical and Electronics	35	65	100	3	0	1	4	3	0	2	5
2	2	KU2DSCELE105	Fundamentals of Digital Circuits	35	65	100	3	0	1	4	3	0	2	5
3	3	KU3DSCELE201	Analog Electronics	35	65	100	3	0	1	4	3	0	2	5
4	3	KU3DSCELE205	Microprocessor and microcontroller	35	65	100	3	0	1	4	3	0	2	5
5	4	KU4DSCELE206	Analog Integrated Circuits	35	65	100	3	0	1	4	3	0	2	5
6	4	KU4DSCELE207	Electronic Communication	35	65	100	3	0	1	4	3	0	2	5
7	4	KU4DSCELE208	Electronic Intstrumentation	35	65	100	3	0	1	4	3	0	2	5
8	5	KU5DSCELE301	Fibre optic communication	30	70	100	4	0	0	4	4	0	0	4
9	5	KU5DSCELE302	Digital System Design	35	65	100	3	0	1	4	3	0	2	5
10	5	KU5DSCELE303	Embedded Systems	35	65	100	3	0	1	4	3	0	2	5
11	5		Elective1											
12	5		Elective2											

13	6	KU6DSCELE304	Python Programming	35	65	100	3	0	1	4	3	0	2	5
14	6	KU6DSCELE305	VLSI	30	70	100	4	0	0	4	4	0	0	4
15	6	KU6DSCELE306	ARM Processor	35	65	100	3	0	1	4	3	0	2	5
16	6	KU6INTELE200	**Intership**							2				
17	6		Elective3											
18	6		Elective4											
19	7	KU7DSCELE401	Low power VLSI	35	65	100	3	0	1	4	3	0	2	5
20	7	KU7DSCELE402	Information Theory and coding	35	65	100	3	0	1	4	3	0	2	5
21	7	KU7DSCELE403	Machine Learning	35	65	100	3	0	1	4	3	0	2	5
22	7	KU7DSCELE404	Printed Antennas	35	65	100	3	0	1	4	3	0	2	5
23	7	KU7DSCELE405	Digital Image processing	35	65	100	3	0	1	4	3	0	2	5
Honours with Research														
24	8	KU8RPHELE400	PROJECT							12				
25	8		Elective5*											
26	8		Elective6*											
27	8		Elective7*											
Honours without research														
28	8	KU8DSCELE406	Embedded OS and RTOS	35	65	100	3	0	1	4	3	0	2	5
29	8	KU8DSCELE407	Advanced Python Programming	35	65	100	3	0	1	4	3	0	2	5
30	8	KU8DSCELE408	Deep learning	35	65	100	3	0	1	4	3	0	2	5
31	8		Elective5											
32	8		Elective6											
33	8		Elective7											

*** These electives can be done as online courses. BoS will decide the title of the online courses upon request from the insitution.**

Discipline Specific Core Courses (DSC) - Minor Pathway

Sl. No.	Semester	Course Code	Course Title	MARKS			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	1	KU1DSCELE102	Fundamentals of Digital Electronics	35	65	100	3	0	1	4	3	0	2	5
2	1	KU1DSCELE103	Basic Electronics	35	65	100	3	0	1	4	3	0	2	5
3	1	KU1DSCELE104	Foundations of Electrical and Electronics	35	65	100	3	0	1	4	3	0	2	5
4	2	KU2DSCELE106	Introduction to 8051 Microcontroller	35	65	100	3	0	1	4	3	0	2	5
5	2	KU2DSCELE107	Electronic Devices and Circuits	35	65	100	3	0	1	4	3	0	2	5
6	2	KU2DSCELE108	Digital Electronics	35	65	100	3	0	1	4	3	0	2	5
7	3	KU3DSCELE202	Embedded C and Arduino programming	35	65	100	3	0	1	4	3	0	2	5
8	3	KU3DSCELE203	Linear Integrated Circuits	35	65	100	3	0	1	4	3	0	2	5
9	3	KU3DSCELE204	Analog Circuits	35	65	100	3	0	1	4	3	0	2	5

Discipline Specific Elective Courses (DSE) – Major Pathway

Sl. No.	Semester	Course Code	Course Title	Marks			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	5	KU5DSEELE307	Programming with C	30	70	100	4	0	0	4	4	0	0	4
2	5	KU5DSEELE308	Signals and Systems	30	70	100	4	0	0	4	4	0	0	4
3	5	KU5DSEELE309	PIC microcontrollers	30	70	100	4	0	0	4	4	0	0	4
4	5	KU5DSEELE310	Electromagnetics	30	70	100	4	0	0	4	4	0	0	4
5	5	KU5DSEELE311	Power Electronics	30	70	100	4	0	0	4	4	0	0	4
6	5	KU5DSEELE312	Control System	30	70	100	4	0	0	4	4	0	0	4
7	5	KU5DSEELE313	Wireless sensor Networks	30	70	100	4	0	0	4	4	0	0	4
8	6	KU6DSEELE314	Fundamentals of IOT	30	70	100	4	0	0	4	4	0	0	4
9	6	KU6DSEELE315	Robotics and Automation	30	70	100	4	0	0	4	4	0	0	4
10	6	KU6DSEELE316	Wireless Communications	30	70	100	4	0	0	4	4	0	0	4
11	6	KU6DSEELE317	Digital Signal Processing	30	70	100	4	0	0	4	4	0	0	4
12	6	KU6DSEELE318	Advanced Power electronics	30	70	100	4	0	0	4	4	0	0	4
13	6	KU6DSEELE319	Antennas and Microwave Devices	30	70	100	4	0	0	4	4	0	0	4
14	6	KU6DSEELE320	MEMS	30	70	100	4	0	0	4	4	0	0	4
15	6	KU6DSEELE321	Cryptography	30	70	100	4	0	0	4	4	0	0	4
16	8	KU8DSEELE409	Research Methodology	30	70	100	4	0	0	4	4	0	0	4

17	8	KU8DSEELE410	Computer networks	30	70	100	4	0	0	4	4	0	0	4
18	8	KU8DSEELE411	Microwave Integrated Circuits	30	70	100	4	0	0	4	4	0	0	4
19	8	KU8DSEELE412	Radar and navigation	30	70	100	4	0	0	4	4	0	0	4
20	8	KU8DSEELE413	Industrial Automation	30	70	100	4	0	0	4	4	0	0	4
21	8	KU8DSEELE414	Optical sensing	30	70	100	4	0	0	4	4	0	0	4
22	8	KU8DSEELE415	Mixed Signal Circuit Design	30	70	100	4	0	0	4	4	0	0	4
23	8	KU8DSEELE416	Secure Communication	30	70	100	4	0	0	4	4	0	0	4
24	8	KU8DSEELE417	Basic Tools of Microwave Engineering	30	70	100	4	0	0	4	4	0	0	4

Discipline Specific Elective Courses (DSE) – Minor Pathway

1	8	KU8DSEELE322	Embedded OS and RTOS	30	70	100	4	0	0	4	4	0	0	4
2	8	KU8DSEELE323	Advanced Python Programming	30	70	100	4	0	0	4	4	0	0	4
3	8	KU8DSEELE324	VLSI	30	70	100	4	0	0	4	4	0	0	4
4	8	KU8DSEELE325	Fundamentals of IOT	30	70	100	4	0	0	4	4	0	0	4

Skill Enhancement Courses (SEC)

Sl. No.	Semester	Course Code	Course Title	Marks			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	4	KU4SECELE109	Embedded product design	25	50	75	2	0	1	3	2	0	2	4
2	5	KU5SECELE110	Computer Aided Circuit design	25	50	75	3	0	0	3	3	0	0	3
3	6	KU6SECELE111	PCB Design and Fabrication	25	50	75	3	0	0	3	3	0	0	3

Value Added Courses (VAC)

Sl. No.	Semester	Course Code	Course Title	Marks			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	3	KU3VACELE112	Web Application Development	25	50	75	3	0	0	3	3	0	0	3
2	4	KU4VACELE113	Mobile Application development	25	50	75	3	0	0	3	3	0	0	3
3	4	KU4VACELE114	Artificial Intelligence for You	25	50	75	3	0	0	3	3	0	0	3

Multi Disciplinary Courses (MDC)

Sl.No.	Semester	Course Code	Course Title	Marks			Credit				Hours/Week			
				CE	ESE	Total	L	T	P	Total	L*	T*	P*	Total
1	1	KU1MDCELE115	Computer Hardware	25	50	75	2	0	1	3	2	0	2	4
2		KU1MDCELE116	Electronics for You	25	50	75	2	0	1	3	2	0	2	4
3	2	KU2MDCELE117	R and Python for Data Analysis	25	50	75	2	0	1	3	2	0	2	4
4	3	KU3MDCELE118	Fundamentals of Electric Vehicles	25	50	75	3	0	0	3	3	0	0	3

* L=Lecture, T=Tutorial, P=Practical

Internship & Project

Sl.No.	Semester	Course Code	Course Title	Credit
1	6	KU6INTELE200	INTERNSHIP	2
2	8	KU8RPHELE400	PROJECT	12

SYLLABUS

5^{th} & 6^{th} Semesters

KU5DSCELE301 Fibre optic communication

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Major	300	**KU5DSCELE301**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course provides a comprehensive understanding of optical fiber communication systems, focusing on the fundamental principles, components, and performance of modern fiber-optic links. Students will learn about the structure and propagation characteristics of optical fibers, loss and dispersion mechanisms, optical sources and detectors, and multiplexing strategies used in high-capacity networks. Emphasis is placed on both the theoretical foundation (optical propagation, numerical aperture, modes) and practical aspects (device operation, link design, and system performance).By the end of the course, students will be equipped with the knowledge to analyze, design, and evaluate basic optical communication systems used in telecommunication, sensor networks, and high-speed data transmission.

Course Prerequisite: Basic Electronics and Electromagnetic Theory, Semiconductor Devices

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Describe the basic structure and propagation mechanisms of optical fibers	U
2	Analyze light propagation in optical fibers using ray and wave theories	An
3	Describe the architecture and working of a complete	U

	fiber optic communication system	
4	Describe the principles, structures, and operating characteristics of optical sources, including LEDs and lasers,	U
5	Describe the principles of optical detection and the operation of photodetectors such as PIN and avalanche photodiodes	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1		1	
CO2	3	2	3	1		2	
CO3	2	1	3	2		2	1
CO4	3	1	2	2		1	
CO5	3	1	2	2		1	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1-Introduction**	10
	1.1	Historical development, general system, advantages disadvantages and applications of optical fiber communication	
	1.2	Basic structure of optical fiber, ray transmission, theory, propagation of light in optical fiber, acceptance angle,numerical aperture, Derivation for numerical aperture, skew rays, Ivanacent waves	

	1.3	Single mode, multimode, step index and graded index fibers,	
	1.4	V number and modes supported by step index and graded index fiber	
2		**Module 2-Optical communication and Transmission losess**	15
	2.1	Block diagram of fiber optic communication system	
	2.2	Multiplexing strategies in optical communication,Time Division Multiplexing (TDM). Wavelength Division Multiplexing (WDM): CWDM, DWDM systems,Demultiplexing	
	2.3	Attenuation, absorption, scattering losses, bending loss,	
	2.4	Dispersion, Intra model dispersion, Inter model dispersion	
		Module 3-:Optical sources	15
	3.1	Light emitting diodes, operating principle, different types, construction, spectral response-LED sources in optical communication.	
	3.2	Lasers: Principle of laser, spontaneous and stimulated emission, Einstein equations, different types	
	3.3	Ruby lasers, He- Ne lasers.	
	3.4	Semiconductor lasers, hetrojunction lasers - operation - comparison with LED's	
4		**Module4 :Optical detectors**	10
	4.1	Introduction to Optical Detection,Photoconductors: Structure, operation, and limitations.	
	4.2	p–n, p–i–n (PIN) photodiodes — structure, working principle, and performance.	
	4.3	Avalanche photodiodes (APD) — avalanche multiplication, gain, and noise characteristics.	

	4.4	Detector Characteristics and Parameters, concepts of responsivity, sensitivity and quantum efficiency	
5		**Teacher Specific Module**	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

John M. Senior Optical fiber communications Principles and Practice , (2nd edition) PHI

Suggested Readings:

1 G. Kaiser Optical fiber communication McGraw Hill

2 SubirkumarSarkar Optical fibers and fiber optic communication systems S.Chand and company

3 R. P. Khare Fiber optics and optoelectronics Oxford University Press

5 AjoyGhatak and K. Thyagarajan Introduction to fiber optics Cambridge University Press 6 D. C.

Agarwal Fiber optic communication Wheeler publications

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSCELE302 Digital System Design

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Major	300	KU5DSCELE302	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE (T+P)	ESE (T+P)	Total	
3	2	0	35 (25+10)	65 (50+15)	100	2

Course Description:

This course provides an in-depth understanding of digital logic design principles and methodologies used in modern digital systems. It begins with the study of combinational logic—covering Boolean functions, canonical forms, and systematic simplification methods such as Karnaugh Maps and the Quine–McCluskey algorithm. Students learn to derive and minimize switching equations and implement efficient logic circuits.

The course progresses to the analysis and design of combinational and sequential circuits, including practical subsystems such as adders, comparators, decoders, multiplexers, flip-flops, and counters. Emphasis is placed on both analysis and synthesis procedures, enabling students to design and optimize circuits from given specifications.

Advanced modules introduce the concept of finite state machines (FSM), including Mealy and Moore models, state diagrams, and algorithmic state machine representations for sequential circuit design. The course also explores asynchronous sequential circuits, focusing on their analysis, design, and state assignment challenges.

Finally, students are introduced to programmable logic devices (PLDs) and field-programmable gate arrays (FPGAs), including their internal architectures and design applications using PALs, PLAs, CPLDs, and FPGAs. Through theoretical and design exercises, students develop the ability to analyze, design, and implement practical digital systems using both fixed and programmable logic.

Course Prerequisite; Basic understanding of Digital electronics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Apply Karnaugh map and Quine–McCluskey minimization method	A
2	Analyze basic combinational circuits and clocked sequential circuits	E
3	Understand Mealy and Moore state machine models	U
4	Apply algorithmic state machine (ASM) concepts for digital system design	A
5	Design combinational and sequential circuits using PALs and PLAs	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2						
CO2			2				
CO3			2				
CO4	3	3					
CO5	3	3		3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Definition of combinational logic, Canonical forms,	

		Generation of switching equations from truth tables	
	1.2	Karnaugh maps-3,4,5 variables	
	1.3	Incompletely specified functions (Don't care terms) Simplifying Max term equations	
	1.4	Quine-McCluskey minimization technique, Quine- McCluskey using don't care terms, Reduced prime implicants Tables	
2		**Module 2**	10
	2.1	Combinational Circuits – Analysis and Design Procedures - Binary Adder-Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator	
	2.2	Decoders – Encoders – Multiplexers. Sequential Circuits - Storage Elements: Latches , Flip-Flops	
	2.3	Analysis of Clocked Sequential Circuits - State Reduction and Assignment	
	2.4	Design Procedure - Registers and Counters	
		Module3	10
	3.1	Introduction to digital systems, Mealy and Moore models, State machine-state diagram, state table, transition table, excitation table and realization	
	3.2	Design and analysis of synchronous sequential circuits- construction of state diagrams, state reduction and state assignment techniques, Algorithmic state machines (ASM).	
	3.3	Asynchronous sequential circuits- Fundamental and pulse mode sequential machines,analysis,flow tables, state assignment and design problems	
	3.4		
4		**Module4**	10
	4.1	Basic concepts - programmable logic devices-	

		programmable array logic(PAL),programmable logic array(PLA)	
	4.2	design examples, Complex PLD(CPLD),Field programmable gate arrays-types of FPGA, Configurable Logic blocks (CLB),Input/output block(IOB), Programmable Interconnect Points(PIP)	
	4.3		
	4.4		
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Abraham Kandel- Foundation of Digital Logic Design

2. N.N. Biswas- Logic design theory

3. John.M. Yarbrough- Digital Logic Applications and Design

4. M. Morris R. Mano, Michael D. Ciletti, —Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, 6th Edition, Pearson Education, 2017.

5. Donald G. Givone, "Digital principles and Design", Tata McGraw Hill 2002.

6. Stephen Brown and Zvonk Vranesic, "Fundamentals of Digital Logic with VHDL Deisgn", Tata McGraw Hill, 2002

Assessment Rubrics:

	Marks
End Semester Evaluation	**65(50+15)**
Continuous Evaluation	**35(25+10)**

Laboratory experiments:

1. 8 to1 multiplexer.
2. Functional tables of (i) JK Edge triggered Flip–Flop (ii) JK Master Slave Flip–Flop (iii) D Flip-lop.
3. Four-bit ring counter using D Flip–Flops/JK Flip Flop.
4. Four bit Johnson's counter using D Flip-Flops/JK Flip Flops.
5. 4-bit Universal Shift Register.
6. MOD-8 ripple counter using T-Flip-Flops.
7. MOD–8 synchronous counter using T Flip-Flop.
8. Single bit comparator
9. Segment Display Circuit Using Decoder and7 Segment LED
10. BCD Adder Circuit.
11. 74154 De-Multiplexer using LEDs for outputs.
12.Design and implementation of Mod-N synchronous counter using J-K flip-flops.
13.Design and implementation of shift register to function as i) SISO, ii) SIPO, iii) PISO, iv) PIPO, v) shift left and vi) shift right operation.
14. Design and implementation of i) Ring counter and ii) Johnson counter using 4-bit shift register.
15. Design and implementation of sequence generator.

KU5DSCELE303: Embedded Systems

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Major	300	KU5DSCELE303	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

This is a complete introductory course designed to provide a basic solid understanding of basic and embedded systems concepts and how to make small embedded systems using microcontroller 8051. Examples of embedded systems are also introduced.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Learn about the general principles of computer architecture	U
2	Learn about the working of a simple embedded system and embedded system applications	A
3	Learn the hardware aspects of embedded systems	U
4	Interface sensors, ADCs and actuators to microcontrollers	A
5	Create the real world examples of embedded systems	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2	3	3	3	3	3	3	2
CO3	2	2	2	2	2	2	2
CO4	3	3	3	3	3	3	2
CO5	2	3	3	3	3	3	3

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1 -** Introduction to embedded systems	10
	1.1	Introduction to embedded systems, Application domain of embedded systems, desirable features and general characteristics of embedded systems	
	1.2	Model of an embedded system, microprocessor Vs microcontroller. Example of a simple embedded system, figure of merit for an embedded system	
	1.3	Classification of MCUs: 4/8/16/32 bits, history of embedded systems, current trends	
2		**Module 2 -** Sensors, ADCs and Actuators	10
	2.1	Temperature Sensor, Light Sensor, Proximity/range Sensor.	
	2.2	Analog to digital converters, ADC Interfacing.	
	2.3	Displays, Actuators, Motors.	
	2.4	Opto couplers/Opto isolators, relays.	
		Module3 – Small Embedded Systems based on 8051	10
	3.1	Interfacing ADC to 8051	
	3.2	Interfacing temperature sensor and humidity sensor to 8051	
	3.3	Interfacing hex key board to 8051	
	3.4	Interfacing 8051 to LCD displays	
4		**Module4 -** Examples of embedded systems	10

	4.1	Mobile phone, Automotive electronics	
	4.2	Radio frequency identification (RFID), wireless sensor networks(WISENET)	
	4.3	Robotics, Biomedical applications	
	4.4	Brain machine interface	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Lyla B Das, Embedded systems: An Integrated Approach, 1st Ed., Pearson, 2013

2.The 8051 microcontroller Architecture programming & Applications(II Edition)-Kenneth .J.Ayala

3. The 8051 microcontroller and Embedded systems-Muhammad Ali Mazidi

Suggested Readings:

1. Shibu, K.V., Introduction to Embedded Systems, 1st Ed., TMH, 2009
2. Kanta Rao B, Embedded Systems, 1st Ed., PHI
3. Frank Vahid & Tony Givargis, Embedded System Design, 2nd Edition, John Wiley

Laboratory sessions:

- FMILIARIZE KEIL µVISION IDE AND DEBUGGER
- SEVEN SEGMENT LED INTERFACING
- 16X2 LCD INTERFACING
- ADC INTERFACING
- MATRIX KEYPAD INTERFACING
- STEPPER MOTOR INTERFACING

- TEMPERATURE SENSOR AND RELAY CONTROL
- HUMIDITY SENSOR AND RELAY CONTROL

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, experimental procedures, circuit diagrams, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU5DSEELE307 Programming with C

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	**KU5DSEELE307**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces students to the fundamentals of programming using the C language and its applications in embedded systems. It begins with the basic concepts of syntax, data types, operators, and control structures, progressing through arrays, strings, and user-defined functions. The course emphasizes problem-solving and logical thinking through hands-on programming exercises. Students will also learn advanced features such as pointers, structures, unions, and memory management. The final module introduces Embedded C programming concepts, focusing on register-level programming, interrupts, and

real-time methods using the 8051 microcontroller. By the end of the course, students will be able to design, implement, and debug C and Embedded C programs for real-world applications.

Course Prerequisite:

Students from any discipline with fundamental mathematical understanding can attend this course.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Describe the basic concepts of C programming, including syntax, data types, operators, and control structures.	U
2	Apply decision-making and looping constructs to develop structured C programs	A
3	Apply arrays, strings, and functions effectively for modular program development.	A
4	Implement and manipulate pointers to efficiently handle data and perform dynamic memory	An
5	Develop and execute Embedded C programs for 8051 microcontroller applications using register-level programming and interrupts.	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1					3		
CO2					3		
CO3					3		
CO4					3		
CO5	3				3	2	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1-C- Fundamentals**	15
	1.1	Introduction, character set, constants and variables, Key words, storage class, Symbolic constant	
	1.2	operators and expressions, statements, operator precedence	
	1.3	Managing input and output operations, simple and formatted input/output	
	1.4	Decision making	
2		**Module 2-:Loops, Arrays and Strings**	10
	2.1	Branching and Looping	
	2.2	Defining and processing of an array,Two dimensional arrays	
	2.3	character arrays and strings	
	2.4		
		Module3 :User defined Functions and pointers	15
	3.1	Need for functions, Elements of function, Defining a function, Accessing a function, function, prototype, passing argument	
	3.2	Pointers, declarations, operations of Pointers,	
	3.3	pointers and arrays, pointers and character strings	
	3.4	Pointers as function parameters,passing pointers to a function	
4		**Module4 :**	10
	4.1	Structure and Union	

	4.2	Introduction to embedded C,register variables	
	4.3	real time methods using interrupts	
	4.4	Embedded C for 8051 microcontroller	
5		**Teacher Specific Module**	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. E Balaguruswamy, Programming in ANSI C, 4 th edition, Tata McGraw Hill

2. Richard Barnett, Larry O'Cull and Sarah Cox , Embedded C Programming and the Atmel AVR,
Cengage India edition
3.Abubeker K M, 80C51 µC - Embedded C & ALP Programming ,Notion Press; 1st edition

Suggested Readings:

1 Byron. S. Gottfried Schaum's Outline of Programming with C TMH

2 J. JayasriThe 'C Language Trainer with C Graphics and C++ WILEY

3 Stephens Cochan Programming in C Prentice hall of India Ltd

4 V. Rajaraman Computer Programming in C Prentice hall of India Ltd.

5.Michael J. Pont,Embedded C, PEARSON EDUCATION LIMITED

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE308: Signals and Systems

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	KU5DSEELE308	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	TutorialIf	CE	ESE	Total	
4	0	0	30	70	100	3

Course Description:

This course provides a comprehensive introduction to the fundamental concepts of signals and systems, which form the basis for understanding communication, control, and digital signal processing systems. It covers the classification and representation of continuous-time and discrete-time signals, system properties, and basic signal operations. Students will analyze system behavior in both the time and frequency domains using differential and difference equations, convolution techniques, and Fourier and Laplace transforms. The course emphasizes both theoretical understanding and analytical problem-solving skills required for applications in signal analysis and system design.

Course Prerequisite: Basic understanding of calculus, Linear algebra and Complex numbers

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Classify different types of signals and represent them graphically and mathematically.	U
2	Categorize systems based on properties such as linearity, time invariance, causality, and stability.	U
3	Solve difference and differential equations representing	A

	discrete-time and continuous-time systems.	
4	Apply convolution operations to evaluate the response of discrete-time and continuous-time linear systems	A
5	Perform time-domain and frequency-domain analysis of analog and discrete systems	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1			2				
CO2			2				
CO3			2				
CO4				2			
CO5	3			2			

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Introduction to Signals (Analog and Digital)**	10
	1.1	Definition of signal, Classification of Signal and representation: Continuous time and discrete time, even/odd, periodic/aperiodic, random/deterministic, energy/power	
	1.2	Elementary Signals: Unit Impulse, Step, Ramp, Exponential, Sinusoidal, and Pulse signals	
	1.3	Basic Signal Operations: Time Shifting, Scaling, and Reversal, Amplitude Scaling and Addition	

	1.4	Definition of system and their classification: CT/DT, linear/non-linear,time variant/non-variant, causal and non-causal system state/dynamic system	
	1.5	System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.	
2		**Module 2:Time-Domain Analysis of Discrete Time Systems**	10
	2.1	Difference equation representations of discrete-time systems	
	2.2	Natural response, forced response and impulse response	
	2.3	Response of systems to standard inputs (impulse, step)	
	2.4	Impulse responce and convolution sum,properties of convolution	
	2.5	Convolution of two sequences, matrix convolution	
3		**Module3:Time-Domain Analysis of Continuous Time Systems**	10
	3.1	Differenctial equation representations of continuous-time systems	
	3.2	Natural response, forced response and impulse response	
	3.3	Step response	
	3.4	Convolution	
4		**Module4: Frequency Domain Analysis**	10
	4.1	Introduction to Fourier analysis, Continuous-time Fourier Series and Transform (Theory only)	
	4.2	Discrete-time Fourier Series and Transform (DTFT), Amplitude and phase spectra – (Theory only)	
	4.3	Laplace Transform, Properties of Laplace transform	

	4.4	Inverse Laplace transform	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Simon Haykin and Barry Van Veen, Signals and Systems, Wiley.

2. P. Ramesh Babu, Signals and Systems, Scitech Publications.

3. Proakis, Digital Signal Processing: Principles, Algorithms and Applications.(PHI)

4. A. V. Oppenheim, A. S. Willsky, and S. Hamid, Signals and Systems, Pearson Education.

Suggested Readings:

1. P-Z Peebles – Probabilities, Random Variables and Random Signal Principles – TMH.

2. B.P. Lathi, Signals & Systems and Communication – BSP.

3. Alan V. Oppenheim & Ronald Schafer, Discrete-Time Signal Processing, Pearson.

4. Michael J. Roberts, Fundamentals of Signals and Systems, McGraw-Hill.

5. Schaum's Outline Series, Signals and Systems, McGraw-Hill.

6.Ashok Ambardar, Digital Signal Processing: A Modern Introduction, Cengage Learning India

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE309: PIC Microcontrollers

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	KU5DSEELE309	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	0

Course Description:

This is a complete introductory course designed to provide a solid understanding of the basics and programming concepts of PIC 16F877A microcontroller. Topics covered includes architecture, programming, IO Port operations, interfacing of PIC microcontroller and system design using the same.

Course Prerequisite; Basic understanding of Digital electronics and microcontrollers

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	To Understand the architecture and features of PIC microcontrollers	U
2	Write and debug assembly/C programs for PIC microcontrollers	A
3	Interface digital and analog peripherals with PIC.	A
4	Design and implement basic embedded system applications.	A
5	Construct working projects using PIC Microcontrollers	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3						
CO2					3		
CO3					3	2	
CO4				3	3	3	3
CO5	3			3	3	3	3

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Introduction to Microcontrollers and PIC Architecture**	10
	1.1	Overview of microcontrollers vs microprocessors	
	1.2	Features and advantages of microcontrollers	
	1.3	Overview of PIC microcontrollers (PIC16F877A)	
	1.4	PIC architecture and memory organization- Harvard architecture, Program memory, data memory, stack, and registers	
	1.5	Clock system and instruction cycle	
	1.6	CPU registers and instruction set classification	
		Module 2: PIC Programming and I/O Port Operations	15

2	2.1	Instruction set and addressing modes	
	2.2	Data transfer, arithmetic, logic, and branch instructions	
	2.3	I/O port configuration and programming	
	2.4	Using TRIS and PORT registers	
	2.5	Delay generation and subroutines	
	2.6	Introduction to embedded C programming for PIC	
		Module3: PIC Peripherals and Interfacing	15
	3.1	Timers and Counters: Configuration and programming	
	3.2	Interrupts: Concept, types, and vector table	
	3.3	Analog-to-Digital Converter (ADC): Configuration and programming	
	3.4	PWM and CCP modules	
	3.5	Serial Communication: UART, SPI, and I²C basics and interfacing	
4		**Module4: Application Development and System Design**	15
	4.1	Interfacing LCD and keypad	
	4.2	Interfacing sensors (temperature, IR, ultrasonic, etc.)	
	4.3	DC motor and stepper motor control	
	4.4	Basic real-time applications using interrupts and timers	
	4.5	Overview of low-power modes and watchdog timer	

	4.6	Introduction to PIC18 series and comparison with PIC16 series (Detailed study not required)	
5		**Teacher Specific Module**	5
	Small working model development using PIC16F877A • Temperature Monitor • Humidity Monitor • Water Level Controller etc.		

Essential Readings:

1. Mazidi, Muhammad Ali & McKinlay, Rolin D., *PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18*, Pearson Education.
2. Han-Way Huang, *PIC Microcontroller: An Introduction to Software and Hardware Interfacing*, Cengage Learning.
3. Myke Predko, *Programming and Customizing the PIC Microcontroller*, McGraw Hill.

Suggested Readings:

4. Microchip Technology Inc. – PIC16F877A Datasheet & Application Notes
5. MPLAB X IDE and XC8 Compiler documentation
6. Online tutorials and Microchip developer resources

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE310: Electromagnetics

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	KU5DSEELE310	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course is desinged to provide indepth knowledge in Electromagnetics. The course starts with basic mathematical techniques useful in Electromagentic problems, and then explains Electrostatics and magnetostatics. Finally Electromagnetics is explained with Maxwell's equations.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain vector calculus & field theorems	U
2	Analyze electrostatic & magnetostatic problems	An
3	Interpret Maxwell's equations	U
4	Examine waves & evaluate Poynting power flow	E
5	Describe radiation, polarization & antennas	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		3			2	
CO2	3		3			2	
CO3	3		3			2	
CO4	3		3			2	
CO5	3					2	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Concept of Circuit & Fields, Vector Analysis	
	1.2	Physical interpretation of gradient, Divergence & curl	
	1.3	Integral theorems & comparison	
2		**Module 2**	15
	2.1	Electrostatics : Introduction, fundamental relations of electro static field – Gauss's law - special Gauss surfaces – the potential function, divergence theorem – Poisson's & Laplace's equation. Boundary conditions	
	2.2	Magnetostatics :Biot – Savart law, force between two current carrying coils	
	2.3	Magnetic flux density, Magnetic field intensity, Intensity of Magnetisation - Ampere's circuital theorem	
	2.4	Lorent's force- Magnetic vector potential –Boundary conditions for magnetic fields	
		Module3	15
	3.1	Electrodynamics: Faraday's law of induction	
	3.2	Modified Amper's law – Maxwell's equation	
	3.3	Wave equation – solutions of wave equation in free space	
	3.4	Poynting vector- electromagnetic energy.	
4		**Module4**	10
	4.1	Radiation of electromagnetic fields – Dipole and monopole antennas (concept only)	
	4.2	Polarization –isotropic radiator –plane waves – electromagnetic spectrum.	
5		Teacher Specific Module	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Electromagnetic waves & radiating systems – Jordan & Balmier -PH (New edition)
2. Fundamentals of Electrodynamics- Grifith (IV Edition)
3. Fundamental of electronic waves – Hugh H. S Ane books
4. Engineering electromagnetics- Haytt

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE311: POWER ELECTRONICS

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	KU5DSEELE311	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: This course covers power semiconductor devices, including their need and types like power diodes and thyristors, with a focus on the Silicon Controlled Rectifier (SCR) and its characteristics, gate-triggering circuits, and protection methods. It also includes other power devices like Diac, Triac, IGBT,

and MOSFET, and delves into their applications, such as rectification and AC voltage control. Furthermore, the course examines power inverters and choppers, which are used to convert and control DC power, as well as electromechanical machines like DC and AC motors, including their basic principles and thyristor-based speed control methods.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the need and types of semiconductor power devices, their structures, characteristics, and applications. Describe the construction, operation, and characteristics of SCRs, and analyze their turn-on, turn-off, and protection circuits (including gate triggering and snubber circuits).	U
2	Explain the operation and characteristics of DIAC, TRIAC, IGBT, Power MOSFETs, and BJTs, and their applications in power control circuits.	U
3	Analyse the operation of SCR-based rectifiers (half-wave, full-wave, and bridge types) for inductive and non-inductive loads, and evaluate their use in phase control and AC voltage regulation.	An
4	Explain the principles, operation, and commutation methods of power inverters and DC choppers, and analyse their role in power conversion systems.	An
5	Develop the construction, working, and characteristics of DC and induction motors, and explain thyristor-based speed control methods for both DC and AC drives.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2				

CO2	3		2				
CO3		3		3			
CO4	3		3				
CO5	3	3		3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Power Devices: Need for semiconductor power devices, Power diodes, Enhancement of reverse blocking capacity, Introduction to family of thyristors.	
	1.2	Silicon Controlled Rectifier (SCR): structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting characteristics/ratings of SCR	
	1.3	Gate-triggering circuits, Control circuits design and Protection circuits, Snubber circuit.	
2		**Module 2**	10
	2.1	Diac and Triac: Basic structure, working and I-V characteristic of, application of a Diac as a triggering device for a Triac.	
	2.2	Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc.	
	2.3	Application of SCR: SCR as a static switch, phase-controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads.	
	2.4	Power MOSFETs: operation modes, switching characteristics.	

		Module3	15
	3.1	Power Inverters: Need for commutating circuits and their various types, d.c. link inverters, Parallel capacitor commutated invertors with and without reactive feedback and its analysis.	
	3.2	Series Inverter, limitations and its improved versions, bridge inverters	
	3.3	Choppers: basic chopper circuit, types of choppers, step-down chopper, step-up chopper	
	3.4	Operation of d.c. chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper (using class D commutation).	
4		Module4	15
	4.1	Electromechanical Machines: DC Motors, Basic understanding of field and armature	
	4.2	Principle of operation, EMF equation, Back EMF, Factors controlling motor speed,	
	4.3	Thyristor based speed control of dc motors, AC motor (Induction Motor only), Rotor and stator, torque & speed of induction motor,	
	4.4	Thyristor control of ac motors (block diagrams only)	
5		Teacher Specific Module	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings: 1. Power Electronics, P.C. Sen, TMH

2. Power Electronics & Controls, S.K. Dutta

3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH

4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education

5.Power Electronics , Bimbhra

6.Power Electronics, Daniel W Hart

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE312: CONTROL SYSTEM

Semester	Course Type	Course Level	Course Code	Credits (L+T+P)	Total Hours (L+T+P)
5	Elective	300	KU5DSEELE312	4+0+0	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the principles and applications of control engineering in electronic system. Students learn to model physical systems using differential equations and transfer functions. To interpret different physical and mechanical systems in terms of electrical models for analysis. It employs time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions. Analyses the stability of a system in time domain and frequency domain. Identify the need for different types of controllers.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the fundamentals of control system ,types of control system and modelling of physical systems	U

2	Evaluate the transfer function of the system using block diagram reduction and Mason's Gain formula.	E
3	Analyse the time -domain response of the control system determine the performance parameters and Analyses different controllers	An
4	Apply stability analysis techniques using Routh -Hurwitz criterion,Root locus,Bode plot and Nyquist plot.	A
5	Create different compensator networks	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	2	1		-	-	-
CO 2	3	3	2	2	-	-	-
CO 3	3	3	2	1	-	-	-
CO 4	3	3	2	2	1	-	-
CO 5	2	3	3	2	1	-	-

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1	**Module I**		**10**
	1.1	Introduction to control system , Types of control systems, Effect of feedback control system	
	1.2	Differential equations of physical system- Mechanical systems Translational systems, Rotational systems,	

	1.3	Electrical systems and analogous system	
	1.4	Transfer functions ,Block diagram algebra signal flow graphs ,Mason's gain formula	
2	**Module II:**		**10**
	2.1	Standard test signals ,unit step response of first order and second order systems	
	2.2	Time response specifications of second order systems	
	2.3	Definition of Pole ,Zero, order and Type.	
	2.4	Steady state errors and error constants for different input signals	
3	**Module III**		**15**
	3.1	Concepts of stability ,Necessary conditions for stability	
	3.2	Routh- Hurwitz stability criteria	
	3.3	Absolute, relative and Marginal stability	
	3.4	PD, PI and PID controllers	
4	**Module IV:**		**15**
	4.1	Root locus technique introduction, concepts and construction of Root loci	
	4.2	Bode plot, Frequency domain specification from plots	
	4.3	Nyquist plot ,frequency domain specification from plots	
	4.4	Compensator networks: Lead, Lag and Lead Lag compensators	
5	**Teacher Specific Module**		**10**

	Directions: Teacher can design this module based on their expertise and demand from the students	
	Space to fill the selected area/ activity	

Essential Readings:

1. Nagarath and M.Gopal , " Control system Engineering", New Age international limited,publishers,Fourth edition-2005

2. M.Gopal, "Control System -Principles and Design", Tata McGraw Hill.

Suggested Readings

3."Control Systems " second edition A. Nagoor Kani

1. Benjamin.C.Kuo, "'Automatic Control System", 11 Edn. Prentice Hall of India, New Delhi

2. "Linear control systems" B.S Manke

3. S.K.Bhattacharya, "Control Systems Engineering', 5thEdn. Wiley.

4. Schaum 's Series Book, "Feedback Control Systems" McGraw-Hill Education; 2nd edition

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU5DSEELE313: Wireless sensor Networks

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
5	Elective	300	**KU5DSEELE313**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the fundamental concepts, design principles, and applications of Wireless Sensor Networks (WSNs). Students will gain an understanding of how distributed sensing, wireless communication, and embedded systems work together to enable modern Internet of Things (IoT) applications

Course Prerequisite: Basic understanding of Computer Networks, Communication Systems and basic programming skills

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Describe the overview of wireless sensor networks and enabling technologies for wireless sensor networks	U
2	Apply the design principles of WSN architectures and operating systems for simulating environment situations.	E
3	Apply various concepts for assignment of MAC addresses.	U
4	Select the appropriate infrastructure, topology, joint routing and information aggregation for wireless sensor networks	C
5	Develop practical experience through projects	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1			1		1		
CO2	3				2		1

CO3	3		3				
CO4	3				3		1
CO5	3		3		3		2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: OVERVIEW OF WIRELESS SENSOR NETWORKS**	10
	1.1	Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints and challenges	
	1.2	Enabling Technologies for Wireless Sensor Networks	
	1.3	Types of wireless sensor networks	
2		**Module 2: ARCHITECTURES**	15
	2.1	Network Architecture- Sensor Networks Scenarios- Design Principle,	
	2.2	Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit,	
	2.3	Gateway Concepts, Operating Systems and Execution Environments	
	2.4	Introduction to Tiny OS and nesC- Internet to WSN Communication	
		Module3: NETWORKING SENSORS	15
	3.1	MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - SMAC, - B-MAC Protocol,	

	3.2	IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol,	
	3.3	Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses,	
	3.4	Routing Protocols Energy Efficient Routing, Geographic Routing.	
4		Module4: INFRASTRUCTURE ESTABLISHMENT	15
	4.1	Topology Control	
	4.2	Clustering	
	4.3	Time Synchronization, Localization and Positioning	
	4.4	Sensor Tasking and Control	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

2. Feng Zhao & Leonidas J.Guibas, "Wireless Sensor Networks-An Information Processing Approach", Elsevier, 2007

3. Waltenegus Dargie , Christian Poellabauer, "Fundamentals Of Wireless Sensor Networks - Theory And Practice", John Wiley & Sons Publications, 2011

Suggested Readings:

1. KazemSohraby, Daniel Minoli, & TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.

2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003

Laboratory Sessions:Practical sessions to include programming and

interfacing programms based on theoretical concepts using microcontroller 8051 trainer kit

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSCELE304: Python Programming

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Major	300	KU6DSCELE304	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	3

Course Description:

This is a complete introductory course designed to provide a basic understanding of the programming concepts of Python Language. Topics covered include basic processor instructions sets ,programming concepts related to arrays and function handling

Course Prerequisite; Basic understanding of Computer systems, architecture and Fundamental Mathematics Concepts

Course Outcomes

CO No.	Expected Outcomes	Learning Domains

1	To explain the concepts of variables, operators, and control flow statements. To describe the purpose and usage of functions and modules of python	U
2	To demonstrate comprehension of Python programming concepts by explaining how loops/conditional statements	A
3	Apply their knowledge to solve problems by writing Python scripts that use standard programming constructs	E
4	To debug Python code by identifying and correcting errors.	C
5	To assess the effectiveness of different programming approaches, and make decisions	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		1		1		
CO2	3		1				
CO3	3		2		1		1
CO4	3		1	2	1		2
CO5	3		3	3	2		2

COURSE CONTENTS

Contents for Classroom Transaction

			Hours
1		**Module 1:** Fundamentals of Python Language	10
	1.1	Python features, comparison with C & Execution of a python program	
	1.2	comments, identifiers, keywords, variables	

	1.3	Different operators in python, operator precedence and associativity, input & output Statements	
2		**Module 2: Control statements, arrays and strings**	10
	2.1	If, if…else, if…else if…. else statements	
	2.2	Loops-while, for, infinite, nested	
	2.3	Break, continue, pass, assert and return statements	
	2.4	Arrays-creating, importing an array module, indexing and slicing on arrays	
		Module3: Sequences, dictionaries and Functions	10
	3.1	String operations-length, indexing, slicing, repeating, concatenation, checking, basic string operations	
	3.2	List- creating list, accessing, updating and deleting elements from a list, basic list operations.	
	3.3	Tuple- creating and accessing tuples in python, basic tuple operations Operations on dictionary, dictionary methods, using for loop with dictionaries	
	3.4	Function-built-in functions, composition of functions, user defined functions , Parameter and arguments, python recursive and anonymous function	
4		**Module4: Object Orientation**	10
	4.1	Procedure orient approach and object orient approach, Problems in procedure orient approach and speciality of python approach	
	4.2	Features of OOPS	
	4.3	Classes, creating a python class, objects-creating a class, declaring class objects	

	4.4	Self-variable, constructor, types of variables and methods	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python
2. Richard L. Halterman, Learning to Program with Python

Suggested Readings:

1. Martin C. Brown, Python: The Complete Reference
2. **https://www.youtube.com/watch?v=eWRfhZUzrAc**
3. **.https://nptel.ac.in/courses/106106145**

Laboratory Sessions: Practical sessions to include installing python and programming based on theoretical concepts

- Find the factorial of a number.
- Check if a number is positive, negative, or zero.
- Find the largest among three numbers.
- Convert decimal to binary, octal, and hexadecimal.
- Generate the Fibonacci sequence.
- Check if a number is a Fibonacci number.
- Check if a string is a palindrome.
- Reverse a string.
- Count the number of vowels in a string.
- Find the sum of elements in a list.
- Find the largest and smallest numbers in a list.
- Reverse a list.
- Sort a list in ascending order
- Reverse a list

- Find the sum of all elements in a list
- Find common elements between two tuples
- Remove duplicates from a tuple
- Program to create multiple objects of a class
- Program to overload + operator using add ()

Lab rules to be followed

Each experiment should be accompanied by a detailed lab note containing the programme with flow chart or algorithm

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU6DSCELE305: VLSI

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Major	300	KU6DSCELE305	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course is designed to provide a solid understanding of the basics of VLSI. The course cover IC fabrication techniques, MOS characteristics, MOS based circuits and design of various subsystems

Course Prerequisite;Basic understanding of Semi conductor and Digital electronics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the VLSI design process, including architectural, logical, and physical design methodologie	U
2	Analyze the electrical characteristics of MOS and CMOS devices, including threshold voltage, MOS models, inverter behavior, and power dissipation.	An
3	Interpret and apply layout design rules to create simple CMOS layouts and evaluate parasitic effects.	A
4	Design pass-transistor and transmission-gate-based logic circuits and evaluate their performance.	C
5	Develop subsystem-level circuits such as parity generators, multiplexers, and basic arithmetic blocks using CMOS logic.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2			2	
CO2	3		3			2	
CO3	3	2	3	2		3	
CO4	3	3	3	3		3	
CO5	3	3	3	3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Overview of design methodology: VLSI design process - Architectural design - Logical design - Physical design - Layout styles - Full custom - Semicustom approaches	
	1.2	BASIC ELECTRICAL PROPERTIES OF MOS AND (- l\4OS CIRCUITS : MOS ransistor - Threshold voltage - Threshold voltage equations - MOS device equalent circuit - Basic DC equations- Second order effects - MOS models - Small signal AC characteristics	
	1.3	MOS invorrer - Depletion mode and enhancement mode pull ups - CMOS inverter - VI characteristics - Inverter delay	
	1.4	Pass tansistor - Transmission gate - Power consumption in CMOS gaus - Static dissipation - Dynamic Dissipation.	
2		**Module 2**	15
	2.1	VLSI fabriration techniques : An overvierv of Wafer fabrication – Wafer processing - Oridation - Patterning - Diffusion - Ion implantation - Deposition	
	2.2	Silicon gate NMOS prorcess - CMOS processes - NWell - PWell – Twin tub - Silicon on insulalor	
	2.3	CMOS process enhancements - Interconnect - Circuit elements- Latch up - Latchup prevention techniques.	
		Module3	15
	3.1	Layout Design Rules : Need for design rules - Mead Conway design rules for the silicon gate NMOS process	
	3.2	CMOS based design rules -Simple lavout examples	
	3.3	Sheet resista rce - Area capacitance - Wiring capacitance - Driving large capacitive loads	
4		**Module4**	15
	4.1	:Logic design,Sub system and ALU: Switch logic - Pass	

		transistor and transmission gate based design	
	4.2	Gate logic - Inverttr - Two input NAND gate - NOR gate	
	4.3	Other forms of CMOS logic – Dynamic CMOS iogic - Clocked CMOS logic - Precharged domino CMOS logic	
	4.4	Structured design – Simple combinational logic design examples - Parity generator - Multiplexers -Subsystem Design Process : General arrangement of a 4-bit arithmetic processor	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Kamran Eshraghian, Douglas A Pucknell and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems,"Prentice Hall of India, New Delhi, 20115.

2. Neil H E West and Kamran Eshranghian, "Principles of CMOS VLSI Design: A system Perspective", Addision-Wesley, 2nd Edition, 2004.

3. Sung-Mo Kang and Yusuf Leblebici," CMOS Digital Integrated Circuits",Tat,r McGraw- Hill,3rd Edition, New Delhi,2008.

4. Jan M Rabaey, Chandrasekaran A and Nikolic B, "Digital Integrated Circuits, ' Pearson Education,3rd Edition, 2004.

5. Amar Mukherjee, "lnroduction to nMOS and CMOS VLSI System Design", Prentice Hall

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSCELE306: ARM Processor

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Major	300	KU6DSCELE306	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

This is a complete introductory course designed to provide knowledge of architecture of ARM 7processor, LPC2148 and assembly programming of ARM. Topics include Learn to design, construct, and program, verify, analyze and troubleshoot ARM assembly and C language programs and supporting hardware.

Course Prerequisite: Knowledge of Digital Electronics, Microcontroller Architecture and Programming

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand the features of embedded systems, architecture of ARM7 and applications.	U
2	Understand the instruction set and development tools of ARM.	A
3	Understand the THUMB state and achieving competency in assembly programming of ARM.	A

4	Understand the architectural features of LPC2148 microcontrollers.	U
5	Understand the hardware and interfacing peripheral devices to LPC2148	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	2	3	3	3	2
CO2	2	2	2	3	3	3	2
CO3	2	2	2	3	3	3	2
CO4	2	2	2	3	3	3	2
CO5	2	2	2	3	3	3	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	The RISC design philosophy, ARM design philosophy, ARM core data flow model.	
	1.2	Embedded system hardware- AMBA bus protocol, embedded system software- applications.	
	1.3	Registers, CPSR-Processor modes, Banked registers. Pipeline- Characteristics.	
2		**Module 2**	10
	2.1	Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples.	

	2.2	Data processing, Branch, Load-store, SWI and Program Status Register instructions.	
		Module3	10
	3.1	Introduction to THUMB, Differences between ARM and THUMB, Register usage in Thumb, ARM Thumb Interworking.	
	3.2	General Structure of ARM assembly module, Assembler directives- AREA, ENTRY, END, SPACE, DCD, DCB, DCW, DCI, DCQ, EQU, EXPORT, ALIGN, CODE16, CODE32, DATA.	
	3.3	Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan.	
4		**Module4**	10
	4.1	LPC 2148 -Salient features, applications, block diagram, memory mapping.	
	4.2	Functional features of Interrupt controller, RTC, USB, UART, I2C, SPI, SSP controllers, watch dog timers and other system control units.	
	4.3	Pin Connect Block- Features, Register description with example. GPIO-Features, Applications, Pin description, Register description with examples	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. ARM System Developer's guide –Andrew N. SLOSS, ELSEVIER Publications,ISBN 978-81-8147-646-3, 2016
2. ARM Assembly Language – William Hohl, CRC Press, ISBN:978-81-89643-04-1
3. ARM System-on-chip Architecture by Steve Furber, Pearson Education,ISBN978-81-317-0840-8, 2E,2012

Suggested Readings:

1. LPC 2148 USER MANUAL
2. IN SIDER'S GUIDE TO PHILIPS ARM7 BASED MICROCONTROLLERS hitex.co.uk
3. ARM Programming Techniques – from ARM website
4. Embedded Systems: A Contemporary Design Tool- James K. PeckolISBN: 978-0-471- 72180-2 October 2007, ©2008
5. www.Arm.com

Laboratory Sessions:

Write Assembly Language Programs to

- Multiply two 16-bit binary numbers.
- Add two 64-bit numbers.
- Find the sum of first 10 integer numbers.
- Find factorial of a number.
- Add an array of 16-bit numbers and store the 32-bit result in internal RAM.
- Find the square of a number (1 to 10) using look-up table.
- Find the largest/smallest number in an array of 32 numbers.
- Arrange a series of 32-bit numbers in ascending/descending order.
- Count the number of ones and zeros in two consecutive memory locations.
- Scan a series of 32-bit numbers to find how many are negative.
- Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
- Interface a DAC and generate Triangular and Square waveforms.
- Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
- Interface a simple Switch and display its status through Relay, Buzzer and LED.

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, experimental procedures, circuit diagrams, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU6DSEELE314:FUNDAMENTALS OF IoT

Semester	Course Type	Course Level	Course Code		Credits (L+T+P)	Total Hours (L+T+P)
6	Elective	300	KU6DSEELE314		4+0+0	60
Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description

This course on Internet of Things (IoT) provides students with a comprehensive understanding of modern connected systems that integrate sensors, embedded devices, communication networks. This

course introduces the Fundamental Architecture of IoT, device hardware, Wireless communication Protocols cloud connectivity and security aspects, This course prepares students to design and develop Smart IOT application for various domains.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain IoT architecture and key Functional elements	U
2	Apply communication protocols for IoT data exchange	A
3	Evaluate sensors and Build IoT based Prototypes	E
4	Analyse the IoT Hardware and communication devices .	An
5	Design and create IoT based Devices in different Fields	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	2	1	-	-	-	-
CO 2	3	3	2	1	-	-	-
CO 3	1	2	2	1	-	-	-
CO 4	2	3		2	1	-	-
CO 5	2	3	3	2	1	-	-

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1	**Module I**		**10**
	1.1	Introduction to IoT: Definition, Evolution, importance and Characteristics of IoT	
	1.2	Physical design of IoT, Logical design of IoT.	
	1.3	IoT functional blocks & architecture Three- Layer and Five layer model of IoT	
	1.4	IoT communication Network: Home Area Network (HAN) Neighbourhood Area Network(NAN) Field Area Network (FAN) Wide Area Network (WAN) Wireless sensor Networks (WSNs)	
2	**Module II:**		**10**
	2.1	IoT protocols: IoT Access Technologies Physical and MAC layer topology and security of IEE 802.15.4,802.15.4g, 802.15.4e	
	2.2	Wireless technologies: Wi-Fi, Bluetooth, Zigbee	
	2.3	LoRa, RFID, NFC	
	2.4	Network and cloud connectivity.	
3	**Module-III**		**15**
	3.1	IoT sensors /Actuators: Sensor Technology Mobile phone based sensors, Medical sensors, Neural sensors characteristics and interfacing	

	3.2	Types of Actuators, characteristics and interfacing	
	3.3	Microcontrollers: Arduino, ESP32,Raspberry Pi overview	
	3.4	IoT Design challenges, Development challenges privacy and security challenges.	

	Module IV:		**15**
4	4.1	Applications of IoT: Smart homes and Smart Appliances	
	4.2	Health care monitoring	
	4.3	Smart Agriculture and environment sensing	
	4.4	Industrial IoT	
	Teacher specific module		**10**
	Directions: Teacher can design this module based on their expertise and demand from the students		
5	Space to fill the selected area/ activity		

Essential Readings:

1.RajKamal ,Internet of Things: Architecture and Design principles Mc Graw Hill(India)

2.Internet of things(A-Hand-on Approach) By Vijay Madisetti and ArshdeepBahga 1st edition,Universal press

3,Internet of Things: connecting objects by Hakima Chaouchi Wiley publication

Suggested Readings:

1 .David Hanes ,IoT Fundamentals: Networking Technologies,Protocols and Use Cases for the Internet of things",Cisco press,Pearson, 2017.

2. Simone Cirani, "Internet of things: Architecture ,protocols and standard", Wiley,2019

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE315: Robotics and Automation

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	**KU6DSEELE315**	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the principles and technologies of Robotics and Automation used in modern manufacturing and industrial systems. It covers automated flow lines, assembly systems, robot anatomy, actuators, sensors, manipulator kinematics and dynamics, trajectory planning, and robot programming. Students gain a foundational understanding of industrial automation and develop the analytical and practical skills required to design, analyze, and apply robotic systems in real-world applications.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the fundamentals of automation, including types, basic elements, and levels of automation used in manufacturing systems	U
2	Analyze automated flow lines and assembly line operations, including transfer mechanisms, buffering, and line balancing methods	A
3	Describe and differentiate industrial robot components such as actuators, sensors, grippers, and feedback devices	U
4	Apply kinematic and dynamic principles (DH notation, Jacobians, Lagrange–Euler/ Newton–Euler methods) to	A

	solve manipulator motion and plan trajectories.	
5	Develop robot programs using suitable programming languages/software and demonstrate industrial applications in material handling, welding, assembly, and inspection.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2				
CO2	2	2	3	2		2	
CO3	3	2	3	2		2	
CO4	3	2	3	2		3	
CO5			2	3	3	2	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	NTRODUCTION TO AUTOMATION Need, Types; Basic elements of an automated system; Manufacturing industries; Types of production; Functions in manufacturing	
	1.2	Organization and information processing in manufacturing; Automation strategies and levels of automation	
	1.3	Hardware components for automation and process control; Mechanical feeders, hoppers, orienters, high-speed automatic insertion devices.	
2		**Module 2**	15
	2.1	AUTOMATED FLOW LINES Part transfer methods and mechanisms; Types of flow lines; Flow line with/without buffer storage; Quantitative	

		analysis of flow lines.	
	2.2	ASSEMBLY LINE BALANCING Assembly process and assembly systems; Assembly line balancing methods; Improving line performance; Flexible assembly lines.	
	2.3	INTRODUCTION TO INDUSTRIAL ROBOTICS Robot configurations; Functional line diagram; Degrees of freedom; Grippers – factors to be considered in the design of grippers	
	2.4	ROBOT ACTUATORS & FEEDBACK COMPONENTS Actuators, pneumatic, hydraulic actuators Electric and stepper motors, comparisons, position sensors, potentiometers, resolvers, encoders, velocity sensors, tactile sensors, Proximity sensors	
		Module3	15
	3.1	MANIPULATOR KINEMATICS & DYNAMICS Homogeneous transformations as applicable to rotation and transition D-H notation, Forward inverse kinemetics	
	3.2	Manipulator dynamics: Differential transformations, Jacobians, Lagrange–Euler and Newton- Euler formations.	
	3.3	Trajectory planning, trajectory planning and avoidance of obstacles path planning, skew motion, joint integrated motion, straight line motion	
4		**Module4**	15
	4.1	ROBOT PROGRAMMING Programming methods; Requirements and features of robot programming languages;	
	4.2	Software packages; Problems with programming languages.	
	4.3	Robot applications in manufacturing: Material transfer, material handling, loading/unloading, welding, spray painting, assembly and inspection.	
	4.4		

5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Automation, Production systems and CIM, M.P. Groover, Pearson Edu.

2. Industrial Robotics-Mikell P Groover and Mitchell Weiss, Roger N Nagel, Nicholas, G Odrey, Mc Graw Hill, 1986

References:

1. Robotics and control, RK Mittal and IJ Nagrath, Tata Mc Graw Hill 2004

2. An Introduction to Robot Technology, P Coiffet and M.Chaironaze, Kogam Page Ltd 1983, London

3. Robotic Engineering-Integrated approach by Richard d Klafter-London, Prentice Hall 1989

4. Robotics, Fundamental concepts and analusis- Ashitave Ghosal, Oxford Press

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE316: Wireless Communications

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	KU6DSEELE	4+0+0	60+0+0

			316		

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course is designed to provide a solid understanding of Modern wireless communication systems. The course focus mainly on Cellular communication systems. It also address multiple access concepts and intelligent cell concepts.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain wireless system evolution & technologies	U
2	Analyze cellular design concepts	An
3	Evaluate interference & system capacity	E
4	Compare multiple access techniques	An
5	Describe intelligent cells & CDMA concepts	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2			2	
CO2	3		3	2		2	
CO3	3		3	3		2	
CO4	3		3	2		2	
CO5	3		2	2		2	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Evolution of mobile radio communications, examples of	

		wireless comm. systems, paging systems,Cordless telephone systems, comparison of various wireless systems.	
	1.2	Modern Wireless Communication Systems: Second generation cellular networks, third generation wireless networks.	
	1.3	Wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks.	
2		**Module 2**	15
	2.1	Spectrum Allocation, basic Cellular Systems, performance Criteria, Cellular System Design Fundamentals: Frequency Reuse.	
	2.2	Operation of cellular systems, analog cellular systems, digital Cellular Systems.	
	2.3	Channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity	
		Module3	15
	3.1	Introduction to Multiple Access, FDMA, TDMA	
	3.2	Spread Spectrum multiple Access, space division multiple access	
	3.3	Packet ratio, capacity of a cellular systems	
4		**Module4**	15
	4.1	Intelligent cell concept, applications of intelligent micro-cell Systems	
	4.2	In-Building Communication	
	4.3	CDMA cellular Radio Networks	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Wireless Communications: Theodore S. Rappaport; Pearsons.

2. Mobile Cellular Telecommunication: W.C.Y.Lee; McGraw Hill

3. Mobile Communications: Jochen Schiller; Pearson

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE317: Digital Signal Processing

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	KU6DSEELE317	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the mathematical foundations and computational techniques used in the analysis and design of discrete-time systems. It covers the Z-transform and its applications in system analysis, the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) algorithms for spectral analysis, and the realization of digital systems using various structures. The

course also explores the design and implementation of Infinite Impulse Response (IIR) digital filters.

Course Prerequisite: Basic understanding of Signals and systems

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Apply the Z-transform and its properties to analyze discrete-time signals and systems	A
2	Interpret the Discrete Fourier Transform (DFT) and apply its properties for spectral analysis of finite-duration sequences	A
3	Analyze discrete-time systems using transfer functions, convolution, and relationships between Z-transform and Laplace transform	A
4	Construct block diagrams and signal flow graphs for recursive and non-recursive systems.	A
5	Design digital IIR filters from analog prototypes using Impulse Invariant and Bilinear Transformation methods.	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	3	1		2	
CO2	3	2	3	1		3	
CO3	3	2	3	1		2	
CO4	2	2	3	2		2	
CO5	3	1	3	3		2	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Z transform**	15
	1.1	Z transform , ROC, Properties	
	1.2	Inverse Z transform	
	1.3	Analysis of LTI system using Z transform, impulse response, transfer function and convolution	
	1.4	Relation between Laplace transform and Z transform	
2		**Module 2: Discrete Fourier transform & Fast Fourier transform**	10
	2.1	Introduction – discrete Fourier transform of finite duration sequences – properties of DFT – circular convolution	
	2.2	computation of DFT	
	2.3	Fast Fourier transform : FFT Algorithms - general computational considerations – decimation in time algorithms – Radix 2 – FFT algorithms	
	2.4	decimation in frequency algorithms – Radix 2 – FFT algorithms	
3		**Module3: Realization of digital systems**	10
	3.1	IIR and FIR filters	
	3.2	Recursive & non recursive systems – block diagrams & signal flow graphs	
	3.3	Realization of IIR filters - direct form realization, cascade & parallel form realization	
	3.4	Realization of FIR filters	
4		**Module4: IIR filter design**	15

	4.1	Frequency response of analog and digital IIR filters	
	4.2	Impulse invariant transformation, Bilinear transformation, relation between analog and digital frequency	
	4.3	Design of lowpass digital IIR Butterworth filter	
	4.4	Frequency transformation	
5		Teacher Specific Module	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. P Ramesh Babu, R Anandanatarajan, Signals and Systems, Scitech Publications (India) Fourth edition
2. A NagoorKani, Digital Signal Processing, Second edition, MacGraw Hill Education
3. Oppenheim A V and Sehafer R W, "Discrete Time Signal Processing", Prentice Hall (1989).
4. Proakis J G and Manolakis D G, "Digital Signal Processing", Pearson Education India.

Suggested Readings:

1.Oppenheim A V, Willsky A S and Young I T, "Signal & Systems", Prentice Hall, (1983).

2. Ifeachor and Jervis, "Digital Signal Processing", Pearson Education India.

3.DeFatta D J, Lucas J G and Hodgkiss W S, "Digital Signal Processing", J Wiley and Sons, Singapore, 1988

4. Sanjit K Mitra "Digital Signal Processing" TMH

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE318: ADVANCED POWER ELECTRONICS

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	KU6DSEELE318	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the theory, operation, and characteristics of power semiconductor devices such as SCRs, UJTs, TRIACs, and PUTs, along with their triggering circuits. It covers thyristor commutation techniques and the principles of phase-controlled rectifiers for AC–DC conversion. Students learn DC chopper operation and design of various switch-mode regulators including buck, boost, and Cuk converters. The course concludes with inverter operation and the study of different types of AC and DC power supplies, including switched-mode and resonant types.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the theory, construction, and operation of SCR, UJT, and TRIAC, and analyse their static and dynamic	U

	characteristics.	
2	Explain and distinguish various thyristor commutation techniques including natural, forced, self, impulse, and complementary commutation methods.	U
3	Describe and analyse the principles of DC choppers and compare different switch-mode DC-DC regulators such as buck, boost, buck-boost, and CUK converters.	A
4	Explain and illustrate the operation of single-phase and three-phase inverters and evaluate voltage control methods in inverters.	E
5	Identify, differentiate, and analyze various types of power supplies including switched-mode, resonant, bidirectional, AC, and DC supplies.	E

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2		3	3			
CO2	2		3				
CO3	3	3		3			
CO4	2	3		3			
CO5		3	3	3			

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Theory and Operation of SCR, UJT and TRIAC	

		Characteristics	
	1.2	Design of relaxation oscillator using UJI- UJT in SCR and TRIAC triggering circuits - PUTs- SILCON bilateral switch	
	1.3	Speed control of DC shunt motor using Thyristors - single phase half wave speed control system- reversible control system.	
2		**Module 2**	10
	2.1	Thyristor Commutation techniques Introduction - natural commutation- forced commutation	
	2.2	Self-commutation - impulse commutation - response- pulse commutation	
	2.3	External pulse commutation - load side commutation and line side commutation- complementary commutation	
	2.4	Controlled rectifiers introduction - principle of phase-controlled converter - single phase semi converter - single phase series converter	
		Module3	15
	3.1	DC Choppers Introduction - principle of step-down operation -step down with RL load - principle of step-up operation- switch mode regulator - buck regulator - boost regulator - buck- Boost regulator - CUK regulator.	
	3.2	Step down with RL load - principle of step-up operation	
	3.3	Switch mode regulator - buck regulator - boost regulator	
	3.4	Buck- Boost regulator - CUK regulator	
4		Module4	15
	4.1	Inverters and Power Supplies Introduction - principle of operation - single phase bridge inverters	

	4.2	Three phase inverters - voltage control of single-phase inverters	
	4.3	Introduction to power supply- AC and DC power supply -	
	4.4	Switched mode DC power supplies - resonant DC power supplies -Bidirertional power supplies -AC power supplies	
5		Teacher Specific Module	10
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Power Electronics, P.C. Sen, TMH

2. Power Electronics & Controls, S.K. Dutta

3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH

4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE319: Antennas and Microwave Devices

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	**KU6DSEELE319**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	3

Course Description:

The "Antennas and Microwave Devices" course describes the principles and applications of microwave engineering and antenna systems, essential for modern wireless communication and radar technologies. This course typically encompasses both theoretical foundations and practical design skills.

Course Prerequisite: Basic understanding of Electromagnetic Theory

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand antenna parameters such as radiation patterns, gain, directivity, impedance, and bandwidth.	U
2	Design and solve various antenna problems including dipole, monopole, microstrip, and array antennas	E
3	Understand the basics of RF filter design	U
4	Design of Rf filters and RF circuits	C
5	Analyze and design microwave amplifier	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1					1		
CO2	3		1				
CO3			3				

CO4		1	3				
CO5			3				3

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Introduction to Antenna systems**	10
	1.1	Physical concept of radiation, Near- and far-field regions	
	1.2	Fields and Power Radiated by a line current distribution	
	1.3	Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area	
	1.4	Friis transmission equation, Link budget and link margin	
2		**Module 2: Practical Antennas**	15
	2.1	Radiation Mechanisms of Linear Wire and Loop antennas	
	2.2	Monopoles and Dipoles and characterization	
	2.3	Aperture antennas, Reflector antennas	
	2.4	Microstrip antennas and Frequency independent antennas, Design considerations and applications.	
		Module3: Phased arrays	15
	3.1	Two-element array, Array factor, Pattern multiplication	
	3.2	Uniformly spaced arrays with uniform and non-uniform excitation amplitudes	
	3.3	Direction of arrival detection using arrays	
	3.4	Smart antennas	

4		Module4: **Microwave Design principles**	15
	4.1	Impedance transformation, Impedance Matching	
	4.2	Microwave Filter Design	
	4.3	RF and Microwave Amplifier Design	
	4.4	Microwave Power amplifier Design	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fourth Edition, Tata McGraw-Hill, 2006. (UNIT I, II, III)

2. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012. (UNIT I,IV,V)

Suggested Readings:

1. Constantine A.Balanis,—Antenna Theory Analysis and Design‖, Third edition, John Wiley India Pvt Ltd., 2005.

2. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press, 2001

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE320: MEMS

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	**KU6DSEELE320**	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the fundamental principles, design concepts, materials, and fabrication techniques involved in Micro Electro Mechanical Systems (MEMS). By the end of this course, students will understand the physical principles, fabrication approaches, and application areas of MEMS devices.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain working principles of MEMS sensors/actuators	U
2	Apply scaling laws to microsystem behaviour	A
3	Classify & compare MEMS materials	An
4	Analyze fabrication processes	An
5	Evaluate packaging & bonding techniques	E

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		3			2	
CO2	3		3			2	
CO3	3		3			2	
CO4	3		3	2		2	
CO5	2			3		2	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	MEMS and Microsystems: Applications – Multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators – micro accelerometer –comb drives - Micro grippers – micro motors, micro valves, micro pumps, Shape Memory Alloys.	
	1.2	Review of Mechanical concepts: Stress, Strain, Modulus of Elasticity, yield strength, ultimate strength – General stress strain relations – compliance matrix.	
	1.3	Overview of commonly used mechanical structures in MEMS - Beams, Cantilevers, Plates, Diaphragms – Typical applications	
2		**Module 2**	15
	2.1	Flexural beams: Types of Beams, longitudinal strain under pure bending – Deflection of beams – Spring constant of cantilever – Intrinsic stresses.	
	2.2	Actuation and Sensing techniques : Thermal sensors and actuators, Electrostatic sensors and actuators	
	2.3	Piezoelectric sensors and actuators, magnetic actuators	
		Module3	15
	3.1	Scaling laws in miniaturization - scaling in geometry, scaling in rigid body dynamics	
	3.2	Trimmer force scaling vector, scaling in electrostatic and electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection.	
	3.3	Materials for MEMS – Silicon – Silicon compounds – Silicon Nitride, Silicon Dioxide, Silicon carbide, Poly Silicon, GaAs , Silicon Piezo resistors	
4		**Module4**	15
	4.1	Overview of Micro manufacturing – Bulk micro manufacturing, Surface micro machining	
	4.2	LIGA process –Microstereo lithography	
	4.3	Micro system Packaging: general considerations in packaging design – Levels of Micro system packaging	

	4.4	Bonding techniques for MEMS : Surface bonding , Anodic bonding , Silicon - on - Insulator, wire bonding , Sealing – Assembly of micro systems	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Chang Liu, Foundations of MEMS, Pearson 2012

2. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, TMH, 2002

3. Chang C Y and Sze S. M., VLSI Technology, McGraw-Hill, New York, 2000

4. Julian W Gardner, Microsensors: Principles and Applications, John Wiley & Sons, 1994

5. Mark Madou, Fundamentals of Micro fabrication, CRC Press, New York, 1997

6. Stephen D. Senturia, Microsystem design, Springer (India), 2006.

7. Thomas B. Jones, Electromechanics and MEMS, Cambridge University Press, 2001

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU6DSEELE321: Cryptography

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
6	Elective	300	**KU6DSEELE321**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course will emphasise on principles and practice of cryptography and network security: classical systems, symmetric block ciphers (DES, AES, other contemporary symmetric ciphers), linear and differential cryptanalysis, perfect secrecy, public-key cryptography algorithms for factoring and discrete logarithms, cryptographic protocols, hash functions, authentication, key management, key exchange, signature schemes, email and web security, viruses, firewalls, digital right management, and other topics. In this course students will learn all aspects of network security and cryptography.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Identify basic security attacks and services	U
2	Use symmetric and asymmetric key algorithms for cryptography	U
3	Design a security solution for a given application	U
4	Analyze Key Management techniques and importance of number Theory.	U
5	Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works.	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3	2	2	2	2	2	2	2
CO4			2		2	2	
CO5					2	2	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	INTRODUCTION: Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security.	
	1.2	CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.	
2		**Module 2**	15
	2.1	BLOCK CIPHER AND DATA ENCRYPTION STANDARDS: Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles.	
	2.2	ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher.	
	2.3	MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4.	
	2.4	INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality,	

		The Chinese Remainder Theorem, Discrete logarithms,	
		Module3	15
	3.1	PUBLIC KEY CRYPTOGRAPHY AND RSA: Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, , Elliptic Curve Arithmetic, Elliptic Curve Cryptography.	
	3.2	MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs.	
	3.3	HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC.	
	3.4	DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.	
4		**Module4**	15
	4.1	DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.	
	4.2	EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME.	
	4.3	IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.	
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

Suggested Readings:

1. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi.
2. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata Mc Grawhill, India.
3. Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata Mc Grawhill, India.

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

SYLLABUS

7^{th} & 8^{th} Semesters

KU7DSCELE401: Low power VLSI

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
7	Major	400	KU7DSCELE401	3+0+1	45+0+30

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35 (25+10)	65 (50+15)	100	2

Course Description:

This course introduces the principles and techniques of low-power VLSI design, focusing on power dissipation mechanisms in CMOS circuits, transistor- and gate-level optimization, low-power synthesis methods, SRAM architectures, and submicron low-voltage circuit design. Students gain foundational understanding and practical skills for analyzing and designing energy-efficient integrated circuits.

Course Prerequisite; Basic understanding of VLSI

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand basics of Power Dissipation.	U
2	Understand low power circuit design.	U
3	Understand circuit level optimization.	U
4	Understand knowledge on SRAM.	U
5	Design low power circuit at submicron level	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2			2	
CO2	3		2	2		2	
CO3	2		3	2		2	
CO4	2	2	3	2		3	

CO5	3	2	3	3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	POWER DISSIPATION IN CMOS Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET	
	1.2	Submicron MOSFET , gate induced drain leakage	
	1.3	Power dissipation in CMOS : short circuit dissipation, dynamic dissipation	
	1.4	Load capacitance– Low power VLSI design: Limits – principles of low power design.	
2		**Module 2**	10
	2.1	DESIGN OF LOW POWER CIRCUITS: Transistor and Gate Sizing : Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction	
	2.2	Network Restructuring and Reorganization : Transistor Network Restructuring	
	2.3	Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops : Self-gating Flip-flop, Varieties of Boolean Functions, Adjustable Device Threshold Voltage.	
		Module3	10
	3.1	SYNTHESIS FOR LOW POWER Behavioral Level Transforms, Logic Level Optimization for Low power, Circuit Level Optimization	
	3.2	LOW POWER STATIC RAM ARCHITECTURES Organization of a static RAM, MOS Static RAM Memory cell,	

		Banked organization of SRAMs	
	3.3	Reducing voltage swings on bit lines, Reducing power in write driver circuits	
	3.4	Reducing power in sense amplifier circuits, method for achieving low core voltages from a single supply.	
4		**Module4**	10
	4.1	DESIGN AND TEST OF LOW VOLTAGE CMOS CIRCUITSCircuit Design style, Leakage current in deep submicrometer transistors	
	4.2	Deep submicrometer device design issues, Low voltage circuit design techniques,	
	4.3	Designing deep submicrometerics with elevated intrinsic leakage, multiple supply voltages	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1.K. Roy and S. C. Prasad, Low Power CMOS VLSI Circuit Design, John Wiley and Sons, 3 rd Edition, 2009.

2. Jan Rabaey, Low Power Design Essentials, Springer Publications, 1 st Edition, 2009.

3. Chandrakasan and R. Brodersen, Low-Power CMOS Design, IEEE Press, 1 st Edition, 1995.

4. Chandrakasan, Bowhill, and Fox, Design of High-Performance Microprocessors, IEEE Press, 1 st Edition, 2000.

List of Experiments

All experiments must be done using LTspice (free), Logisim-Evolution (free), Microwind Demo (free), and Python (NumPy/Matplotlib).

1. Power Dissipation in CMOS Inverter (LTspice)

4. Measure **dynamic power**, **short-circuit power**, and **leakage** for:
    1. Different input frequencies
    2. Different load capacitances
5. LTspice supports MOS Level-1/BSIM models (free).

2. Effect of Supply Voltage Scaling (VDD Variation)

- Simulate a CMOS inverter for VDD = 1.8 V, 1.2 V, 0.9 V.
- Observe changes in:
    - Propagation delay
    - Dynamic power
    - Leakage power

3. Transistor Sizing Impact on Delay & Power

- Use LTspice to create 3 versions of inverter: minimum, medium, large width.
- Measure:
    - Rise/fall times
    - Power consumption
- Relates to **Transistor & Gate sizing**

4. Switching Activity Calculation Using Digital Simulation (Logisim-Evolution)

4. Build a small logic circuit (e.g., XOR-Adder).
5. Export logic values → use Python script to compute switching activity.
6. Estimate **dynamic power** = $\alpha\, C\, V^2\, f$.

5. Logic Restructuring for Low Power

7. Implement a Boolean function in:

1. SOP form
2. Factored/optimized form

8. Compare number of transitions and activity.
9. Tools: Logisim + Python for power estimation.

6. Clock Gating in Sequential Logic (Logisim-Evolution)

4. Build a D-Flip Flop circuit with and without **clock gating**.
5. Count transitions in clock signal and output.
6. Show significant power reduction due to reduced switching.

7. 6T SRAM Cell Simulation (LTspice)

6. Simulate:
    1. Read operation
    2. Write operation
    3. Hold state
7. Measure:
    1. Static noise margin (SNM)
    2. Power drawn during read/write
8. Very important for Unit IV.

8. Bit-Line Voltage Swing Reduction (LTspice)

- Simulate read operation with:
    - Full swing (0–VDD)
    - Reduced swing (0–300 mV)
- Compare energy per read cycle.

9. Leakage Modeling in Short-Channel MOSFET (LTspice)

5. Use BSIM4 model (freely available online).
6. Measure:
    1. Subthreshold leakage
    2. Gate leakage

3. DIBL effect

7. Vary channel length and VTH.

10. Multi-VDD Low-Power Block (Logisim + Python)

3. Build a simple 4-bit adder with:
    1. Main logic at 1.8 V
    2. Low-power block at 1.0 V
4. Estimate power using switching data.
5. Demonstrates **multiple supply voltage** technique (Unit V).

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU7DSCELE402: Information Theory and Coding

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
7	Major	400	KU7DSCELE402	3+0+1	45+0+30

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

The course introduces the fundamental limits of data compression and reliable communication, and the practical methods to achieve them. Key topics include information theory concepts like entropy, channel capacity, and source coding theorems, as well as coding techniques and convolutional codes

for data compression and error correction. The course aims to equip students with the ability to analyze and design efficient and robust communication systems.

Course Prerequisite; Basic understanding of Data communication

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Interpret and summarize the role of information theory and linear algebra in source coding and channel coding.	U
2	Make use of various error control encoding and decoding techniques	A
3	Implement various error control techniques	A
4	Analyse the performance of error control codes	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2		2				1
CO2		2	2		2		1
CO3			1		2		1
CO4	2		2	2	2	3	1

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1 : Information Theory**	10
	1.1	Introduction, Measure of information.	
	1.2	Information content of message, Average information content of symbols in Long Independent sequences, Average information content of symbols in Long Dependent sequences.	

	1.3	Markov Statistical model of Information Sources, Entropy and Information rate of Markoff sources.	
2		**Module 2: Source Coding**	10
	2.1	Source Coding theorem, Kraft McMillan Inequality Property.	
	2.2	Encoding of the source output, Shannon Fano Codes, Huffman Codes, Arithmetic Coding, Lempel –Ziv algorithm.	
		Module 3: Information Channels	10
	3.1	Communication Channels, Channel models, Channel Matrix, Joint Probability Matrix, Binary Symmetric Channel, System Entropies.	
	3.2	Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel.	
	3.3	Binary Erasure Channel, Muroga's Theorem.	
4		**Module 4: Error Control Coding**	10
	4.1	Introduction, Examples of Error Control Coding, Methods of Controlling Errors.	
	4.2	Types of Errors, Types of Codes, Linear Block Codes: Matrix description of Linear Block Codes. Error detection and Correction capabilities of Linear Block Codes. Single Error Correction Hamming Code, Table lookup decoding using standard array.	
	4.3	Binary Cyclic Codes – Algebraic structure of cyclic codes, Encoding using an (n-k) Bit Shift Register, Syndrome Calculation, Error detection and correction.	
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Digital and Analog Communication System, K. Sam Shanmugham, John wiley India Pvt Ltd 1996.

2. Digital Communication, Simon Haykin, John wiley India Pvt Ltd 2008.

Suggested Readings:

1. ITC and Cryptography, Ranjan Bose, TMH second Edition, 2007.
2. Principles of Digital Communication, J. Das, S. K. Mullick, P. K. Chattergee, Wiley 1986 – Technology & Engineering.
3. Digital Communications – Fundamentals and Applications, Bernard Sklar, Second Edition, Pearson Education 2016.
4. Information Theory and Coding, Hari Bhat, Ganesh Rao, Cengage 2017.
5. Error Correction Coding, Todd K. Moon, Wiley Std. Edition, 2006.

Laboratory Sessions:

Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated.

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, experimental procedures, circuit diagrams, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU7DSCELE403: Machine Learning

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
7	Major	400	KU7DSCELE403	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description: This course provides a comprehensive introduction to Machine Learning, covering fundamental concepts, algorithms, and real-world applications. It begins with the basics of supervised, unsupervised, and reinforcement learning, along with essential data preprocessing and dimensionality reduction techniques. Students will explore **r**egression, clustering, and classification methods, including neural networks and performance evaluation metrics. Advanced topics such as ensemble learning, bagging, boosting, and stacking are also discussed to enhance model accuracy and robustness. By the end of the course, learners will gain a strong foundation to design, implement, and evaluate intelligent data-driven systems.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand fundamental concepts and techniques of Machine Learning	U
2	Apply data preprocessing and dimensionality reduction methods	A

3	Implement and evaluate regression, clustering, and classification algorithms	E
4	Design and train artificial neural networks	C
5	Analyse and improve model performance using ensemble learning techniques	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2						
CO2	2	3					
CO3	2	2		3	3		
CO4	2	3			3		
CO5		3			3		

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	**Introduction**: Basic definitions and concepts, key elements, supervised and unsupervised learning	
	1.2	Introduction to reinforcement learning, applications of ML.	
	1.3	**Preprocessing**: Feature scaling, feature selection methods.	
	1.4	Dimensionality reduction (Principal Component Analysis).	

2		**Module 2**	10
	2.1	**Regression**: Linear regression with one variable, linear regression with multiple variables.	
	2.2	Gradient descent, over-fitting, regularization. Regression evaluation metrics	
	2.3	**Clustering**: Approaches for clustering, distance metrics	
	2.4	K-means clustering, Hierarchical clustering	
		Module3	10
	3.1	**Classification**: Decision trees, Naive Bayes classifier, logistic regression, k-nearest neighbour classifier	
	3.2	Support Vector Machine (SVM). Classification evaluation metrics.	
	3.3	**Neural networks**: Perceptron	
	3.4	Multilayer perceptron, Back-propagation algorithm	
4		Module4	10
	4.1	**Combining Multiple Learners:** Generating diverse learners - model combination schemes	
	4.2	Voting - error-correcting output codes	
	4.3	Bagging - boosting	
	4.4	Stacked generalization – cascading	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential/recommended readings

1. Mitchell, T.M. Machine Learning, McGraw Hill Education, 2017.

2. James, G., Witten. D., Hastie. T., Tibshirani., R. An Introduction to Statistical Learning with Applications in R, Springer, 2014.

3. Alpaydin, E. Introduction to Machine Learning, MIT press, 2009.

Additional References

1. Flach, P., Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, 2015.

2. Christopher & Bishop, M., Pattern Recognition and Machine Learning, New York: Springer-Verlag, 2016.

3. Sebastian Raschka, Python Machine Learning, Packt Publishing Ltd, 2019

Use Python for practical labs for Machine Learning. Utilize publicly available datasets from repositories like https://data.gov.in/ and https://archive.ics.uci.edu/ml/datasets.php

For evaluation of the regression/classification models, perform experiments as follows: •

Scale/Normalize the data

• Reduce dimension of the data with different feature selection techniques

• Split datasets into training and test sets and evaluate the decision models

• Perform k-cross-validation on datasets for evaluation

Report the efficacy of the machine learning models as follows:

• MSE and R2 score for regression models

• Accuracy, TP, TN, FP, TN, error, Recall, Specificity, F1-score, AUC for classification models

Laboratory sessions: Practical sessions to reinforce theoretical concepts

For relevant datasets make prediction models for the following

1. Naïve Bayes Classifier
2. Simple Linear Regression multiple linear regression
3. Polynomial Regression
4. Lasso and Ridge Regression
5. Logistic regression
6. Artificial Neural Network
7. k-NN classifier
8. Decision tree classification
9. SVM classification
10. K-Means Clustering
11. Hierarchical Clustering

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, experimental procedures, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU7DSCELE404: Printed Antennas

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
7	Major	400	KU7DSCELE404	3+0+1	45+0+30

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35 (25+10)	65 (50+15)	100	2

Course Description:

This course introduces the fundamentals of printed antennas, covering radiation mechanisms, antenna parameters, and common wire and aperture antenna types. Students learn the design and analysis of microstrip patch antennas, feeding techniques, bandwidth enhancement methods, and printed antenna arrays. The course also includes hands-on simulation and design using HFSS for practical understanding of modern printed antenna technologies

Course Prerequisite: Basic understanding of Electromagnetics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain radiation mechanisms & antenna parameters	U
2	Analyze wire, aperture & advanced antennas	An
3	Apply printed antenna design & feeding techniques	A
4	Evaluate bandwidth & performance enhancement methods	E
5	Design & simulate printed antennas in HFSS	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		3			2	
CO2	3		3			2	

CO3	3	3	3	2		2	
CO4	2		3	2		2	
CO5	2	3	2	3		3	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Radiation of EM waves: Radiation mechanism	
	1.2	Theories of radiation, antenna parameters,	
	1.3	Schelkunoff's equivalence theorem, image theory, Polarisation, Friss transmission formula	
	1.4	Effective aperture, EIRP, short Antennas Antenna Measurements.	
2		**Module 2**	10
	2.1	Wire antennas and Aperture antennas, dipoles and loops	
	2.2	Helical antenna horns, lens and reflector antennas	
	2.3	Log periodic antennas	
		Module3	10
	3.1	Printed antennas: Rectangular design, Radiation mechanism	
	3.2	Feeding techniques for micro strip antennas	
	3.3	Circular patch antenna, Printed antenna arrays,	
	3.4	Band width enhancement techniques of microstrip antennas.	
4		**Module4**	10
	4.1	Design rectangular and circular microstrip patch antenna geometry for specific frequency band	

	4.2	Design of aperture coupled feeding mechanism for microstrip patch antenna	
	4.3	Introduction to HFSS Simulation Software	
	4.4	Simulation setup in HFSS for a microstrip patch antenna	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Constantine Balanis A., Antenna Theory-Analysis and Design ,John wiley, 2005

2. Bahl I. J., and Bhartia, Microstrip Antennas, Artech House, 1982

3. James J. R. Hall P. S. Wood C., Micro strip Antenna-Theory and Design, IET

Electromagnetic Wave series, 1985

4. John D. Kraus, Ronald J. Marhefka, Ahmed S. Khan, Antennas and Wave Propagation, 4th Edition, McGraw hill Education, 2006

List of Experiments

1. Design a microstrip line for 50Ohm characteristic impedance and simuate the design using an EM simulator

2. Using EM simulation package, plot the Electric field distribution in a microstip line

3. Design a Quarterwave transformer (Source imedance = 50 Ohms and load impedance = 100 ohms)

4. Perform EM Simulation of a microstrip antenna (rectangular) working at 2.4 GHz and plot the 2D and 3D radiation patterns

5. Perform EM Simulation of a microstrip antenna (circcular) working at 2.4 GHz and plot the 2D and 3D radiation patterns

6. Using a simulation package plot the J-Surface on a rectangular microstrip antenna working at 1900MHz. Identify the dominent mode.

7. Using EM simulation package model an aperture coupled microstrip patch antenna operating at 2.4 GHz. Also perform parametric analysis to understand the influence of microstrip stub length on Return loss characteristics

8. Design a 2 element microstip antenna array and simulate the performance using an EM simulator

9. Design a 2 element microstip antenna array and estimate the mutual coupling value and study how mutual coupling changes with interelement spacing

10. Design a 2 port aperture coupled microstrip patch antenna and simulate the performance using an EM CAD tool

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU7DSCELE405: Digital Image Processing

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
7	Major	400	KU7DSCELE405	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

Digital Image Processing (DIP) is a branch of engineering and computer science that focuses on the analysis, manipulation, and enhancement of digital images using computational techniques. It involves converting images into digital form and applying algorithms to improve their quality or extract useful information.

DIP deals with operations such as image enhancement, restoration, compression, segmentation, feature extraction, and pattern recognition. These techniques are used to remove noise, adjust brightness and contrast, detect edges, identify objects, and transform images for better interpretation.

Digital image processing plays a vital role in various fields including medical imaging (X-ray, MRI), remote sensing, computer vision, robotics, surveillance, photography, multimedia, and scientific research. With advancements in AI and machine learning, DIP has become essential for enabling intelligent systems to understand and analyze visual data.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Analyse general terminology of Digital image Processing	An
2	Understand Various types of Images, intensity transformations and spatial filtering	U
3	Evalute the methodologies for image segmentation ,restoration	E
4	Apply fourier Transform for image Processing	A
5	Apply Image processing algorithm in Practical Applications	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	1	2		
CO2	3	3	2		3	2	
CO3	2	3	3	2	3		

CO4	3	2	3		3		
CO5	2	2	3	2	3	3	

COURSE CONTENTS

Contents for Classroom Transaction

			Hours
1		**Module 1:introduction to Image Processing System**	10
	1.1	Fundamental steps in DIP, Components of digital image processing system, elements of visual perception, Structure of the human eye, Image formation in the eye, Brightness adaptation and discrimination.	
	1.2	Image sensing and acquisition, Image formation model, Sampling and quantization of images, Two dimensional sampling	
	1.3	Representation of digital image, Spatial and gray level resolution, Zooming and shrinking,	
	1.4	Classification of digital Images Some basic relationships between pixels.	
2		**Module 2: Image Enhancement**	10
	2.1	Introduction , Image enhancement in Spatial Domain, Enhancement through Point operation.	
	2.2	Gray level transformations, Piecewise linear transformation, Histogram processing,	
	2.3	Enhancement using Arithmetic/ logic operations, Basics of	

		spatial filtering, Smoothing and sharpening spatial filters	
	2.4	Image Enhancement in Frequency Domain: Homomorphic Filtering	
		Module3: Image Restoration	10
	3.1	Model of image degradation/ Restoration process, Noise models, Noise reduction in spatial domain	
	3.2	Inverse filtering, Wiener filtering.	
	3.3	Image Segmentation, Detection of discontinuities (point, line edge), Edge linking and boundary detection	
	3.4	Thresholding, Basic global thresholding, Adaptive thresholding, Region based segmentation, region growing, splitting and merging	
4		**Module4:Image Compression**	10
	4.1	Fundamentals of Image compression, Types of redundancy. Image compression model, concepts of information theory,	
	4.2	Fundamental coding theorems, Estimation of entropy, Variable length coding, Huffman coding, Near optimal variable length coding	
	4.3	Arithmetic coding, LWZ coding, Bit plane coding, constant area coding, run length coding, Lossless predictive coding	
	4.4	Image compression standards (JPEG, JPEG2000)	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1.Digital image Processing: S Jayaraman ,S Esakkirajan .T Veerakumar

2. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
3. S.Sridhar, Digital Image Processing, Oxford University Press

Suggested Readings:

Laboratory Sessions:Practical sessions to include programming

1.Simulation and Display of an Image, Negative of an image(Binary and Gray Scale)

2.Implementation of Relationships between Pixels

3.Implementation of Transformation of an Image

4.Display of Bitplane of an Image

5.Computation of Mean ,Standard deviation , correlation coefficient of the given image

6.Implimentation of Image Smoothening Filters(Mean and Median Filters)

7.Implementation of Image Sharpening Filters and Edge Detection using Gradient Filters

8.Image compressionm by DCT,DPCM,Huffman coding

9. Implementaion of Image restoring techniques

10.Implementation of image Intensity Slicing Technique for Image enhancement

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU8RPHELE400: PROJECT

GUIDELINES

- The project can be done at any registred company/Startups. The students can also perform the project work at any University/College research centers or under the supervision of a teacher having PhD
- An internal guide from the parent instituion must guide the student throughout the project phases
- The internal guide must keep all records such as approval letter from the host insitution, Project phase evaluation records, attendance at the host insitution and Plagiarism report of the publications obtained from the project work.
- The final thesis must be checked in plagiarism checker software before the submission for thesis evaluation
- A project completion certificate duly signed by the External guide must be included in the thesis
- The project evaluation phases are,

Sl.No.	Evaluation Phase	Deliverables
1	Phase I	Literature review and identification of problem
2	Phase II	Block level design/flow charts
3	Phase III	Results
4	Phase IV	Submission of thesis

KU8DSEELE409 Research Methodology

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	**KU8DSEELE409**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course provides a foundational understanding of research ethics, experimental design, data analysis, scientific writing, and research communication. It equips students with the skills needed to plan, conduct, analyze, and present scientific research responsibly and effectively.

Course Prerequisite: Any student with interest in Science and science communication

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand the fundamental concepts of philosophy, ethics, scientific integrity, and publication ethics, and identify various forms of scientific and publication misconduct.	U
2	Apply principles of experimental design, error analysis, and statistical methods to plan, execute, and evaluate scientific experiments.	A
3	Analyze and present scientific data effectively using graphs, tables, software tools, and reference management systems such as Mendeley and EndNote.	A
4	Evaluate research databases, indexing systems, journal	E

	metrics, and open-access resources to select appropriate journals and avoid predatory publishers.	
5	Develop structured scientific documents including reports, reviews, research proposals, and manuscripts while understanding IPR, copyright, patents, and ethical guidelines for scientific communication.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2		2			2	
CO2	2	3	3			3	
CO3		2	2			3	
CO4	2		3			3	
CO5	2		2	2		2	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Introduction to Philosophy: definition, nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgements and reactions	
	1.2	Ethics in science research. Intellectual honesty and research integrity. Scientific misconducts: falsification, fabrication and plagiarism (FFP). Redundant Publications: duplicate and overlapping publications, salami slicing.	
	1.3	Selective reporting and misrepresentation of data. Publication Ethics: Best practices/standards setting initiatives	

		and guidelines: COPE, WAME, etc. Conflicts of interest.	
	1.4	Publication Misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types. Violation of publication ethics, authorship and contributor ship. Identification of publication misconduct, complaints and appeals. Predatory publishers and journals	
2		**Module 2**	15
	2.1	Design and planning of Experiments: Aims and objectives, expected outcome, methodology to be adopted - importance of reproducibility of research work.	
	2.2	Interpolation, Extrapolation, Types of errors, Error analysis and statistical principles. Objectives and basic principles of designs of experiments.	
	2.3	Analysis and presentation data: using graphs, presenting data in tables, schemes and figures. Statistical tests, software for drawing, statistical analyses, bibliography using Mendeley and endnote. Software used in Science (LaTeX, Chemdraw, isis draw, Origin, statistical software (SPSS) etc.	
	2.4	Familiarization of Spreadsheet Tools, Presentation Tools and Writing Tools. Presentation of Tables and Figures. Use and Format of Appendices, Indexing	
		Module 3	15
	3.1	Databases and Research Metrics: Databases – Indexing databases, Citation databases: Web of Science, Scopus, etc.	
	3.2	Research Metrics, Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score. Metrics: h-index, g-index, i10 index, altmetrics.	
	3.3	Open access publications and initiatives. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies.	
	3.4	Software tool to identify predatory publications. Journal	

		finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc. Predatory publishers and journals.	
4		**Module4**	15
	4.1	Communicating information: General aspects of scientific writing, reporting practical and project work, writing literature survey and reviews, organizing a poster display, oral presentation.	
	4.2	Guidelines for writing the abstract, introduction, methodology, results and discussion, and conclusion sections of a manuscript.	
	4.3	References, Citation and listing system of documents. Developing a Research Proposal – Thesis proposal. Format of research proposal.	
	4.4	Research Report: Format of the research report, style of writing the report, references and bibliography. IPR and cyber law: Patents, Patent laws, process of patenting a research findings, Intellectual property (IP), intellectual property right (IPR), copyright, trademarks, GI, cyber laws.	
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

References:

1. Bird, A. (2006) Philosophy of Science. Routledge.

2. Alasdair C MacIntyre (1998), A short history of ethics: a history of moral philosophy from the Homeric Age to the twentieth century. London

3. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped, do not get plagiarized

4. National Academy of Sciences, National Academy of Engineering, Institute of Medicine (2009). On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition. National Academies Press

5. Resnik, D.B (2011). What is ethics in Research & Why is it important? National Institute of Environmental Health Sciences

6. Beall. J. (2012). Predatory publishers are Corrupting Open access. Nature, 489 (7415), 179

7. Indian National Science Academy (INSA), Ethics in Science Education, Research and

Governance (2019)

8. Bordens, K. S. and Abbott, B. B. (2011) Research Design and Methods – A Process Approach. 8th Edition, McGraw-Hill.

9. Davis, M., Davis K.J, and Dunagan M. (2013) Scientific Papers and Presentations. 3rd Edition, Elsevier Inc.

10. Kothari C. R. (2004) Research Methodology – Methods and Techniques 2nd Edition. New Age International Publishers

11. Angelika H. Hofmann, (2010) Scientific Writing and Communication: Papers, Proposals, and Presentations, Oxford University Press

12. Michael P. M (2011) Research Methods for Science. Cambridge University Press.

13. George C. T (2015) Research Methodology and Scientific Writing. Springer Nature

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE410 Computer networks

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	KU8DSEELE410	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:
This course introduces learners to the essential networking principles and communication technologies that form the backbone of the Internet of Things. As billions of devices become interconnected, understanding how these systems communicate, share data, and remain secure is critical. This course provides a solid foundation in core networking concepts, including the OSI and TCP/IP models, IP addressing, wired and wireless communication, and key protocols used in IoT environments. Learners will explore specialized low-power and short-range communication technologies such as BLE, Zigbee, LoRaWAN, NB-IoT, and Wi-Fi, along with modern messaging and application-layer protocols like MQTT, CoAP, and HTTP.

Course Prerequisite: Basic knowledge of computers or electronics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand the fundamentals of computer networks	U
2	Identify wireless protocols used in IoT	U
3	Identify messaging protocols used in IoT	U
4	Apply security principles to IoT communications	A

5	Analyze real-world IoT network architectures	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1:Introduction to Networking**	10
	1.1	Basics of networking: LAN, WAN, MAN	
	1.2	OSI Model vs TCP/IP Model (conceptual focus)	
	1.3	Networking Hardware and Media :Routers, switches, gateways, and access points, Wired vs wireless communication	
	1.4	Network addressing: MAC & IP fundamentals	
2		**Module 2: Protocols**	15
	2.1	IPv4/IPv6 addressing and subnetting	
	2.2	DHCP, DNS, and NAT	
	2.3	TCP vs UDP	
	2.4	HTTP/HTTPS, WebSockets, REST APIs for IoT data exchange	
3		**Module3: Wireless Networking**	15
	3.1	Wi-Fi standards & power considerations	
	3.2	Cellular IoT connections, Network coexistence in IoT	

		deployments	
	3.3	LoRaWAN, Sigfox, NB-IoT, LTE-M	
	3.4	Coverage vs power vs data rate trade-offs	
4		**Module4:Messaging Protocols and Network Security**	15
	4.1	MQTT, CoAP, AMQP, Broker-based communication	
	4.2	Cloud IoT platforms overview (AWS, Azure, GCP)	
	4.3	Common threats & vulnerabilities, Authentication & encryption basics	
	4.4	Secure communication (TLS, DTLS)	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Internet of Things: A Hands-On Approach – Arshdeep Bahga & Vijay Madisetti
2. IoT Fundamentals: Networking Technologies, Protocols & Use Cases – Cisco Networking Academy
3. IEEE/ITU standards for IoT
4. Andrew S. Tanenbaum, Computer Networks, 5/e, Pearson Education India.
5. Behrouz A Forouzan, Data Communication and Networking, 5/e, McGraw Hill Education

References

1. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e,Morgan Kaufmann.
2. Fred Halsall, Computer Networking and the Internet, 5/e.
3. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.

4. Keshav, An Engineering Approach to Computer Networks, Addison Wesley, 1998.
5. W. Richard Stevens. TCP/IP Illustrated Volume 1, Addison-Wesley, 2005.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE411: Microwave Integrated Circuits

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	**KU8DSEELE411**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course provides an in-depth study of the principles, design techniques, and technologies used in microwave integrated circuits (MICs) for high-frequency electronic systems. Topics include microwave circuit analysis, impedance matching networks/smith chart, microwave tarnsistors and integrated circuits. The course covers the use of measurement techniques using vector network analyser to characterize microwave passive and active devices

Course Prerequisite: Basic understanding of Electromagnetic Theory

Course Outcomes

CO No.	Expected Outcomes	Learning

		Domains
1	Understand the basics of Scattering parameters, ABCD matrix and two port analysis that are essential to characterize microwave circuits and systems	U
2	Understand and analyse the matching performance of microwave circuits using Smith chart	U
3	*Evaluate* the performance of active microwave devices	E
4	*Interpret* stability, noise, and nonlinear behavior in MIC designs	A
5	Develop practical experience through laboratory experiments using Vector network analyzers	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1				1		
CO2	3		2				
CO3	3		3		1		1
CO4	3		3	2	3	3	3
CO5	3		3	3		3	3

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Microwave Network Analysis**	10
	1.1	Equivalent Voltages and Currents, Impedance and Admittance Matrices - Reciprocal Networks, Lossless	

		Networks	
	1.2	Scattering Matrix – Reciprocal and Lossless Networks, Shift in Reference Planes	
	1.3	Transmission (ABCD) Matrix – Relation to Impedance Matrix, Equivalent Circuits for Two-Port Networks	
	1.4	Interrelation between [s], [ABCD], [z] and [y] parameters.	
2		**Module 2: Smith Chart and Impedance Matching**	15
	2.1	Smith chart configuration, Constant R Circle, Constant X circles, Impedance and Admittance Smith Chart	
	2.2	Basic Smith chart operations. Design of Matching Networks:With Lumped Elements (L Section)	
	2.3	Single Stub Tuning, Double stubTuning using smith chart and Analytic Solution	
	2.4	Quarter wave transformer	
		Module3: Microwave Transistors and Integrated Circuits	15
	3.1	Characteristics of microwave transistors – Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks	
	3.2	Introduction to Monolithic Microwave Integrated Circuits (MMICs), their advantages over discrete circuits	
	3.3	MMIC fabrication techniques, thick and thin film technologies and materials	
	3.4	Encapsulation and mounting of active devices	
4		Module4: Microwave Measurements	15
	4.1	Measurement of reflection coefficient, Low, Medium, High VSWR measurements, Standing wave pattern, Slotted Line section and its limitation	

	4.2	Vector Network analyzer, Concept and description	
	4.3	Reflection and Transmission measurements, magnitude and Phase	
	4.4	Measurement of S- Parameters, SWR and Impedances measurements,	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. R.E. Collin, "Foundations for microwave Engineering", McGraw hill Kogakusha, Ltd, International Student edition, 2nd Edition.

2. Ahmad Shahid Khan, "Microwave Engineering Concepts and Fundamental", CRC Press

Suggested Readings:

1. David. M. Pozar, "Microwave Engineering", 3rd Edition, John wiley& Sons Inc, 1998.

2. M.L. Sisodia, G.S. Raghuvamsi, "Microwave Circuits and Passive Devices", New Age International Pub. Ltd, WEL-1995.

3. E.I. Ginzton, "Microwave Measurements", McGraw Hill Book Comp, INC, 1957.

4. Ganesh Prasad Srivastava, Vijaya Lakshmi Guptha, "Microwave and Circuit design", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., New Delhi-2006

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**

Continuous Evaluation	**30**

KU8DSEELE412: Radar and Navigation

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	**KU8DSEELE412**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This subject course imparts fundamental concepts on Radar Systems. Course begins with a description of how a simple Radar Equation can be formulated, discusses on the improvement factors in arriving at the final Radar equation. The course goes on to educate the students on design aspects of various sub systems, performance, limitations and application aspects of Radar systems using block diagram. The course probes into the functioning details of CW, FM-CW, and isolation details. The course describes methods of determination of radar cross section of targets, system losses. Finally, the fundamentals of Radar navigation systems with emphasis on GPS navigation is discussed in detail

Course Prerequisite: Basic understanding of Electromagnetic Theory, Antenna and wave propagation and Electronic Communication systems

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	To develop the knowledge on fundamentals of radar	U

	and parameters of general radar equation	
2	To enable the students to demonstrate the Doppler Effect and the concepts of continuous wave radars and the FM-CW Altimeter.	U
3	Able to know operation of MTI radar	U
4	*Analyse the detection of radar signals*	A
5	To gain an in-depth knowledge about modern GPS navigation systems	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1		1				
CO2	2		3		1		1
CO3	3		3		2		1
CO4	3		3				1
CO5			3			3	3

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Basics of Radar**	10
	1.1	Introduction, Maximum Unambiguous Range, Simple form of Radar Equation	
	1.2	Radar Block Diagram and Operation, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation	

	1.3	Envelope Detector – False Alarm Time and Probability, Integration of Radar Pulses	
	1.4	Radar Cross Section of Targets (simple targets – sphere, cone-sphere) , PRF and Range Ambiguities	
2		**Module 2: CW and Frequency Modulated Radar**	15
	2.1	Doppler Effect, CW Radar-Block Diagram, Isolation between Transmitter and Receiver	
	2.2	Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar	
	2.3	FM-CW Radar, Range and Doppler Measurement Block Diagram and Characteristics (Approaching/ Receding Targets)	
	2.4	FM-CW altimeter, Multiple Frequency CW Radar	
		Module 3: MTI and Pulse Doppler Radar	15
	3.1	Introduction, Principle, MTI Radar with – Power Amplifier Transmitter and Power Oscillator Transmitter	
	3.2	Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters	
	3.3	MTI Radar Parameters, Limitations to MTI Performance	
	3.4	MTI versus Pulse Doppler Radar	
4		**Module 4: Navigational Aids and Modern navigation**	15
	4.1	Introduction, Four Methods of Navigation	
	4.2	Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation	
	4.3	Doppler navigation-Doppler frequency equations-Doppler navigation system	

	4.4	GPS principle of operation, Position location determination, principle of GPS receiver.	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. Introduction to Radar System M.I. Skolnik , Publisher: McGraw Hill
2. Radar Systems and Radio Aids to Navigation, Sen & Bhattacharya, Publisher: Khanna publishers
3. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
4. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
5. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics".
6. N S Nagaraja, "Elements of Electronic Navigation", TMH.

Web Resources:

1. http://nptel.iitm.ac.in/courses.php?branch=Ece
2. http://www.radartutorial.eu/07.waves/wa04.en.html

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE413: Industrial Automation

Semester	Course type	Course	Course code	Credits (L+T+P)	Total hours(L+

		level			T+P)
8	Elective	400	KU8DSEELE413	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This is a complete introductory course designed to provide a solid understanding of the basic concepts of Industrial Automation. Topics covered include introduction to industrial automation hierarchy, types of automation, sensors used in automation, PLCs, basics of industrial communication, SCADA and industrial robotics

Course Prerequisite; Basic understanding of Digital and Analog electronics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand Introduction to Industrial Automation	U
2	Explain various sensors used in Industrial automation	E
3	Understand PLCs	U
4	Understand Industrial Communication	U
5	Understand Industrial Robotics	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO7
CO1	3	1	2	1		1	
CO2	3	2	2	2		2	
CO3	2	2	3	3	3	3	1
CO4	2	2	3	3		3	2
CO5	3	1	3	2		3	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1:** Introduction to Industrial Automation (Basics & Components)	10
	1.1	Definition, scope and evolution of industrial automation	
	1.2	Hierarchy of industrial automation: Field level, Control level, Supervisory level, Enterprise level	

	1.3	Types of automation: Fixed, Programmable, Flexible, Integrated	
	1.4	Industrial sensors & transducers-Proximity sensors, photoelectric sensors, encoders, temperature sensors, pressure sensors	
	1.5	Actuators-Pneumatic, hydraulic, electric actuators, Solenoids, relays, stepper/servo motors	
	1.6	Signal conditioning basics: Filtering, amplification, isolation	
	1.7	Introduction to industrial communication signals: 4–20 mA, 0–10 V, digital I/O	
2		**Module 2:** Programmable Logic Controllers (PLC)	15
	2.1	PLC architecture: CPU, memory, power supply, I/O modules- Types of PLCs (compact, modular)	
	2.2	PLC programming basics -Ladder Logic- Instruction List (IL) / Function Block Diagram (FBD) (overview)- Programming elements	
	2.3	Contacts, coils, timers, counters, comparators	
	2.4	PLC scan cycle-Process control using PLC-On/Off control, sequential control	
	2.5	Interlocking and safety logic	
	2.6	Introduction to HMI (Human–Machine Interface)	
		Module3: Industrial Communication & SCADA Systems	15

	3.1	Overview of industrial communication	
	3.2	RS-232, RS-485, Modbus, CAN, Profibus, Ethernet/IP	
	3.3	Concepts of distributed control	
	3.4	SCADA system architecture	
	3.5	RTU, PLC, communication interface, master station	
	3.6	Industrial networking and cyber security basics	
4		**Module4:** Industrial Robotics, Drives, and Automation Applications	15
	4.1	Introduction to industrial robotics-Types of robots: Cartesian, SCARA, articulated	
	4.2	Robot components, End effectors and sensors in robotics	
	4.3	Motor drives & motion control-VFDs (Variable Frequency Drives)-Servo drive basics	
	4.4	Industrial safety standards (ISO, IEC)	
	4.5	Modern industrial automation systems and Industry 4.0 concepts: IIoT, smart sensors, predictive maintenance	
	4.6	Cloud-based monitoring	
5		**Teacher Specific Module**	5

Essential Readings:

1. Programmable Logic Controllers – Frank D. Petruzella
2. Industrial Automation and Robotics – A.K. Gupta
3. Modern Control Engineering – Ogata (for reference)

Suggested Readings:

1. Industrial Instrumentation – D. Patranabis

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE414 Optical sensing

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L +T+P)
8	Elective	400	KU8DSEELE414	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:
Optical sensing has become a critical technology across modern engineering domains, enabling high-precision and high-speed detection of physical, chemical,

and biological parameters. This course provides an in-depth understanding of the principles, device architectures, and applications of optical sensors with a strong focus on fiber-optic systems, micro- and nano-photonic sensing, and imaging-based remote sensing. The learners will gain the ability to select, design, and evaluate optical sensors for applications in structural health monitoring, biomedicine, aerospace, defense, environmental monitoring, and smart infrastructure.

Course Prerequisite: Electromagnetics, Signals & Systems,Fundamentals of optics and fibre optics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand physical principles of optical sensing mechanisms	U
2	Analyze fiber optic sensor architectures and measurement techniques	An
3	Analyze Imaging and Remote Optical Sensing techniques	An
4	Design practical optical sensing systems	E
5	Apply ML pipelines to extract features from imaging sensors (RGB, IR, hyperspectral, LIDAR).	An

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1:Fundamentals of Optical Sensing**	10

	1.1	Introduction to optical sensors: advantages, limitations, classifications	
	1.2	Light-matter interactions: absorption, scattering, fluorescence, Raman Photometric and radiometric concepts	
	1.3	Optical modulation techniques (Intensity, Phase, Wavelength, Polarization)	
	1.4	Sensor performance metrics: Responsivity, Sensitivity, SNR, Dynamic range, NEP	
2		**Module 2:Fiber Optic Sensing Techniques**	15
	2.1	Fiber optic waveguiding fundamentals, single-mode vs multi-mode , Intrinsic vs Extrinsic sensors	
	2.2	Interferometric sensors: Mach–Zehnder, Michelson, Fabry-Perot	
	2.3	Fiber Bragg Grating (FBG)-based sensing: Strain, temperature cross-sensitivity, Wavelength interrogation techniques	
	2.4	Distributed sensing: OTDR, BOTDR, Brillouin & Rayleigh scattering-based sensing, Case studies in structural health monitoring & defense	
3		**Module3:Imaging and Remote Optical Sensing**	15
	3.1	LIDAR fundamentals: Time-of-flight, scanning mechanisms, 3D mapping	
	3.2	Hyperspectral & multispectral imaging	
	3.3	Thermal infrared sensors & night vision optical systems	
	3.4	Environmental optical sensing: air quality, water contaminants	
4		**Module4:AI/ML approaches in optical image-based**	15

		sensing	
	4.1	Machine Learning Techniques for Sensing: Feature extraction (edges, textures, spectral signatures),	
	4.2	Classical ML models: SVM, KNN, Random Forest, PCA/LDA for dimensionality reduction, Real-time image classification and object detection	
	4.3	Deep Learning for Optical Sensing: Neural networks for feature learning	
	4.4	CNN architectures (ResNet, UNet, YOLO) for: Defect inspection in manufacturing, Biomedical diagnosis (fluorescence imaging, OCT), Aerial surveillance using EO/IR cameras	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. B. Culshaw & A. Dakin — Optical Fiber Sensors
2. J. Wilson & J.F.B. Hawkes — Optoelectronics: An Introduction
3. Eric Udd — Fiber Optic Sensors
4. Wolfbeis — Optical Chemical Sensors
5. Katsunari Okamoto — Fundamentals of Optical Waveguides

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE415 Mixed Signal Circuit Design

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	KU8DSEELE415	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the principles and design of mixed-signal circuits, focusing on switched-capacitor systems, PLLs, data converters, and modern techniques used to integrate analog and digital blocks in electronic systems.

Course Prerequisites: Basic understanding of Analog and digital systems

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the principles, operation, and non-idealities of switched-capacitor circuits and first-order/band-pass filter structures	U
2	Analyze the architecture, dynamics, and non-ideal effects of phase-locked loop (PLL) and charge-pump PLL systems.	An
3	Apply data converter fundamentals to compute dynamic specifications and interpret quantization noise in DAC/ADC systems	A
4	Evaluate the performance of Nyquist-rate ADC architectures such as SAR, Flash, Pipeline, and Interpolating converters	E

	based on speed, resolution, and accuracy.	
5	Design and construct oversampling converter blocks, including sigma-delta modulators and digital decimation/interpolation filters, to meet target specifications.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2			2	
CO2	3		3			3	
CO3	3	2	3	2		3	
CO4	2		3	2		2	
CO5	2	3	2	3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Introduction to Switched Capacitor circuits	
	1.2	Basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits	
	1.3	Switched capacitor integrators first order filters, Switch sharing, biquad filters.	
2		**Module 2**	15
	2.1	Phased Lock Loop (PLL) Basic PLL topology, Dynamics of simple PLL	

	2.2	Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump	
	2.3	Basic charge pump PLL, Non-ideal effects in PLLs- PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.	
		Module 3	15
	3.1	Data Converter Fundamentals DC and dynamic specifications	
	3.2	Quantization noise, Nyquist rate D/A converters- Decoder based converters	
	3.3	Binary-Scaled converters, Thermometer-code converters, Hybrid converters	
		Module4	15
	4.1	Nyquist Rate A/D Converters Successive approximation converters, Flash converter	
4	4.2	Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Time interleaved converters.	
	4.3	Oversampling Converters Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibitquantizers, Delta sigma D/A	
		Teacher Specific Module	5
5	Directions: Teacher can design this module based on their expertise and demand from the students		

References:

1. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition, 2002

2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

3. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition, 2013

4. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters- Rudy Van De Plassche, Kluwer Academic Publishers, 2003

5. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.

6. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience,2009

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE416: Secure Communication

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	KU8DSEELE416	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course aims to provide an insight into the theory and technology behind secure communication.
Course Prerequisite: Basic understanding of Data communication

Course Outcomes

CO No.	Expected Outcomes	Learning Domains

1	Explain network security services & mechanisms and the types of attacks they are designed for.	U
2	Model the symmetric encryption process and different encryption techniques.	A
3	Apply the concept of Group, Ring, Field, Modular arithmetic, Euclidean algorithm, Finite fields and Polynomial arithmetic.	A
4	Explain the principles of modern symmetric ciphers.	U
5	Outline the concept of public key cryptography, RSA algorithm, Key distribution and management for public key systems.	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1			1		1
CO2	1	1				1	
CO3	1		2	2			
CO4	1		2		2	2	
CO5	1			1			

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1: Introduction and Classic Encryption Techniques**	10
	1.1	OSI security architecture - Security attacks: Passive attacks and Active attacks.	
	1.2	Security Services: Authentication, Access Control, Data Confidentiality, Data Integrity, Non-repudiation	
	1.3	Model for network security: Symmetric Cipher model, Cryptography,	

		Cryptanalysis	
	1.4	Substitution techniques: Hill Cipher, One time pad, Transposition techniques.	
2		**Module 2: Finite Fields**	15
	2.1	Groups, Rings, Fields, Modular arithmetic, Euclidean algorithm, Finite fields of the form GF(p), Polynomial arithmetic.	
		Module3: Block Ciphers, Data Encryption Standard, AES Cypher	15
	3.1	Block Cipher Principles – Stream Ciphers and Block Ciphers.	
	3.2	Feistel Cipher: Feistel decryption algorithm, The Data Encryption Standard, DES Decryption, Avalanche effect.	
	3.3	The AES Cipher: substitute bytes transformation, Shift row transformation, Mix Column transformation.	
4		**Module 4: Public Key Cryptography, RSA and Key Management**	15
	4.1	Principles of public key cryptosystems – Public key cryptosystems – Application for public key cryptosystem requirements.	
	4.2	Fermat's theorem – Euler's Totient function – Euler's theorem.	
	4.3	RSA algorithm – key management – Distribution of public keys – Publicly available directory – Public key authority – Public key certificates – Distribution of secret keys using public key cryptography.	
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India.
2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.

Suggested Readings:

1. Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw Hill 2008.

2. David S. Dummit & Richard M Foote, Abstract Algebra, Second Edition, Wiley India Pvt Ltd 2008.
3. Douglas A. Stinson, Cryptography, Theory and Practice, second Edition, Chapman & Hall, CRC Press Company, Washington 2005.
4. Lawrence C. Washington, Elliptic Curves: Theory and Cryptography, Chapman & Hall, CRC Press Company, Washington 2008.
5. N. Koeblitz: A course in Number theory and Cryptography, 2008

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE417: Basic Tools of Microwave Engineering

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	KU8DSEELE417	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This is a complete introductory course designed to provide a solid understanding of the basic concepts used in measurements and

calibration of RF and microwave frequencies. Topics includes introduction to microwave measurements, basics of Smith chart, power frequency and attenuation measurements and scattering parameters.

Course Prerequisite; Basic understanding of EMT and Microwave devises

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the need for specialized microwave measurement techniques and the functioning of basic microwave laboratory components.	U
2	Interpret Smith Chart fundamentals and apply it for impedance/admittance transformation, reflection coefficient determination, and basic transmission-line calculations.	A
3	Describe and analyze microwave power, frequency, and attenuation measurement techniques using standard microwave instruments.	An
4	Explain scattering parameters and analyze two-port microwave networks using S-parameter properties and conversions.	An
5	Demonstrate the basic operation and applications of microwave network analyzers for S-parameter measurement and network characterization.	U

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO7
CO1	3	2	2	1		2	
CO2	3	2	3	2		3	
CO3	3	2	3	2		3	
CO4	3	2	3	3		3	1
CO5	3	2	3	3		3	1

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1:** Introduction to Microwave Measurements	10
	1.1	Need for specialized microwave measurement techniques	
	1.2	Overview of microwave laboratory components- Klystron power supply- Gunn diode oscillator-	
	1.3	Waveguides and coaxial components	
	1.4	Standing Waves & SWR basics	

	1.5	General measurement setups: slotted line systems	
	1.6	Safety precautions in microwave labs	
2		**Module 2:** Smith Chart & Impedance Matching Techniques	15
	2.1	Introduction to the Smith Chart- Impedance and admittance representation-	
	2.2	Normalized impedance, Constant-R and constant-X circles	
	2.3	Using Smith Chart for: Finding reflection coefficients, Impedance/ admittance conversion, SWR calculations	
	2.4	Transmission line problem solving (shorted/open stubs)	
	2.5	Impedance matching-Single-stub and double-stub matching, Quarter-wave transformer	
	2.6	Applications in RF/microwave design	
		Module 3: Power, Frequency & Attenuation Measurements	15
	3.1	Power Measurement- Calorimetric power meters, Thermistor and bolometer mounts' Diode detectors	
	3.2	Frequency Measurement- Waveguide wavemeters, Resonant cavity wavemeters, Frequency counters (microwave range)	
	3.3	Attenuation Measurement- Fixed & variable	

		attenuators, Direct and substitution methods, Measurement using attenuator calibration	
4		**Module 4:** Scattering (S-) Parameters and Microwave Network Analysis	15
	4.1	Need for S-parameters at microwave frequencies and Definition of scattering parameters (S11, S21, S12, S22)	
	4.2	Properties of S-parameters-Reciprocity-Lossless networks- Symmetry	
	4.3	Two-port and multi-port network analysis	
	4.4	Practical interpretation of S11 & S21 using Smith Chart	
	4.5	Conversion between Z, Y, h, and S-parameters	
	4.6	S-parameter measurement basics-Network Analizers (Introduction only)	
5		**Teacher Specific Module**	5
	S parameter measurements of a Tx line and waveguide using a network analyzer		

Essential Readings:

1. Microwave Measurements by G W D Roberts
2. Introduction to Microwave measurements by Leo Young

3. High Frequency Techniques: An introduction to RF & Microwave Engineering by Joseph F White

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSCELE406 Embedded OS and RTOS

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Major	400	**KU8DSCELE406**	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

This course introduces the concepts and functionalities of Embedded Operating Systems and Real-Time Operating Systems. It covers UNIX/Linux basics, process management, file I/O, inter-process communication mechanisms, interrupts, timers, exception handling, and the architecture of popular RTOS platforms such as RT Linux, MicroC/OS-II, VxWorks, and TinyOS. The course enables learners to understand how embedded systems achieve real-time performance and reliability.

Course Prerequisite: Basic understanding of Microcontrollers and embedded system

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	**Explain** the fundamental concepts of UNIX/LINUX operating systems, including processes, file I/O operations, and process control mechanisms.	U
2	**Apply** inter-process communication techniques such as pipes, signals, event registers, and subsystem operations to embedded applications.	A
3	**Analyze** exceptions, interrupts, timer operations, and ISR handling in embedded and real-time systems.	An
4	**Describe** real-time operating system kernels, including RT Linux, MicroC/OS-II, VxWorks, and Embedded Linux.	U
5	**Compare** features of lightweight embedded OS platforms such as TinyOS and Android OS for real-time and embedded applications.	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1		2	
CO2	3	2	3	2		2	1
CO3	3	2	3	2		3	1
CO4	2	1	2	2		2	1
CO5	2	1	3	2		2	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10

	1.1	Introduction to UNIX/LINUX, Process	
	1.2	Overview of Commands, File I/O,(open, create, close, lseek, read,write),	
	1.3	Control (fork, vfork, exit, wait, waitpid, exec.	
2		**Module 2**	10
	2.1	Pipes, Event Registers, Subsystem	
	2.2	Signals, Other Building Blocks,	
	2.3	Component Configuration, Basic I/O Concepts, I/O	
		Module 3	10
	3.1	Exceptions, Interrupts, Applications	
	3.2	Processing of Exceptions and Spurious Interrupts, Real Time Clocks	
	3.3	Programmable Timers, Timer Interrupt Service Routines (ISR),	
	3.4	Soft Timers, Operations.	
4		**Module4**	10
	4.1	RT Linux, Micro C/OS-II	
	4.2	Vx Works, Embedded Linux,	
	4.3	Tiny OS and Basic Concepts of Android OS.	
	4.4		
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

References:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011

2. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.

3. Advanced UNIX Programming, Richard Stevens

4. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh

Laboratory Experiments:

1. Basic Linux Shell Commands & File Operations

2. Simple Process Creation Using fork()

3. Inter-Process Communication Using Pipes

4. Thread Creation Using pthreads

5. Introduction to RTOS Using Online Simulator

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU8DSCELE407: Advanced Python Programming

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Major	400	KU8DSCELE407	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practica	Tutorial	CE	ESE	Total	

	I					
3	2	0	35	65	100	2

Course Description: This course introduces Python programming through control flow, functions, data structures, and modular programming. It advances into object-oriented concepts, GUI development, exception handling, file processing, and basic web applications. Learners further explore numerical computing, data analysis, and visualization using NumPy, Pandas, and plotting tools. Through hands-on case studies, students develop real-world problem-solving skills in algorithms, data processing, and application development.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand the syntax and control flow algorithms	U
2	Program and debug object- oriented concepts	C
3	Handle exceptions in the programs and the operations in the file	A
4	Identify the suitability of NumPy and data frames for organizing data	E
5	Identify and apply the correct data structure for programming	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3			3	3	

CO2	2	2	3		3		
CO3		2	3		3	3	
CO4	3		3		3	3	2
CO5	2		3	2	3	3	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**: Control flow statements and Basic Data Structures	10
	1.1	Data types, Variables, Operators, Conditional Statements, Loops**-**While, for; Functions-Structure, Parameters types, return types-String and multiple;	
	1.2	Packages and modules-importing, strings-indexing, slicing, operators and methods, List-creation, accessing. deleting, updating operations, functions, methods, comprehension	
	1.3	Tuple-Creation, accessing, deleting, updating operation, conversion(list/string), methods and functions-Dictionary-accessing, deleting, updating operation methods and functions	
	1.4	Case study-Anagrams, binary search, bubble sort, calender,color picker, datetime,dictionary	
2		**Module 2**: Object Oriented Paradigm and GUI	10
	2.1	Classes and objects, Method overloading and overriding, Data hiding	

	2.2	Data abstraction, Inheritance, Copying and cloning objects	
	2.3	Introduction to GUI, create a web page using GUI functionality	
	2.4	Case Study: Rock paper scissor, Snake and ladder	
		Module3: Exception Handling Files	10
	3.1	Files-Opening, Closing, reading and writing. Renaming and deleting file and dictionary-related standard function	
	3.2	Exception handling-Introduction, use of finally and else block, raise statement, user-defined exception	
	3.3	Introduction about Testing Flask App.	
	3.4	Case study-Simple web application creation using python, time zones.	
4		Module4: Advanced Data Structure in Python	10
	4.1	NumPy-creating arrays, Data Type objects, Numerical operation, NumPy Arrays: Concatenating Flattening and Adding dimensions, NumPy: Boolean index, Reading and Writing Data files	
	4.2	Data Frames-Accessing and changing values, Pandas-group by, Reading and writing Data with NaN	
	4.3	Binning in python and pandas. Generators and iterators	
	4.4	Case study-Plotting graph, Analysis of graph,Gambling,gmplot,graph,graph edge node, image compression, image transposition, image enhancing	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

TEXT BOOKS

1. Anuratha A Puntambekar,"Programming with Python", Technical Publications,1st edition 2020

2. Bernadklein," Python course Data Analysis with Python", Bodenseo,1st edition 2021

3. Daniel Gaspar, Jack stoufter,"Mastering Flask web Development Build enterprise-grade, scalable python web applications",packt publishing,2nd edition 2018

4.https://spark.apache.org/docs/latest/api/python/getting_started/intex.html

References

1. Jeeva Jose, "Taming Python by programming ",Khanna Book publishing company, New Delhi,1st edition 2017

2.Jeeva Jose," Introduction to computing and problem solving with python", Khanna Book publishing company, New Delhi,1st edition 2016

3. Case study-(Joy of computing in python)-https://onlinecourses.nptel.ac.in/

4. https://www.udemy.com/course/complete-python-developer-zero-to-mastery/

5. https://www.coursera.org/learn/python-crash-course

Laboratory sessions: Practical sessions to reinforce theoretical concepts

1.Write a python program to demonstrate working of calendar module

2.Write a python program to create user defined exceptions

3.Write a python program that uses raise and exception class to throw an exception

4.Write a python program to create a module and import the module in another python program

5.Write a python program to print checkerboard pattern of n*n using NumPy

6.Write a python program to demonstrate use of group by() method

7.Write a python program to demonstrate pandas merging, joining and concatenating

8.Write a python program to implement pandas' series with labels

9.Create a white image using NumPy in python

10.Write a python program to demonstrate working of defaultdict

Lab rules to be followed

Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, experimental procedures, circuit diagrams, program listings, and expected outcomes.

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU8DSCELE408: DEEP LEARNING

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Major	400	KU8DSCELE408	3+0+1	45+0+30

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2

Course Description:

This course provides a comprehensive introduction to Deep Learning. It is a subfield of machine learning that focuses on computational models inspired by the human brain, known as artificial neural networks. This course introduces the fundamental principles, architectures, and training methods of deep neural networks. Students will learn how deep learning models are built, optimised, and deployed for real-world tasks such as image recognition, natural language processing, speech processing, and data analytics.

The course covers key concepts including perceptrons, multilayer neural networks, backpropagation, regularization techniques, convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory (LSTM) networks, generative models, and modern frameworks like TensorFlow and PyTorch. Emphasis is placed on both theory and hands-on practice through experiments and mini-projects, enabling students to design, train, and evaluate deep learning models effectively.

By the end of the course, learners will acquire the skills to apply deep learning techniques to solve complex problems across various domains.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the fundamental concepts of neural networks, activation functions, and optimization techniques.	u
2	Design and implement deep neural network models for classification and prediction tasks.	An
3	Apply Convolutional Neural Networks (CNNs) for image-related applications such as image recognition and object detection.	A
4	Analyze and build sequence models including RNN, LSTM, and GRU for natural language processing tasks	An
5	Create and evaluate generative models such as Autoencoders, VAEs, and GANs for data generation and anomaly detection.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	1			
CO2	2	3	2	1	2		
CO3	2	3	3	2			
CO4	1	3	3	1	1		
CO5	1	3	3	2			

COURSE CONTENTS

Contents for Classroom Transaction

		Descriptions	Hours
1		**Module 1:**	10
	1.1	Introduction to neural networks-Single layer perceptrons, Multilayer Perceptrons Biological neuron vs. artificial neuron	
	1.2	Linear regression, logistic regression Perceptron, multilayer perceptron	
	1.3	Introduction to Deep learning, Deep feed forward	

		networks, training Deep models, Optimisation Techniques	
	1.4	Activation functions (ReLU, Sigmoid, Tanh, Softmax) Loss functions and evaluation metrics	
2		**Module 2:**	10
	2.1	Convolutional neural networks: Convolution operation, kernel, padding, stride Pooling: Max pooling, Average pooling	
	2.2	CNN architecture – feature Popular CNN models: LeNet-5, AlexNet, VGG, ResNet	
	2.3	Transfer Learning: Fine-tuning and feature extraction Data augmentation techniques	
	2.4	Applications: Image classification, object detection (basics)	
		Module3:	10
	3.1	Recurrent Neural Networks (RNNs): concept computational Graph ,Design, encoder- decoder sequence to sequence architectures training LSTM and GRU networks	
	3.2	Word embeddings: Word2Vec, GloVe Attention mechanism (basic idea)	
	3.3	Introduction to Transformers (concept only):Applications: Sentiment analysis ,Text generation and Language translation	

		(basics)	
	3.4	Speech recognition,natural language processing	
4		Module4:	10
	4.1	Autoencoders, Denoising Autoencoders Variational Autoencoders (VAE) – concept	
	4.2	Generative Adversarial Networks (GANs): Generator & Discriminator Applications of generative models: Image synthesis, anomaly detection	
	4.3	Introduction to Deep Learning tools: TensorFlow / PyTorch, Model evaluation, optimization, and deployment (ONNX / TFLite basics	
	4.4	Ethical issues: Bias, fairness, privacy, explainability	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

Essential Readings:

Textbooks

1. ***SatishKumar, Neural Networks: A Classroom Approach,Tata MC GRAW-Hill Education2004***
2. **Michael Nielsen — *Neural Networks and Deep Learning* (Online)**

3. ***Practical tutorials from TensorFlow.org and PyTorch.org***

Suggested Readings:

4. Ian Goodfellow, Yoshua Bengio, Aaron Courville — *Deep Learning*
5. Charu C. Aggarwal — *Neural Networks and Deep Learning*
6. François Chollet — *Deep Learning with Python*

Laboratory Sessions:Practical sessions to include programming based on PYTHON

1. Implement perceptron and simple neural network
2. Train MLP for classification tasks
3. Experiment with activation function
4. Implement CNN for image classification (MNIST/CIFAR)
5. Transfer learning with pretrained mode
6. Build an RNN or LSTM for text generation
7. Aanalysis using embeddings
8. Build and train an autoencode
9. Implement a simple GAN
10. Deploy a model using TensorFlow Lite or ONNX

Lab rules to be followed :*Each laboratory experiment should be accompanied by a detailed lab note containing theoretical background, program listings, and expected outcomes.*

Assessment Rubrics:

	Marks
End Semester Evaluation	**65**
Continuous Evaluation	**35**

KU8DSEELE322: Embedded OS and RTOS

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	KU8DSEELE322	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course introduces the concepts and functionalities of Embedded Operating Systems and Real-Time Operating Systems. It covers UNIX/Linux basics, process management, file I/O, inter-process communication mechanisms, interrupts, timers, exception handling, and the architecture of popular RTOS platforms such as RT Linux, MicroC/OS-II, VxWorks, and TinyOS. The course enables learners to understand how embedded systems achieve real-time performance and reliability.

Course Prerequisite: Basic understanding of Microcontrollers and embedded system

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	**Explain** the fundamental concepts of UNIX/LINUX operating systems, including processes, file I/O operations, and process control mechanisms.	U
2	**Apply** inter-process communication techniques such as pipes, signals, event registers, and subsystem operations to embedded applications.	A
3	**Analyze** exceptions, interrupts, timer operations, and ISR handling in embedded and real-time systems.	An
4	**Describe** real-time operating system kernels, including RT Linux, MicroC/OS-II, VxWorks, and Embedded Linux.	U
5	**Compare** features of lightweight embedded OS platforms such as TinyOS and Android OS for real-time and embedded applications.	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	2	1		2	
CO2	3	2	3	2		2	1
CO3	3	2	3	2		3	1
CO4	2	1	2	2		2	1
CO5	2	1	3	2		2	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Introduction to UNIX/LINUX, Process	

	1.2	Overview of Commands, File I/O,(open, create, close, lseek, read,write),	
	1.3	Control (fork, vfork, exit, wait, waitpid, exec.	
2		**Module 2**	15
	2.1	Pipes, Event Registers, Subsystem	
	2.2	Signals, Other Building Blocks,	
	2.3	Component Configuration, Basic I/O Concepts, I/O	
		Module 3	15
	3.1	Exceptions, Interrupts, Applications	
	3.2	Processing of Exceptions and Spurious Interrupts, Real Time Clocks	
	3.3	Programmable Timers, Timer Interrupt Service Routines (ISR),	
	3.4	Soft Timers, Operations.	
4		**Module4**	15
	4.1	RT Linux, Micro C/OS-II	
	4.2	Vx Works, Embedded Linux,	
	4.3	Tiny OS and Basic Concepts of Android OS.	
	4.4		
5		**Teacher Specific Module**	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

References:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011

2. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.

3. Advanced UNIX Programming, Richard Stevens

4. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE323: Advanced Python Programming

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	**KU8DSEELE323**	4+0+0	60+0+0

Learning Approach (Hours\ week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: This course introduces Python programming through control flow, functions, data structures, and modular programming. It advances into object-oriented concepts, GUI development, exception handling, file processing, and basic web applications.

Learners further explore numerical computing, data analysis, and visualization using NumPy, Pandas, and plotting tools. Through hands-on case studies, students develop real-world problem-solving skills in algorithms, data processing, and application development.

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Understand the syntax and control flow algorithms	U
2	Program and debug object- oriented concepts	C
3	Handle exceptions in the programs and the operations in the file	A
4	Identify the suitability of NumPy and data frames for organizing data	E
5	Identify and apply the correct data structure for programming	A

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3			3	3	
CO2	2	2	3		3		
CO3		2	3		3	3	
CO4	3		3		3	3	2
CO5	2		3	2	3	3	2

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**: Control flow statements and Basic Data Structures	10
	1.1	Data types, Variables, Operators, Conditional Statements, Loops**-**While, for; Functions-Structure, Parameters types, return types-String and multiple;	
	1.2	Packages and modules-importing, strings-indexing, slicing, operators and methods, List-creation, accessing. deleting, updating operations, functions, methods, comprehension	
	1.3	Tuple-Creation, accessing, deleting, updating operation, conversion(list/string), methods and functions-Dictionary-accessing, deleting, updating operation methods and functions	
	1.4	Case study-Anagrams, binary search, bubble sort, calender,color picker, datetime,dictionary	
2		**Module 2**: Object Oriented Paradigm and GUI	15
	2.1	Classes and objects, Method overloading and overriding, Data hiding	
	2.2	Data abstraction, Inheritance, Copying and cloning objects	
	2.3	Introduction to GUI, create a web page using GUI functionality	
	2.4	Case Study: Rock paper scissor, Snake and ladder	
		Module3: Exception Handling Files	15
	3.1	Files-Opening, Closing, reading and writing. Renaming and deleting file and dictionary-related standard function	
	3.2	Exception handling-Introduction, use of finally and else block,	

		raise statement, user-defined exception	
	3.3	Introduction about Testing Flask App.	
	3.4	Case study-Simple web application creation using python, time zones.	
4		Module4: Advanced Data Structure in Python	15
	4.1	NumPy-creating arrays, Data Type objects, Numerical operation, NumPy Arrays: Concatenating Flattening and Adding dimensions, NumPy: Boolean index, Reading and Writing Data files	
	4.2	Data Frames-Accessing and changing values, Pandas-group by, Reading and writing Data with NaN	
	4.3	Binning in python and pandas. Generators and iterators	
	4.4	Case study-Plotting graph, Analysis of graph,Gambling,gmplot,graph,graph edge node, image compression, image transposition, image enhancing	
5		Teacher Specific Module	5
	Directions: Teacher can design this module based on their expertise and demand from the students		

TEXT BOOKS

1. Anuratha A Puntambekar,”Programming with Python”, Technical Publications,1st edition 2020

2. Bernadklein,” Python course Data Analysis with Python”, Bodenseo,1st edition 2021

3. Daniel Gaspar, Jack stoufter,”Mastering Flask web Development Build enterprise-grade, scalable python web applications”,packt publishing,2nd edition 2018

4.https://spark.apache.org/docs/latest/api/python/getting_started/intex.html

References

1. Jeeva Jose, "Taming Python by programming ",Khanna Book publishing company, New Delhi,1st edition 2017

2.Jeeva Jose," Introduction to computing and problem solving with python", Khanna Book publishing company, New Delhi,1st edition 2016

3. Case study-(Joy of computing in python)-https://onlinecourses.nptel.ac.in/

4. https://www.udemy.com/course/complete-python-developer-zero-to-mastery/

5. https://www.coursera.org/learn/python-crash-course

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE324: VLSI

Semester	Course type	Course level	Course code	Credits (L+T+P)	Total hours(L+T+P)
8	Elective	400	**KU8DSEELE324**	4+0+0	60+0+0

Learning Approach (Hours\week)			Mark Distribution			Duration of ESE(Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description:

This course is designed to provide a solid understanding of the basics of VLSI. The course cover IC fabrication techniques, MOS characteristics, MOS based circuits and design of various subsystems

Course Prerequisite;Basic understanding of Semi conductor and Digital electronics

Course Outcomes

CO No.	Expected Outcomes	Learning Domains
1	Explain the VLSI design process, including architectural, logical, and physical design methodologie	U
2	Analyze the electrical characteristics of MOS and CMOS devices, including threshold voltage, MOS models, inverter behavior, and power dissipation.	An
3	Interpret and apply layout design rules to create simple CMOS layouts and evaluate parasitic effects.	A
4	Design pass-transistor and transmission-gate-based logic circuits and evaluate their performance.	C
5	Develop subsystem-level circuits such as parity generators, multiplexers, and basic arithmetic blocks using CMOS logic.	C

Remember(R) Understand (U) Apply (A) Analyse (An) Evaluate (E) Create(C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3		2			2	
CO2	3		3			2	
CO3	3	2	3	2		3	
CO4	3	3	3	3		3	
CO5	3	3	3	3		3	

COURSE CONTENTS

Contents for Classroom Transaction

		Description	Hours
1		**Module 1**	10
	1.1	Overview of design methodology: VLSI design process - Architectural design - Logical design - Physical design - Layout styles - Full custom - Semicustom approaches	
	1.2	BASIC ELECTRICAL PROPERTIES OF MOS AND (- l\4OS CIRCUITS : MOS ransistor - Threshold voltage - Threshold voltage equations - MOS device equalent circuit - Basic DC	

		equations- Second order effects - MOS models - Small signal AC characteristics	
	1.3	MOS invorrer - Depletion mode and enhancement mode pull ups - CMOS inverter - VI characteristics - Inverter delay	
	1.4	Pass tansistor - Transmission gate - Power consumption in CMOS gaus - Static dissipation - Dynamic Dissipation.	
2		**Module 2**	15
	2.1	VLSI fabriration techniques : An overvierv of Wafer fabrication – Wafer processing - Oridation - Patterning - Diffusion - Ion implantation - Deposition	
	2.2	Silicon gate NMOS prorcess - CMOS processes - NWell - PWell – Twin tub - Silicon on insulalor	
	2.3	CMOS process enhancements - Interconnect - Circuit elements- Latch up - Latchup prevention techniques.	
		Module3	15
	3.1	Layout Design Rules : Need for design rules - Mead Conway design rules for the silicon gate NMOS process	
	3.2	CMOS based design rules -Simple lavout examples	
	3.3	Sheet resista rce - Area capacitance - Wiring capacitance - Driving large capacitive loads	
4		**Module4**	15
	4.1	:Logic design,Sub system and ALU: Switch logic - Pass transistor and transmission gate based design	
	4.2	Gate logic - Inverttr - Two input NAND gate - NOR gate	
	4.3	Other forms of CMOS logic – Dynamic CMOS iogic - Clocked CMOS logic - Precharged domino CMOS logic	
	4.4	Structured design – Simple combinational logic design examples - Parity generator - Multiplexers -Subsystem Design Process : General arrangement of a 4-bit arithmetic processor	
5		Teacher Specific Module	10

	Directions: Teacher can design this module based on their expertise and demand from the students	

Essential Readings:

1. Kamran Eshraghian, Douglas A Pucknell and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems,"Prentice Hall of India, New Delhi, 20115.

2. Neil H E West and Kamran Eshranghian, "Principles of CMOS VLSI Design: A system Perspective", Addision-Wesley, 2nd Edition, 2004.

3. Sung-Mo Kang and Yusuf Leblebici," CMOS Digital Integrated Circuits",Tat,r McGraw- Hill,3rd Edition, New Delhi,2008.

4. Jan M Rabaey, Chandrasekaran A and Nikolic B, "Digital Integrated Circuits, ' Pearson Education,3rd Edition, 2004.

5. Amar Mukherjee, "lnroduction to nMOS and CMOS VLSI System Design", Prentice Hall

Assessment Rubrics:

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

KU8DSEELE325:FUNDAMENTALS OF IoT

Semester	Course Type	Course Level	Course Code	Credits (L+T+P)	Total Hours (L+T+P)
8	Elective	400	KU8DSEELE325	4+0+0	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description

This course on Internet of Things (IoT) provides students with a comprehensive understanding of modern connected systems that integrate sensors, embedded devices, communication networks. This course introduces the Fundamental Architecture of IoT, device hardware, Wireless communication Protocols cloud connectivity and security aspects, This course prepares students to design and develop Smart IOT application for various domains.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain IoT architecture and key Functional elements	U
2	Apply communication protocols for IoT data exchange	A
3	Evaluate sensors and Build IoT based Prototypes	E
4	Analyse the IoT Hardware and communication devices .	An
5	Design and create IoT based Devices in different Fields	C

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	3	2	1	-	-	-	-
CO 2	3	3	2	1	-	-	-
CO 3	1	2	2	1	-	-	-
CO 4	2	3		2	1	-	-
CO 5	2	3	3	2	1	-	-

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION	HOURS
1	**Module I**		**10**
	1.1	Introduction to IoT: Definition, Evolution, importance and Characteristics of IoT	
	1.2	Physical design of IoT, Logical design of IoT.	
	1.3	IoT functional blocks & architecture Three- Layer and Five layer model of IoT	
	1.4	IoT communication Network: Home Area Network (HAN) Neighbourhood Area Network(NAN) Field Area Network (FAN) Wide Area Network (WAN) Wireless sensor Networks (WSNs)	
2	**Module II:**		**15**

	2.1	IoT protocols: IoT Access Technologies Physical and MAC layer topology and security of IEE 802.15.4,802.15.4g, 802.15.4e	
	2.2	Wireless technologies: Wi-Fi, Bluetooth, Zigbee	
	2.3	LoRa, RFID, NFC	
	2.4	Network and cloud connectivity.	
3	**Module-III**		**15**
	3.1	IoT sensors /Actuators: Sensor Technology Mobile phone based sensors, Medical sensors, Neural sensors characteristics and interfacing	
	3.2	Types of Actuators, characteristics and interfacing	
	3.3	Microcontrollers: Arduino, ESP32,Raspberry Pi overview	
	3.4	IoT Design challenges, Development challenges privacy and security challenges.	
4	**Module IV:**		**15**
	4.1	Applications of IoT: Smart homes and Smart Appliances	
	4.2	Health care monitoring	
	4.3	Smart Agriculture and environment sensing	
	4.4	Industrial IoT	
5	**Teacher specific module**		**5**
	Directions: Teacher can design this module based on their expertise and demand from the students		

	Space to fill the selected area/ activity	

Essential Readings:

1.RajKamal ,Internet of Things: Architecture and Design principles Mc Graw Hill(India)
2.Internet of things(A-Hand-on Approach) By Vijay Madisetti and ArshdeepBahga 1st edition,Universal press
3,Internet of Things: connecting objects by Hakima Chaouchi Wiley publication
Suggested Readings:
4.David Hanes ,IoT Fundamentals: Networking Technologies,Protocols and Use Cases for the Internet of things",Cisco press,Pearson, 2017.
5,Simone Cirani, "Internet of things: Architecture ,protocols and standard", Wiley,2019

	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**