University of Kerala

Four Year Under Graduate Programme

(UK FYUGP)

Syllabus

Major Discipline: ELECTRONICS

May 2024

ABOUT THE DISCIPLINE

Goal of the Electronics graduate programme is to provide graduates with specific skills to meet industry demands. Electronic science has grown at a rate never seen before in terms of new concepts, ideas, and technologies in recent years. Manpower with advanced skills and a scientific bent is required by the research institutions and enterprises and research groups in this progressive field require skilled professionals with a strong scientific back ground. To achieve this, adaptable and progressive training programs are needed that foster collaboration with research organizations, academia and industry. Key areas of study encompass semiconductor devices, analog and digital circuit design, microprocessor systems, communication technologies, nanoelectronics, advanced computer and data communication, embedded systems, and mastery of high-level programming languages.

The four-year undergraduate programme in Electronics (FYUGP) gives students experiences that help them gain a broad understanding of the fundamental ideas in the field and gives them advanced scientific and technological skills for analyzing and solving problems in the field. Additionally, through diligence, leadership, teamwork, and lifelong learning, it seeks to develop student's abilities to apply their knowledge and skills to the solution of particular theoretical and applied problems in electronics as well as to design and develop innovative solutions for the benefit of society. The program provides students the skills they need to become entrepreneurs, for seeking higher education, for completing research projects and finding jobs in the industry.

GRADUATE ATTRIBUTES

Graduate attributes bridge the gap between academia and the real world, fostering lifelong learning and meaningful contributions. They denote the skills, competencies and high-level qualities that a student should acquire during their university education. Apart from gathering content knowledge, these attributes go beyond the assimilation of information to its application in various contexts throughout a graduate's life. It aims in inculcating the art of critical thinking, problem solving, professionalism, leadership readiness, teamwork, communication skills and intellectual breadth of knowledge. The University of Kerala envisages to pave the path in guiding the student's journey to shape these attributes uniquely, making them integral to personal growth and success in various spheres of life. The University strives to ensure that these graduate attributes

are not just checkboxes, but they play a pivotal role in shaping the students into capable, compassionate and responsible individuals with a high degree of social responsibility.

PROGRAMME OUTCOMES

No.	Programme Outcomes (POs)
PO-1	**Critical thinking** ● Analyze information objectively and make a reasoned judgment. ● Draw reasonable conclusions from a set of information, and discriminate between useful and less useful details to solve problems or make decisions. ● Identify logical flaws in the arguments of others. ● Evaluate data, facts, observable phenomena, and research findings to draw valid and relevant results that are domain-specific.
PO-2	**Complex problem-solving** ● Solve different kinds of problems in familiar and no-familiar contexts and apply the learning to real-life situations. ● Analyze a problem, generate and implement a solution and to assess the success of the plan. ● Understand how the solution will affect both the people involved and the surrounding environment.
PO-3	**Creativity** ● Produce or develop original work, theories and techniques. ● Think in multiple ways for making connections between seemingly unrelated concepts or phenomena. ● Add a unique perspective or improve existing ideas or solutions. ● Generate, develop and express original ideas that are useful or have values.
PO-4	**Communication skills** ● Convey or share ideas or feelings effectively. ● Use words in delivering the intended message with utmost clarity. ● engage the audience effectively. ● Be a good listener who are able to understand, respond and empathize with the speaker. ● Confidently share views and express himself/herself.
PO-5	**Leadership qualities** ● Work effectively and lead respectfully with diverse teams. ● Build a team working towards a common goal. ● Motivate a group of people and make them achieve the best possible solution. ● Help and support others in their difficult times to tide over adverse situations with courage.
PO-6	**Learning ‘how to learn’ skills**

	● Acquire new knowledge and skills, including 'learning how to learn skills, that are necessary for pursuing learning activities throughout life, through self-paced and self-directed learning. ● Work independently, identify appropriate resources required for further learning. ● Acquire organizational skills and time management to set self-defined goals and targets with timelines. ● Inculcate a healthy attitude to be a lifelong learner.
PO-7	**Digital and technological skills** ● Use ICT in a variety of learning and work situations, access, evaluate, and use a variety of relevant information sources. ● Use appropriate software for analysis of data. ● Understand the pitfalls in the digital world and keep safe from them.
PO-8	**Value inculcation** ● Embrace and practice constitutional, humanistic, ethical, and moral values in life including universal human values of truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values. ● Formulate a position/argument about an ethical issue from multiple perspectives. ● Identify ethical issues related to work, and follow ethical practices, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights. ● Adopt objective, unbiased, and truthful actions in all aspects of work.

PROGRAMME SPECIFIC OUTCOMES

The programme specific outcome (PSO) expected from a student who completes a graduate/honours programme in Electronics are given below.

PSO-1	Applying the knowledge of mathematics & science in solving electronics related Problems.
PSO-2	Designing and conducting electronics experiments, as well as to analyze and interpret data.
PSO-3	Designing and managing electronic systems or processes that conforms to a given specification within ethical and economic constraints.
PSO-4	Identify, formulate, solve, and analyze the problems in various disciplines of electronics.

PSO-5	Developing the ability to function as a member of a multidisciplinary team with a sense of ethics, integrity and social responsibility.
PSO-6	Communicating effectively in terms of oral and written communication skills.
PSO-7	Recognizing the need for and being able to engage in lifelong learning.
PSO-8	Using techniques, skills, and modern technological/scientific /engineering software/tools for professional practices.
PSO-9	Associating renewable energy systems into existing energy infrastructure, optimizing their performance, enhancing overall energy efficiency and to design electronic devices and systems with a focus on energy efficiency, using low-power components, energy-efficient algorithms, and standby power reduction techniques.

Courses Details:

Sem	Course Code	Course Name	Description
Sem 1	UK1DSCELE100	Electronics in Modern Technology	5 modules, 3T+2P, (45+30)hrs
	UK1DSCELE101	Basic Electronic Technology	5 modules, 3T+2P, (45+30)hrs
	UK1DSCELE102	Electronics Fundamentals	5 modules, 4T, 60 hrs
	UK1MDCELE100	Electronics for Biology	5 modules, 3T, 45 hrs
	UK1MDCELE101	Basics of IoT	5 modules, 3T, 45 hrs
Sem 2	UK2DSCELE100	Digital electronics	5 modules, 3T+2P, (45+30)hrs
	UK2DSCELE101	Electronic Technology	5 modules, 3T+2P, (45+30)hrs
	UK2DSCELE102	Fundamentals of Digital Technology	5 modules, 4T, 60 hrs
	UK2MDCELE100	AI for Beginners	5 modules, 3T, 45 hrs
	UK2MDCELE101	Essential Electronics	5 modules, 3T, 45 hrs
Sem 3	UK3DSCELE200	Electronic Circuits	5 modules, 3T+2P, (45+30)hrs
	UK3DSCELE201	Microprocessor Architecture and Applications	5 modules, 4T, 60 hrs
	UK3DSCELE202	Communication Systems	5 modules, 4T, 60 hrs
	UK3DSCELE203	Space Electronics	5 modules, 4T, 60 hrs
	UK3DSEELE200	Management for Start-Ups	5 modules, 4T, 60 hrs
	UK3DSEELE201	Introduction to AI	5 modules, 4T, 60 hrs
	UK3DSEELE202	Basic Industrial Electronics	5 modules, 4T, 60 hrs
	UK3DSEELE203	Embedded Systems & IoT - I	5 modules, 4T, 60 hrs
	UK3VACELE200	Professional Ethics for Technicians and Scientists	5 modules, 2T+2P, (30+30) hrs
	UK3VACELE201	Renewable Energy Sources	5 modules, 2T+2P, (30+30) hrs
Sem 4	UK4DSCELE200	Introduction to Analog and Digital Communication	5 modules, 4T, 60 hrs
	UK4DSCELE201	Mathematics for Electronics	5 modules, 4T, 60 hrs
	UK4DSCELE202	Semiconductor Devices	5 modules, 4T, 60 hrs
	UK4DSEELE200	Introduction to Mobile Communication	5 modules, 3T+2P, (45+30)hrs

	UK4DSEELE201	Introduction to Robotics	5 modules, 3T+2P, (45+30)hrs
	UK4DSEELE202	Advanced Concepts of Industrial Electronics	5 modules, 3T+2P, (45+30)hrs
	UK4DSEELE203	Embedded Systems & IoT - II	5 modules, 3T+2P, (45+30)hrs
	UK4VACELE200	Life skills for Technicians and Scientists	5 modules, 2T+2P, (30+30) hrs
	UK4VACELE201	Space Exploration Fundamentals	5 modules, 2T+2P, (30+30) hrs
	UK4SECELE200	Advanced 3D Printing & PCB Design	5 modules, 2T+2P, (30+30) hrs
	UK4SECELE201	Safety Engineering	5 modules, 2T+2P, (30+30) hrs
	UK4INTELE200	Internship	
Sem 5	UK5DSCELE300	Microprocessor and Microcontroller	5 modules,3T+2P, (45+30)hrs
	UK5DSCELE301	Fibre Optics and Optical Communication	5 modules, 4T, 60 hrs
	UK5DSCELE302	Electronic Instrumentation	5 modules, 4T, 60 hrs
	UK5DSEELE300	Electromagnetic Theory	5 modules, 4T, 60 hrs
	UK5DSEELE301	AI & Machine Learning	5 modules, 4T, 60 hrs
	UK5DSEELE302	Industrial Electronics - Machines and Systems	5 modules, 4T, 60 hrs
	UK5DSEELE303	Embedded Systems & IoT - III	5 modules, 4T, 60 hrs
	UK5DSEELE304	Network Analysis	5 modules, 4T, 60 hrs
	UK5SECELE300	Solar Technology & Security Systems	5 modules, 2T+2P, (30+30) hrs
	UK5SECELE301	Disaster Management	5 modules, 2T+2P, (30+30) hrs
Sem 6	UK6DSCELE300	Linear Integrated Circuits	5 modules, 3T+2P, (45+30)hrs
	UK6DSCELE301	Biomedical Engineering	5 modules, 4T, 60 hrs
	UK6DSCELE302	Digital Signal Processing	5 modules, 4T, 60 hrs
	UK6DSCELE303	Mini Project	8P 60 hrs
	UK6DSEELE300	Nano Electronics	5 modules, 4T, 60 hrs
	UK6DSEELE301	Industrial Robotics	5 modules, 4T, 60 hrs
	UK6DSEELE302	Smart Solar Power Systems & Electric Vehicles	5 modules, 4T, 60 hrs
	UK6DSEELE303	Embedded Systems & IoT - IV	5 modules, 4T, 60 hrs

	UK6DSEELE304	Advanced Communication Systems	5 modules, 4T, 60 hrs
	UK6SECELE300	Matlab and its Applications	5 modules, 2T+2P, (30+30) hrs
	UK6SECELE301	Next Generation Networking	5 modules, 2T+2P, (30+30) hrs
Sem 7	UK7DSCELE400	Control Systems	5 modules, 3T+2P, (45+30)hrs
	UK7DSCELE401	VHDL	5 modules, 3T+2P, (45+30)hrs
	UK7DSCELE402	Digital Image Processing	5 modules, 3T+2P, (45+30)hrs
	UK7DSCELE403	Radar Technology	5 modules, 3T+2P, (45+30)hrs
	UK7DSEELE400	Industrial Automation	5 modules, 3T+2P, (45+30)hrs
Sem 8	UK8DSCELE400	Capstone online course	
	UK8DSCELE401	Capstone online course	
	UK8CIPELE400	Capstone Internship	
	UK8RPHELE400	Research Project	

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK1DSCELE100				
Course Title	Electronics in Modern Technology				
Type of Course	**DSC**				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course provides a comprehensive overview of electronics, emphasizing its significance in modern life. The course then delves into the fundamentals of active and passive components, including resistance, capacitors, and inductors. It also covers semiconductor diodes, AC fundamentals, waveform parameters, and classification of elements. The practical component includes hands-on activities such as familiarization with electronic components, breadboard usage, waveform generation, Ohm's Law verification, and logic gate truth table verification.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Importance of Electronics in Modern life**	**9**
	1	Definition of electronics, Role of electronics in different fields	
	2	Artificial intelligence, Virtual reality (Basic concepts only)	
	3	Internet of Things, Robotics (Basic concepts only)	
	4	Biometrics (Basic concepts only)	
II		**Passive Components**	**9**
	5	Resistance, Colour coding, Resistance in series, Resistance in parallel	
	6	Capacitor, Capacitor coding, Capacitors in series and parallel	
	7	Basic concepts of Inductors and transformers	
III		**Introduction to Active components**	**9**
	8	Semiconductor diodes – Introduction	
	9	PN junction, PN junction with no external voltage	
	10	Forward and Reversed biased PN junction, VI characteristics of PN junction diode	
	11	Static and Dynamic resistance of diode	
	12	Zener diode, Photo diode, LED and solar cell (basic idea only)	

IV		**AC Fundamentals**	**9**
	13	AC Fundamentals: Introduction, Generation of sinusoidal emf, Definitions of waveform	
	14	Waveform parameters - Instantaneous value, cycle, time period, amplitude, frequency, phase, phase difference, phase angle.	
	15	RMS and Average value of sine wave	
V		**Number Systems**	**9**
	16	Number systems – Decimal, Binary, Octal & Hexadecimal – conversions	
	17	Digital codes – BCD, Excess 3, Gray code-conversions, ASCI I codes, Boolean algebra & theorems, SOP & POS, De Morgan‘s theorem	
	18	Simplification of Boolean expressions using Boolean Algebra & K Map (up to four variables).	
	19	Logic gates- Symbols and Truth tables of AND, OR, NOT, NAND, NOR, XOR.	
		PRACTICALS	**30**
		● Familiarization of Breadboard, Nose Plier, Wire Cutter, screwdriver set, connectors and insulation materials. Passive & Active Components, Multimeter, Power Supply, Soldering Practice. ● Production of simple wave forms using Function generator and CRO. ● Ohm‘s Law: To verify Ohm‘s Law using a known value resistance, ammeter and a DC source. ● Study of resistance when connected in series: To find the total resistance, the current flowing in the circuit and the voltage dropped across each resistor, both theoretically and practically. ● Study of resistance when connected in parallel: To find the total resistance, the current flowing in the circuit and the current flowing through each resistor and the voltage dropped across each resistor, both theoretically and practically. ● Demonstration of one lamp controlled by one switch ● Demonstration of staircase wiring: one lamp controlled by two switches ● Demonstration of house wiring - Two lamps controlled by two switches ● Truth table verifications of Logic Gates using ICs– AND,OR,NOT,NAND,NOR.XOR	

Text Books

1. V.K. Mehta and Rohit Mehta, Principles of Electronics, S. Chand
2. Thomas L Floyd, Digital Fundamentals, Pearson, 10/e,2011

Text for Reference

- Basic Electronics, B.L. Theraja and A.K. Theraja, S.Chand.
- Electronics Lab Manual,VOL-1,Fifth Edition, K A Navas, PHI
- Electronics: A Systems Approach, Neil Storey, Pearson
- Electronic Devices and Circuit Theory" by Robert L. Boylestad and Louis Nashelsky, Pearson
- Electronic Technologies in Modern Society, John Smith
- Digital Electronics: Principles and Applications" by Roger L. Tokheim
- Introduction to Electronics, Earl D. Gates, Cengage Learning
- Practical Electronics for Inventors, Paul Scherz and Simon Monk, McGraw Hill.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe electronics' definition and its applications in AI, VR, IoT, robotics, and biometrics classifying electronic elements and systems	U	PSO-2,3
CO-2	Demonstrate knowledge of components like resistors, capacitors, and inductors	U, Ap	PSO 1
CO-3	Explain semiconductor diode principles	U, Ap	PSO 1
CO-4	Comprehend AC fundamentals	U, Ap	PSO 3
CO-5	Infer number systems and Logic Gates	U, Ap	PSO 3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronics in Modern Technology

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 6	U	C	L	P
2	CO-2	PO 1	U, Ap	C,P	L	P
3	CO-3	PO 4	U, Ap	C,P	L	P
4	CO-4	PO 3,4	U, Ap	C,P	L	P
5	CO-5	PO 1	U, Ap	C,P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PO1	PO3	PO4	PO6
CO 1	-	1	1	-	-	-	1
CO 2	2	-	-	1	-	-	-
CO 3	2	-	-	-	-	1	-
CO 4	-	-	2	-	1	1	-
CO 5	-	-	1	2	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK1DSCELE101				
Course Title	Basic Electronic Technology				
Type of Course	**DSC**				
Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course provides a comprehensive overview of electronics, covering both theoretical concepts and practical applications. Students will learn about semiconductor diodes, including their PN junctions, characteristics, and applications like LED and Zener diodes. The course also covers number systems, binary arithmetic, Boolean algebra, logic gates, and digital codes. Practical sessions focus on familiarization with tools and components, circuit building, waveform generation, and verification of gate operations. By the end of the course, students will have a strong foundation in electronics theory and hands-on experience with electronic circuits.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Importance of Electronics**	**9**
	1	Importance of Electronic Technologies in Modern Society:	
	2	Role of electronics in different fields- Internet of Things, Artificial intelligence, Augmented reality, Virtual reality, Robotics, Biometrics.(concept only)	
II		**Semiconductor diodes**	**9**
	3	Introduction to Electronics: Semiconductor diodes – Introduction, PN junction, PN junction with no external voltage	
	4	Forward and Reversed biased PN junction, VI characteristics of PN junction diode.	
	5	Light Emitting Diodes -Working principle-forward reverse characteristics.	
	6	Zener diode-symbol- Voltage regulator circuit	
III		**Number systems**	**9**
	7	Number systems : Decimal, Binary, Octal, and Hexadecimal number systems, Binary-Decimal-Octal-Hexadecimal Inter conversions,	
	8	Signed Binary numbers, 1’s and 2’s complement representation	

	9	Binary arithmetic (Addition & Subtraction)	
IV		**Boolean Algebra**	**9**
	10	Digital codes – BCD, Excess 3, Gray code-conversions, ASCI I codes	
	11	Boolean algebra & theorems	
	12	SOP & POS, De Morgan's theorem	
	13	Simplification of Boolean expressions using Boolean Algebra	
	14	Simplification of Boolean expressions using K Map (up to four variables).	
V		**Logic gates**	**9**
	15	Logic gates : AND, OR, NOT, NAND, NOR and XOR gates (Symbols and Truth Tables)	
	16	Realization of Logic gates using Universal Gates	
		PRACTICALS	30
		● Familiarization of Breadboard, Nose Plier, Wire Cutter, screwdriver set, connectors and insulation materials. Passive & Active Components, Multimeter, Power Supply, Soldering Practice. ● Production of Sine, square, triangular waveforms using Function generator and CRO. ● Study and identification of Passive & Active Components ● Demonstration of one lamp controlled by one switch ● Demonstration of staircase wiring: one lamp controlled by two switches ● Demonstration of house wiring - Two lamps controlled by two switches ● Truth table verification of Gates – AND, OR, NOT, NAND, NOR. XOR. ● To plot the VI characteristics of a PN junction diode(forward) ● To plot the VI characteristics of an LED (forward)	

Text Books

1. Principles of Electronics,V.K. Mehta and Rohit Mehta, S.Chand
2. Basic Electronics, B.L. Theraja and A.K. Theraja, S.Chand
3. Thomas L Floyd, Digital Fundamentals, Pearson, 10/e, 2011

Text for Reference

1. Electronics: A Systems Approach, Neil Storey, Pearson.
2. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson
3. Electronic Technologies in Modern Society, John Smith, PHI
4. Digital Electronics: Principles and Applications" by Roger L. Tokheim
5. Introduction to Electronics, by Earl D. Gates
6. Practical Electronics for Inventors, Paul Scherz and Simon Monk, McGraw Hill
7. Electronics Lab Manual, VOL-1,Fifth Edition, K A Navas

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Infer the role of electronics in different fields	U	PSO 2,3,7
CO-2	Associate various types of diodes, working & characteristics	R , U	PSO 1,5,7
CO3	Analyze number system & code conversion	U,An	PSO 1,4,7
CO4	Interpret digital coding & verification of Boolean expressions.	U,An	PSO 2,3,7
CO5	Summarize with gates and their applications	U,Ap	PSO 2,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Basic Electronic Technology
Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO 1	PO 1	U	F, C	L	P
2	CO 2	PO 1,2	R,U	P	L	P
3	CO 3	PO 1,2	U,An	C	L	P
4	CO 4	PO 1,2,3	U,An	P	L	P
5	CO 5	PO 1,2,3,6	U,Ap	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO7	PO1	PO2	PO3	PO6
CO 1	-	2	1	-	-	1	2	-	-	-
CO 2	2	-	-	-	1	1	2	1	-	-
CO 3	2	-	-	2	-	1	2	1	-	-
CO 4	-	2	2	-	-	1	2	2	1	-
CO 5	-	2	2	-	-	1	2	2	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK1DSCELE102				
Course Title	Electronics Fundamentals				
Type of Course	**DSC**				
Semester	1				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites					
Course Summary	This course provides a comprehensive overview of electronics, focusing on its significance in modern society and its applications in various fields. It covers semiconductor diodes, including PN junction diodes and their characteristics, as well as light-emitting diodes and Zener diodes. The course also delves into transistors, discussing types, operation principles, and applications. Additionally, it explores the applications of PN junction diodes in rectifiers, clippers, and clamps. Finally, it introduces AC fundamentals, discussing sinusoidal emf generation and key waveform parameters. Through theoretical concepts and practical applications, students gain a solid foundation in electronics essential for future studies and careers in the field.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Importance of Electronics**	**12**
	1	Importance of Electronic Technologies in Modern Society:	
	2	Role of electronics in different fields- Internet of Things, Artificial intelligence, Augmented reality, Virtual reality, Robotics, Biometrics.(concept only)	
II		**Semiconductor diodes**	**12**
	3	Introduction to Electronics: Semiconductor diodes – Introduction, PN junction, PN junction with no external voltage	
	4	Forward and Reversed biased PN junction, VI characteristics of PN junction diode.	
	5	Light Emitting Diodes -Working principle-forward reverse characteristics.	
	6	Zener diode-symbol- Voltage regulator circuit	
		Transistors	**12**
	7	Active components: BJT - Types (PNP, NPN) -symbol and terminal identification, Principle of operation.	

III	8	FET-Symbol and Terminal identification	
	9	Transistor applications - switch and amplifier (Block diagram)	
IV	**Applications of PN Junction Diode**		**12**
	10	Rectifier-Half wave Rectifier	
	11	Centre Tapped rectifier,	
	12	Clipper (positive and negative)	
	13	Clamper (positive, and negative)	
V	**AC Fundamentals**		**12**
	14	Introduction, generation of sinusoidal EMF	
	15	Definitions of waveform, instantaneous value, cycle, time period, amplitude, frequency, phase, phase difference, phase angle	
	16	RMS and average value of Sine Wave	

Text books:

1. Navas, KA and Suhail, TA, Basic Electrical and Electronics Engineering, Rajat Publishers, Kochi
2. Rajendran, N, Basic Electrical and Electronics Engineering, Moonlight Publishers, Trivandrum
3. Thankachan, Aneesh P, Basics of Electronics Engineering, Phoenix, Kollam
4. Babu, Suresh V and Gopi, Varun P, Basics of Electronics Engineering, Owl Books, Trivandrum

Reference:

1. Electronic Technologies in Modern Society, John Smith, Wiley.
2. Principles of Electronics, V.K. Mehta and Rohit Mehta, S.Chan.d
3. Mittle,V N, Basic Electrical Engineering, TMH .

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Generalize with mono electronic technology	U	PSO 3,5
CO-2	Discuss various semiconductor diodes, transmitters and their applications	R, U	PSO 2
CO-3	Demonstrate various active components- BJT, FET and their applications	U	PSO 2
CO-4	Describe rectifiers , their classifications, clippers and clampers	U	PSO 2
CO -5	Develop knowledge on ac fundamentals and related terms	Ap	PSO 1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronics Fundamentals

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 1	U	F	L	-
2	CO-2	PO 3	R, U	F	L	-
3	CO-3	PO 3	U	C	L	-
4	CO-4	PO 1	U	C	L	-
5	CO-5	PO 4,6	Ap	P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO5	PO1	PO3	PO4	PO6
CO 1	-	-	1	1	1	-	-	-
CO 2	-	2	-	-	-	1	-	-
CO 3	-	1	-	-	-	1	-	-
CO 4	-	2	-	-	2	-	-	-
CO 5	2	1	-	-	-	-	2	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK1MDCELE100				
Course Title	Electronics for Biology				
Type of Course	**MDC**				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	Nil				
Course Summary	• To understand the inter-connection between biology and future technologies • To motivate technology application for biological and life science challenges				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Module 1: Need to study Biology**		**9**
	1	Significance of studies in Life Science by engineers, Bio Inspired Inventions	
	2	Role of Biology in Next Generation Technology Development	
	3	Cell Structure, Cell Potential – Action Potential	
	4	ECG and other common signals, Sodium pump	
II	**Module 2: Neuron channels**		**9**
	5	Neuron function	
	6	Central Nervous Systems	
	7	Discussion Topics: Evolution of Artificial Neural Networks	
	8	Machine Learning techniques	
III	**Module 3: Sensing Techniques**		**10**
	9	Understanding the working of Sense organs	
	10	Sensing mechanisms	
	11	Sensor Development issues	
	12	Discussion Topics: Digital Camera, Eye Comparison, electronic nose, electronic tongue, electronic skin	
IV	**Module 4: Physiological Assistive Device**		**8**
	13	Artificial Organ Development of	
	14	Kidney, Liver, Pancreas, heart valves	

	15	Design Challenges and Technological Developments	
V	**Module 5: Medical instrumentation**		**9**
	16	Design criteria of medical instruments	
	17	Principles of medical imaging – X ray, CT Scan, Ultrasound, MRI	
	18	Introduction to electrical safety	
	19	Macro current and microcurrent shocks and their hazards	

Books for Study:

1. Leslie Cromwell, Biomedical Instrumentation, Prentice Hall 2011.
2. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S.Chand Jaganthan M.K., Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.

References and Advanced Learning:

1. Sohini Singh and Tanu Allen, Biology for Engineers, Vayu Education of India, New Delhi, 2014.
2. Maria Rodriguez Mende, Electronic Noses and Tongues in Food Science, Academic Press, 2016
3. T Johnson, Biology for Engineers, CRC press, 2011 Molecular Biology and Biotechnology 2nd Ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.
4. Sandhya Mitra, Genetic Engineering, MGH Education

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the biological concepts from an engineering perspective	U	PSO-1,2
CO-2	Infer the concepts of biological sensing and its challenges	R, U	PSO-1,2
CO-3	Demonstrate development of artificial systems mimicking human action	U	PSO-1,2
CO-4	Integrate biological principles for developing next generation technologies	U, R	PSO-1,2
CO-5	Discuss the basic diagnostic methods today and precautionary measures for engineers in the biomedical field	R,U	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronics for Biology
Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1.	CO1	PO-1,6	U	F, C	L	-
2.	CO2	PO-1,6	R, U	F	L	-
3.	CO3	PO-1,6	U	F	L	-
4.	CO4	PO-1,6	U, R	F	L	-
5.	CO5	PO-1,6	R,U	F	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :Correlation Levels:

	PSO1	PSO2	PO1	PO6
CO 1	1	1	2	1
CO 2	1	2	1	1
CO 3	1	1	1	1
CO 4	2	1	1	1
CO 5	1	1	1	1

Correlation levels

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK1MDCELE101				
Course Title	Basics of IoT				
Type of Course	MDC				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites					
Course Summary	The course aims to inculcate basic ideas of IoT through 5 modules, introduction IoT and M2M communication, sensor technologies,introduction to embedded technologies and applications of IoT.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to IoT**		**9**
	1	What Is IoT, Evolutionary Phases of the Internet	
	2	IoT and Digitization, IoT Impact, IoT challenges	
	3	A Simplified IoT Architecture, IoT applications	
	4	Connectivity layers, Connectivity terminologies	
		(Refer Textbook 1 and Reference 1)	
II	**IoT and M2M Communications**		**9**
	5	Introduction- M2M, M2M applications,	
	6	Differences between M2M and IoT,	
	7	M2M standards- Bluetooth-LE, Zigbee, NFC, Wifi and LoRaWAN	
		(Refer Textbook1,3, and 4)	
III	**Sensor Technologies**		**8**
	8	Sensors and actuators for IoT	
	9	Sensor types- Voltage, Current, Speed, Temperature and humidity sensors	
	10	Wireless sensor network	
	11	Types of Actuators-MEMS.	
		(Refer Textbook 1)	
IV	**Introduction to Embedded System Platform**		**10**
	12	Introduction to Arduino, Features of Arduino.	
	13	Types of Arduino board, Arduino UNO, Board details,	

	14	Introduction to Raspberry Pi- Specifications, Basic architecture	
	15	Intel Galileo, Intel Edison .	
		(Refer Textbook 4)	
V	**Application of IoT**		**9**
	16	Real life application of IOT	
	17	Industry automation, Home automation	
	18	Pollution Monitoring, Agricultural monitoring	
	19	Smart city application, Public Safety	
	20	Automobile IoT- Electric vehicles	
		(Refer textbook 1,2 and 3)	

Text books

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 standards", Wiley, 2019
3. Internet of Things: A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti Universities, Press.
4. Rajkamal, Internet of Things: Architecture and Design Principles, McGraw Hill (India) Private Limited.

References

1. Course material of NPTEL: online course on Introduction to Internet of things
2. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, Pethuru Raj and Anupama C. Raman, CRC Press.
3. Internet of Things Principles and Paradigms - Rajkumar Buyya, Amir Vahid Dastjerdi, MK

4. Internet of things with Audrino blueprints, Pradeeka Seneviratne, PCKT publishing – open source

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the importance of market perspective and architectural features of internet-of-things (IoT) based systems.	U	PSO-1,4
CO-2	Distinguish M2M and IoT and Perceive ideas on the different connectivity technologies.	R, U	PSO-1,2
CO-3	Explore and employ the concepts on sensing, actuation and Perceive ideas on Wireless Sensor Networks.	R, U	PSO-1,2
CO-4	Classify various Embedded System Platforms.	R, U	PSO-1,8
CO5	Apply the basics of IoT for different applications like Smart Homes, Industrial IoT, Smart City, Smart Transportation, Smart Manufacturing, and Smart Healthcare	R, U, Ap	PSO-4,5,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module

Name of the Course: Basics of Io T
Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,6; PSO-1,4	U	F, C	L/T	-
2	CO-2	PO-1,6; PSO-1,2	R, U	F,C	L/T	-
3	CO-3	PO-5,6; PSO-1,2	R, U	P	L/T	-
4	CO-4	PO-1,6; PSO-1,8	R, U	F,P	L/T	-
5	CO-5	PO-1,2,3; PSO-4,5,8	R, U, Ap	P	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO 2	PSO 4	PSO 5	PSO 8	PO 1	PO 2	PO 3	PO 5	PO 6
CO 1	1	-	2	-	-	1	-	-	-	2
CO 2	2	1	-	-	-	2	-	-	-	2
CO 3	1	2	-	-	-	-	-	-	3	2
CO 4	2	-	-	-	1	2	-	-	-	1
CO 5	-	-	2	2	2	2	2	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK2DSCELE100				
Course Title	Digital Electronics				
Type of Course	**DSC**				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course covers the fundamentals of digital electronics, focusing on combinational and sequential circuits. In the first module, students learn about adders, subtractors, and flip-flops. The second module covers comparators, decoders, encoders, and code converters. The third module introduces multiplexers, demultiplexers, and their applications in realizing Boolean expressions. Shift registers and their applications, such as latches, are discussed in the fourth module. The fifth module explores counters, including state diagrams, asynchronous and synchronous counters, and their designs. Practical sessions complement theoretical learning, reinforcing concepts through hands-on experiments with flip-flops, encoders, decoders, multiplexers, demultiplexers, and counters. Students gain practical skills in implementing digital circuits using logic gates and flip-flops, enhancing their understanding of digital electronics principles.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Combinational circuits & Sequential circuits**	**9**
	1	Binary addition and subtraction.	
	2	Adders - Half adder and Full adder.	
	3	Subtractors - Half and Full subtractor	
	4	Flip Flops: RS, D, JK, T and Master slave	
II		**Comparators & Decoders**	**9**
	5	Comparators - 1-bit magnitude & 2-bit magnitude.	
	6	Decoders - 2 to 4 & 3 to 8. Encoders - Octal to Binary & Decimal to BCD	
	7	Code converters - Gray to Binary, Binary to Gray and Binary to BCD	
		Multiplexers & Demultiplexers	**9**
	8	Multiplexers: 2 input, 4 input & 8 input.	
	9	Demultiplexers: 1 to 4 & 1 to 8.	

III	10	Realization of Boolean expression using multiplexers and demultiplexers.	
	11	Familiarization of popular ICs: 7483, 74151, 74154 and its applications	
IV	**Shift registers**		**9**
	12	Applications – Latches, typical circuits	
	13	Shift registers	
	14	SISO,SIPO,PISO,PIPO	
	15	Applications as Ring counter and Johnson counter.	
V	**Counters**		**9**
	16	State diagram & State table. Asynchronous counters: Concepts and Design of 2bit & 4 bit Up/Down counter,	
	17	MOD 10 up counter	
	18	Synchronous counters	
	PRACTICALS		30
		● Verify the truth tables of SR and JK flip-flops ● Binary to BCD converter ● Octal to Binary encoder using Gates. ● Half Adder circuits using logic gates ● Full Adder circuits using logic gates ● 1 bit magnitude comparator using gates ● Realization of 4 to 1 MUX using gates ● Realization of 1 to 4 Demultiplexer using gates ● Realisation of asynchronous decade up counter using flip flops ● Realisation of Shift registers-SISO, SIPO, PISO, PIPO using flip flops. ● Realisation of asynchronous decade up counter using flip flops.	

Text Books

1. Anand Kumar, Fundamentals of digital circuits, PHI, 2/e, 2012.
2. Thomas L Floyd, Digital Fundamentals, Pearson, 10/e, 2011.

Text for Reference

1. John MYarbrough, Digital logic- Application and Design, Thomson Learning, 2006.
2. John Wakerly, Digital Design Principles and Practice, Pearson,4/e, 2012.
3. Electronics Lab Manual,VOL-1,Fifth Edition, K A Navas
4. Morris Mano,Ciletti, Digital Design, 4/e, Pearson ,4/e, 2009
5. Thomas A.DeMessa, Zack Ciecone: Digital Integrated Circuits, Wiley India,2007
6. Ghoshal, Digital Electronics, Cengage, 2012.
7. Malvino & Leach, Digital principles and applications,TMH.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Summarize combinational and sequential circuits	U	PSO-1,2
CO-2	Analyze comparators,decoders & code converters	R, U	PSO2,3
CO3	Summarize MUX,DEMUX &Boolean expressions.	U,An	PSO2,3,4
CO4	Apply Latches,Shift registers and counters	An, Ap	PSO2,3,4,7
CO5	Infer the application of counters	Ap	PSO2,3,4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course :Digital Electronics

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PO1,2	U	F, C	T	P
2	CO2	PO 2,3	R,U	C	T	P
3	CO3	PO 2,3,4	U,An	P	T	P
4	CO4	PO 2,3,4	An,Ap	P	T	P
5	CO5	PO 2,3,4	An,Ap	P	T	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO7	PO1	PO2	PO3	PO4
CO 1	2	1	-	-	-	2	1	-	-
CO 2	-	2	1	-	-	-	2	1	-
CO 3	-	2	2	1	-	-	1	1	1
CO 4	-	2	2	2	1	-	2	1	1

CO 5	-	2	2	2	1	-	2	1	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK2DSCELE101				
Course Title	Electronic Technology				
Type of Course	**DSC**				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course covers fundamental topics in electronics over five modules. Module I focuses on rectifiers, covering half wave, full wave, and bridge rectifiers, along with concepts like average value, ripple factor, and efficiency. Module II delves into active and passive components, including resistance in series and parallel, and a comparison study of BJT and FET transistors. Module III explores combinational and sequential circuits, discussing adders, flip flops, and their applications. Module IV covers multiplexers, demultiplexers, comparators, decoders, and encoders. Finally, Module V investigates the applications of flip flops, including shift registers, counters, and MOD 10 up counters. Practical sessions include experiments on rectifiers, resistance, logic gates, flip flops, multiplexers, demultiplexers, and counters, providing hands-on experience.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Active and passive components**	**9**
	1	Basic study of active and passive components	
	2	resistance in series	
	3	resistance in parallel	
	4	Transistors : Terminals and comparison study of BJT and FET transistors	
		Rectifiers	**9**
	5	Rectifiers: Definition and the importance in Electronics	

II	6	Half wave, Full wave and bridge rectifiers	
	7	Average value – ripple factor – efficiency. (Derivations not required)	
III	**Combinational circuits & Sequential circuits**		**9**
	8	Combinational circuits: Adders - Half adder and Full adder.	
	9	Sequential circuits: Flip Flops: RS latch, clocked RS, D, JK and T	
IV	**Multiplexers & Demultiplexers**		**9**
	10	Comparators - 1-bit magnitude & 2-bit magnitude.	
	11	Decoders - 2 to 4 & 3 to 8	
	12	Encoders - Octal to Binary & Decimal to BCD	
	13	Multiplexers: 2 input, 4 input & 8 input.	
	14	Demultiplexers: 1 to 4 & 1 to 8	
V	**Applications of Flip flops**		**9**
	15	Applications –Shift registers (SISO,SIPO,PISO & PIPO), typical circuits & applications as Ring counter and Johnson counter.	
	16	Asynchronous counters: Concepts and Design of 2 bit & 4 bit Up/Down counter	
	17	MOD 10 up counter	
		PRACTICALS	30
		• Rectifiers-half wave, full wave, Bridge without filter • Study of resistance when connected in series & parallel. • Half Adder circuits using logic gates • Full Adder circuits using logic gates • Verify the truth tables of SR and JK flipflops • Realization of 4 to 1 MUX using gates • Realisation of 1 to 4 Demultiplexer using gates • Realisation of asynchronous decade up counter using flip flops • Realisation of Shift registers-SISO, SIPO, PISO, PIPO using flip flops. • Realisation of asynchronous decade up counter using flip flops.	

Text books

1. Principles of Electronics, V.K. Mehta and Rohit Mehta, S. Chand
2. Thomas L Floyd, Digital Fundamentals, Pearson, 10/e,2011.

Reference

1. Boylestad & Nashelsky, Electronic Devices & Circuit Theory, PHI.
2. Electronics Lab Manual,VOL-1, Fifth Edition, K A Navas
3. Electronic Devices and Circuits, David A. Bell, Mc Graw Hill
4. Morris Mano,Ciletti, Digital Design, 4/e, Pearson , 4/e, 2009
5. Thomas A.DeMessa, Zack Ciecone: Digital Integrated Circuits, Wiley India,2007
6. Ghoshal, Digital Electronics, Cengage, 2012.
7. Malvino & Leach, Digital principles and applications,TMH.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate Knowledge of Active and Passive Components	U, Ap	PSO 1,2,7
CO-2	Understand Rectifiers	U	PSO 1,2,5
CO-3	Master Combinational and Sequential Circuits	An	PSO 5,7,8
CO-4	Exhibit Proficiency in Comparators, Decoders, and Encoders	Ap	PSO 1,3,7
CO-5	Apply Flip-Flops in Circuits	Ap	PSO 2,7,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronic Technology

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 1,2	U, Ap	C,P	L	-
2	CO-2	PO 1,2,6	U	C	L	-
3	CO-3	PO 3	An	C	L	-
4	CO-4	PO 2,3,6	Ap	P	L	P
5	CO-5	PO 1,2,3,6	Ap	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO5	PSO7	PSO 8	PO1	PO2	PO3	PO6
CO 1	2	1	-	-	1	-	1	1	-	-
CO 2	2	1	-	1	-	-	1	1	-	2
CO 3	-	-	1	2	1	2	-	-	2	-
CO 4	2	-	2	-	1	-	-	1	1	2

CO 5	-	2	-	-	1	1	2	1	1	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK2DSCELE102				
Course Title	Fundamentals of Digital Technology				
Type of Course	**DSC**				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites					
Course Summary	This course introduces digital systems fundamentals. It covers number systems including binary, octal, and hexadecimal, Boolean algebra, logic gates, combinational and sequential circuits, multiplexers, demultiplexers, and applications of flip flops. Topics include digital signal concepts, conversions, digital codes, simplification of Boolean expressions, logic gates operations, building blocks, adders, flip flops, comparators, decoders, encoders, multiplexers, demultiplexers, shift registers, counters, and MOD 10 up counter design. Through lectures and hands-on exercises, students gain a comprehensive understanding of digital electronics principles, essential for further studies or practical applications.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Number systems**	**9**
	1	Introduction to the concept of digital signal	
	2	Number systems – Decimal, Binary, Octal & Hexadecimal – conversions,	
	3	Digital codes – BCD, Excess 3, Gray code-conversions, ASCI I codes	
	4	Boolean algebra & theorems SOP & POS De Morgan‘s theorem	
	5	Simplification of Boolean expressions using Boolean Algebra & K Map (up to four variables).	
II		**Logic Gates**	**9**
	6	Logic gates : AND, OR, NOT, NAND, NOR, EXOR gates,	
	7	Realisation of Logic Gates Using Universal Gates.	
III		**Combinational circuits & Sequential circuits**	**9**
	8	Combinational circuits: Adders - Half adder and Full adder.	
	9	Sequential circuits: Flip Flops: RS, D, JK and T	
IV		**Multiplexers & Demultiplexers**	**9**
	10	Comparators - 1-bit magnitude & 2-bit magnitude.	
	11	Decoders - 2 to 4 & 3 to 8	
	12	Encoders - Octal to Binary & Decimal to BCD	
	13	Multiplexers: 2 input, 4 input & 8 input.	

	14	Demultiplexers: 1 to 4 & 1 to 8	
V	**Applications of Flip flops**		**9**
	15	Applications –Shift registers (SISO,SIPO,PISO & PIPO), typical circuits & applications as Ring counter and Johnson counter.	
	16	Asynchronous counters: Concepts and Design of 2 bit & 4 bit Up/Down counter	
	17	MOD 10 up counter	

Texts for reference

Text Books

1. Anand Kumar, Fundamentals of digital circuits, PHI, 2/e, 2012.
2. Thomas L Floyd, Digital Fundamentals, Pearson, 10/e,2011.

Reference

1. John MYarbrough, Digital logic- Application and Design,Thomson Learning, 2006.
2. John Wakerly, Digital Design Principles and Practice, Pearson, 4/e, 2012.
3. Morris Mano,Ciletti, Digital Design, Pearson, 4/e, 2009
4. Thomas A.DeMessa, Zack Ciecone: Digital Integrated Circuits, Wiley India, 2007
5. Ghoshal, Digital Electronics, Cengage, 2012.
6. Malvino & Leach, Digital principles and applications, TMH.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Classify number system and conversion of digital codes	An	PSO 1,2
CO-2	Identify of logic gates their truth table and applications	Ap	PSO 2,3,4
CO-3	Analyse combinational as well as sequential circuits	An	PSO 3,4
CO-4	Summarize different types of comparators , decoders, Encoder, MUX and DEMUX	U	PSO 5
CO-5	Apply flip flops	Ap	PSO 3,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Fundamentals of digital technology
Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 6	An	F	L	-
2	CO-2	PO 1,6	Ap	C	L	-
3	CO-3	PO 3	An	C	L	-
4	CO-4	PO 1,2	U	F	L	-
5	CO-5	PO 1,6	Ap	P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO6
CO 1	2	1	-	-	-	-	-	-	-	1
CO 2		1	1	1	-	-	2	-	-	1
CO 3	-	-	1	1	-	-	-	-	2	-
CO 4	-	-	-	-	2	-	2	2	-	-
CO 5	-	-	2	-	1	-	2	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK2MDCELE100				
Course Title	AI FOR BEGINNERS				
Type of Course	**MDC**				
Semester	II				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites	Nil				
Course Summary	This course enables to understand the fundamentals of Artificial Intelligence and Machine Learning				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to AI**	**9**
	1	Definition of Artificial Intelligence (AI)	
	2	History of AI-The Foundations of AI	
	3	Applications of AI	
	4	Intelligent Agents – Agents and Environments	
	5	Good behavior: The concept of rationality, Nature of Environments, Structure of Agents, Types of Agents	
II		**Knowledge Representation and Reasoning**	**9**
	6	Types of Knowledge to Represent in AI	
	7	Categories of Knowledge Representation Schemes	
	8	Properties of Knowledge Representation (KR)	
	9	Approaches to Knowledge Representation	
	10	Propositional logic	
	11	First Order Logic	
	12	Rules of Inference	
III		**Problem Solving**	**9**
	13	Problem solving Agents	
	14	Search algorithm Terminologies	
	15	Search algorithm Properties	
	16	Search Algorithm Types	
	17	Uninformed Search Breadth First Search, Depth first search	
	18	Informed Search - Best first Search	

IV	**Machine Learning**		**9**
	19	Definition -Applications	
	20	Processes involved in Machine Learning	
	21	Machine Learning Techniques-Supervised Learning, Unsupervised Learning and Reinforcement Learning	
V	**Future of AI**		**9**
	22	Generative AI- Definition, Benefits, Limitations, and Issues	
	23	Generative AI tools Chat GPT, Google Bard, and DALL-E	

Text Books

1.Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition. Prentice Hall.

References

2.Nilsson N.J., Artificial Intelligence - A New Synthesis, Harcourt Asia Pvt. Ltd.

3.Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill

4.Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India).

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the evolution and impact of AI	U	1,2
CO-2	Interpret different types of knowledge and their representation schemes	U	1,2
CO-3	Identify problem solving agents.	U	1,4
CO-4	Analyze Breadth First Search, Depth first search and Best first Search	U, An	1,3
CO-5	Discuss the process involved in Machine Learning	U	1,2
CO-6	Distinguish between Supervised Learning, Unsupervised Learning and Reinforcement Learning	U	1,2
CO-7	To understand the prospects of AI	U	1,3

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: AI for beginners

Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1.	CO-1	PO-1,2; PSO-1,2	U	F,C	L	-
2.	CO-2	PO-1,2; PSO-1,2	U	F,C	L	-
3.	CO-3	PO-1,2; PSO-1,4	U	F,C	L	-
4.	CO-4	PO-1,2; PSO-1,3	U, An	F,C	L	-
5.	CO-5	PO-1,2; PSO-1,2	U	F,C	L	-
6.	CO-6	PO-1,2; PSO-1,2	U	F,C	L	-
7.	CO-7	PO-1,2; PSO-1,2	U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PO1	PO2
CO 1	1	1	-	-	1	2
CO 2	2	3	-	-	1	2
CO 3	1	-	-	1	1	2
CO 4	1	-	-	3	1	2
CO 5	2	1	-	-	2	2
CO 6	1	-	2	-	3	2
CO-7	1	1	-	-	1	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		✓
CO7	✓			

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK2MDCELE101				
Course Title	Essential Electronics				
Type of Course	**MDC**				
Semester	II				
Academic Level	100 – 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	3 hours	-	-	3
Pre-requisites					
Course Summary	Acquire the basic knowledge of essential electronic devices used in day-to-day life.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction**	**9**
	1	Arduino Development Boards: IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Designing of 1st sketch, Programming of an Arduino (Arduino ISP)	
	2	Transducers sensors	
	3	Piezoelectric sensors, light (photo-conductive, photo emissive, photovoltaic, semiconductor, LDR), Temperature (electrical and non-electrical), Pressure sensor.	
	4	PIR based systems	
II		**Video Teleconferencing**	**9**
	5	Audio systems: PA system, Microphone, Amplifier, Loudspeakers. Basic Troubleshooting.	
	6	Projectors: DLP, Home Theatres requirements, Remote Controls.	
	7	GPRS & Bluetooth. GPS Navigation system. Modular Smartphones. Video conferencing equipment	
	8	Home appliances troubleshooting: - Fault finding procedure for Power supply, Home Theatre, LED Bulbs, FAN, Iron Box	
III		**Computer & Laptop Basics**	**9**
	9	Functional block diagram of a computer system. Overview of Software, hardware and firmware	
	10	Input and Output Devices - Keyboard, Mouse, scanner, Monitors, Printers and Scanners – Types. Memory: EEPROM, ROM, DDR, and SDRAM. Storage devices: SSD, HDD Basics of Processors, Basics of MotherBoard. And chipsets	
	11	Expansion Slots and ports- PCI, PCIe, AGP., USB standards, SATA, PATA.	
	12	Add-on Cards: NIC, Graphics card. Hardware**.**	

	13	Troubleshooting. Error codes: Motherboard, processor, Memory, Basic troubleshooting devices	
	14	Power supply requirements and testing methods	
IV	**Electrical wiring Basics & Standards**		**9**
	15	Concept of Voltage, Current, Resistance, Power and its measurement, earthing procedure, Testing of line faults	
	16	Wiring Colour code for domestic and industry, selection of proper wire gauge, Cabling accessories, Concept of FUSE, MCB, RCCB, ELCB and load requirement calculation	
	17	Basic Electrical safety rules, Equipment and component level inspection, Overload and short circuit identification, Earthing technique	
	18	Electrical Measurement tools: - Voltmeter, Ammeter, MultiMate (Digital and Analog), Clamp meter, LCR Meter	
V	**Modern Electronic Gadgets**		**9**
	19	Modern Electronic Gadgets: Vacuum cleaners, High voltage and under voltage protecting devices. BLDC Technology, Energy star devices. Power saving mechanism. Basic electronics safety measures**.**	

Books for Study:

1. R. P. Bali, Consumer Electronics, Pearson Education (2008)
2. R. G. Gupta, Audio and Video systems, Tata McGraw Hill (2004)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate the basic components needed for electronic project	R, U	PSO-1,4
CO-2	Discuss the basic components of remote communications methods	R, U, A	PSO-1,3
CO-3	Assemble self-required computer and laptop systems.	R, U, A, An	PSO-1,3,4
CO-4	Discuss the basic details of electrical system in home	R, U	PSO-1,4,7
CO-5	Demonstrate systems of linear equations using matrices and determinants.	R, U	PSO-1,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Essential Electronics
Credits: 3:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,4	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,3	R, U	F, C	L	-
3	CO-3	PO-1,7; PSO-1, 3,4	R, U	F, C	L	-
4	CO-4	PO-1,8: PSO-1,4,7	R, U, Ap	F, C	L	-
5	CO-5	PO-1,8, PSO-1,4,8	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO 8	PO1	PO3	PO 7	PO 8
CO 1	1	-	-	1	-	-	1	1	-	-
CO 2	2	-	2	-	-	-	2	1	-	-
CO 3	1	-	1	1	-	-	1	-	1	-
CO 4	1	-	-	3	1	-	1	-	-	1
CO 5	1	-	-	1	-	2	1	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSCELE200				
Course Title	Electronic Circuits				
Type of Course	**DSC**				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course covers the fundamentals of electronics with a focus on practical applications. It starts with rectifiers and filters, discussing their types and characteristics. Next, it explores transistors, including BJTs and FETs, their configurations, and comparison. Amplifiers and oscillators are then studied, emphasizing concepts like amplification, frequency response, and oscillator principles. RC circuits are discussed in detail, including high pass, low pass, differentiator, and integrator circuits. The course concludes with multivibrators, covering their types and applications. Practical sessions include experiments on diodes, transistors, amplifiers, and oscillators to reinforce theoretical concepts.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Rectifiers & Filters**	**9**
	1	Rectifiers: Half wave, Full wave and bridge rectifiers	
	2	Average value – ripple factor –efficiency	
	3	Simple capacitor filter, RC, LC, CLC filters	
	4	comparison of filter circuits	
II		**Transistors**	**9**
	5	Bipolar Junction Transistor: Construction, Operation of a transistor	
	6	Transistor currents, Transistor circuit configurations Current gain, Relation between α, ß, γ	
	7	Field Effect Transistor: Operation of JFET, Transfer and drain characteristics	
	8	Comparison of BJT and FET.	
		Amplifiers & Oscillators	**9**
	9	Amplifiers: Concept of amplification, RC coupled amplifier.	
	10	Frequency response — concept of gain band -width product	
	11	Emitter follower – applications.	

III	12	Oscillators: Principle of sinusoidal oscillators – Barkhausen criteria – RC phase shift Oscillator	
IV	**RC Circuits**		**9**
	13	RC Circuits: Response of high pass and low pass RC circuits to step and square wave inputs.	
	14	Differentiator (RC)	
	15	Integrator (RC)	
	16	clipping (positive and negative)	
	17	clamping circuits (positive and negative)	
V	**Multivibrators Using BJT**		**9**
	18	Astable multivibrators	
	19	Monostable multivibrators	
	20	Bistable multivibrators	
	PRACTICALS		**30**
		1. To plot the VI characteristics of a PN junction diode 2. To plot the VI characteristics of an LED 3. Clipping and clamping circuits. 4. Integrating and Differentiating circuits 5. Characteristics of Transistors (CE configuration) 6. Rectifiers-half wave, full wave, Bridge with and without filter 7. Single stage RC coupled amplifier – design –measure DC operating point –frequency response plot – find bandwidth, mid band voltage gain 8. Mutivibrators (astable) – design – measure frequency of oscillation – plot output waveforms 9. Sinusoidal oscillator (RC phase shift) – design – measure operating point – measure frequency of oscillation.	

Text books

1. Principles of Electronics by V. K. Mehta and Rohit Mehta, S.Chand

2. Basic Electronics by B. L. Theraja, S.Chand

Reference

1. Boylestad & Nashelsky, Electronic Devices & Circuit Theory, PHI.
2. Millman and Halkias : Integrated Electronics,TMH.
3. Electronic Principles" by Albert Malvino and David Bates
4. Electronic Devices and Circuits" by David A. Bell
5. Integrated Electronics: Analog and Digital Circuits and Systems" by Jacob Millman and Christos C. Halkias
6. Electronics Lab Manual,VOL-1,Fifth Edition, K A Navas
7. Electronic Circuit Analysis and Design" by Donald A. Neamen

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand Rectifiers and Filters	U	PSO 2
CO-2	Explain Transistors and their Characteristics	U	PSO 1
CO-3	Analyze Amplifiers and Oscillators	An	PSO 2
CO-4	Apply RC Circuits and Their Applications	Ap	PSO 3
CO-5	Design and Analyze Multivibrators	An	PSO 2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronic Circuits

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 1	U	C	L	P
2	CO-2	PO 1	U	C	L	P
3	CO-3	PO 2	An	C	L	P
4	CO-4	PO 3	Ap	P	L	P
5	CO-5	PO 3	An	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PO1	PO2	PO3
CO 1	-	1	-	2	-	-
CO 2	1	-	-	2	-	-
CO 3	-	1	-	-	1	-
CO 4	-	-	1	-	-	1
CO 5	-	1	-	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSCELE201				
Course Title	Microprocessor Architecture and Applications				
Type of Course	**DSC**				
Semester	III				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. Basic concept of computer 2. Understanding the functional units of a standard PC				
Course Summary	This course focuses on the architecture, assembly language programming, interrupt handling and interfacing of microprocessors with peripheral devices. It helps the learners to extend the study of latest processors and develop hardware based solutions.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to microprocessors**		**8**
	1	Overview of microprocessors and their importance in modern computing	
	2	Basic architecture and components of a microprocessor.	
	3	Types of microprocessors and their applications	
II	**Architecture of Intel 8086 microprocessor**		**15**
	4	Introduction to Intel 8086 microprocessor.	
	5	Architecture and pin organization of Intel 8086 microprocessor	
	6	EU and BIU, Min/Max modes	
	7	Register organization, Memory segmentation and addressing in Intel 8086	
III	**Programming with Intel 8086 Microprocessor**		**15**
	8	Introduction to assembly language programming	
	9	Instruction format and addressing modes in assembly language	
	10	Instruction set architecture of Intel 8086	
	11	Assembly language programming concepts: data movement, arithmetic and logical operations, branching, and looping	
	12	Writing simple programs using Intel 8086 assembly language	
IV	**Input Output operations with 8086**		**10**
	13	Interrupts and interrupt handling mechanism	
	14	Overview of I/O operations and interfacing.	
	16	I/O port addressing and I/O instructions in Intel 8086	
	17	Interfacing I/O devices like LED and switch with Intel 8086 microprocessor	
	18	Interfacing peripherals using 8255.	

V	**Advanced Programming Concepts and Applications**		**12**
	19	Advanced programming techniques: Assembler derivatives, subroutines, macros, and procedures	
	20	Advanced technologies like pipelining and multiprocessing - Stages of pipelining- advantages.	
	21	Comparison of 8086 microprocessor families (such as 8088, 80186, and 80286)-Features only.	
	22	Real-world applications and case studies involving Intel 8086 microprocessor	

TEXT BOOK(S):

1. The 8086 Microprocessors- Architecture, Programming and Interfacing – Lyla B Das – Pearson Second edition.
2. 8086 Microprocessor and Applications, Nagoor Kani, 3Ed, PHI, 2011
3. Microprocessor 8086 Architecture, Programming and Interfacing by Sunil Mathur, PHI, 2011

REFERENCES:

1. The 8088 and 8086 Microprocessors – Programming, Interfacing, Software and Hardware Applications by Walter A. Triebel & Avatar Singh, Pearson Fourth Edition,
2. The Intel Microprocessors : Architecture, Programming and Interfacing- Barry B. Brey Pearson -8 Edition
3. Microprocessor and Microcontroller - R. Theagarajan – SCITECH-2010

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Develop the idea of Microprocessor and its role in computing world	R,U	PSO-4
CO-2	Illustrate the architecture, modes of operation and addressing modes of microprocessors	R, U	PSO-4
CO-3	Develop 8086 assembly language programming skills.	U, Ap, C	PSO-1,2,3,4,8
CO-4	Demonstrate interrupts, its handling	U,Ap,	PSO-4
CO-5	Illustrate the interfacing of 8086 microprocessor with input output devices	R,U,Ap,C	PSO-2,3,4,8
CO-6	Evaluate the advanced programming techniques and 8086 microprocessor family	R,U,An	PSO-4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Microprocessor Architecture and Applications
Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,3,7/PSO-4	R,U	F	L	-
2	CO-2	PO-1,3,7/PSO-4	R, U	F	L	-
3	CO-3	PO-1,3,7/PSO-1,2,3,4,8	U, Ap, C	C,P	L/T	-
4	CO-4	PO-1,3,7/PSO-4	U,Ap,	C	L/T	-
5	CO-5	PO-1,3,7/PSO-2,3,4,8	R,U,Ap,C	C,P	L/T	-
6	CO-6	PO-7/PSO-4,7	R,U,An	F	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO8	PO1	PO3	PO7
CO 1	-	-	-	2	-	-	1	2	-
CO 2	-	-	-	3	-	-	1	2	2
CO 3	1	3	3	2	1	3	1	2	2
CO 4	-	-	-	2	-	-	1	2	2
CO 5	-	2	2	2	-	3	1	2	2
CO 6	-	-	-	2	1	3	1	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSCELE202				
Course Title	COMMUNICATION SYSTEMS				
Type of Course	**DSC**				
Semester	III				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites					
Course Summary	A communication systems course provides a foundational understanding of how information is transmitted and received electronically. It covers essential concepts like signal analysis using modulation techniques for audio and visual data (AM, FM, PM), digital communication principles (sampling, quantization), and basic channel analysis. This knowledge equips students to analyse basic communication systems, understand transmission limitations due to noise, and paves the way for further studies in advanced communication technologies like wireless networks				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Analog Communication**	**12**
	1	Radio communication: principle of AM, waveforms	
	2	Principles of FM, waveforms, bandwidths	
	3	Block diagrams of AM & FM transmitter	
	4	Block diagram of AM & FM super heterodyne receiver	
II		Digital Communication	**12**
	5	Pulse modulation – Sampling theorem, Nyquist Rate	
	6	Pulse Amplitude Modulation (PAM): Generation of PAM: Block diagram	
	7	Pulse Width Modulation, Pulse Position Modulation (block diagram and waveform).	
	8	PCM, FDM, TDM (basic block diagrams only).	
III		**Satellite Communication**	**12**
	9	Satellite block diagram, concept of geo-stationary satellite, frequency bands used	
	10	Earth station transmitter & receiver (block diagram) and transponder.	
	11	Advantages and dis-advantages of satellite communication	
IV		**Optical Communication**	**12**
	12	Optical communication: block diagram of the optical communication system	

	13	Optical fibre structure, principle of light transmission through fibre	
	14	Different types of optical fibre	
	15	Advantages and disadvantages of optical communication	
V	**Cellular Telephone Systems**		**12**
	16	Cellular telephone systems, differences between wireless and fixed telephone networks. PSTN	
	17	Radio Transmission techniques- Simplex, Half duplex, Full duplex, Cellular Concept.	
	18	Operational Channels- Forward voice channel, Reverse voice channel, Forward control channel, Reverse control channel.	
	19	A basic cellular system, Frequency reuse.	

Textbooks

1. K Gopakumar, Introduction to Electronics and Communication, Phasor Books, 2013.
2. Mittle V.N. and A. Mittal, Basic Electrical Engineering, Tata McGraw Hill Second Edition, 2012.
3. 1. George Kennedy, Communication System, TMH. 2. Thankachan, Anish P, Analog Communication Engineering, Phoenix, Kollam

References

1. Dennis Roody & John Coolen, Electronic Communication, 4/e. PHI. 2. Leon W.Couch II, Digital and Analog Communication Systems, 6/e, Pearson Education.
2. William C.Y. Lee, Mobile Cellular Telecommunications, Analog and Digital Systems

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the requirements and the protocols employed in the fundamental components in a communication system	U	PSO-1,2
CO-2	Explain AM and FM communication system	R, U	PSO-1,2,5
CO-3	Discuss digital communication system	U	PSO-1,2
CO-4	Describe about satellite communication system	U	PSO-1,2
CO-5	Demonstrate the principles of optical communication system	U	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: COMMUNICATION SYSTEMS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,2,4 PSO-1,2	U	F, C	L	-
2	CO-2	PO-1,2,6 PSO-1,2,5	R, U	F, C	L	-
3	CO-3	PO-1,2 PSO-1,2	U	F, C	L	-
4	CO-4	PO-1,2,3 PSO-1,2	U	F, C	L	-
5	CO-5	PO-1,2 PSO-1,2	U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO5	PO1	PO2	PO3	PO4	PO6
CO 1	1	2	-	2	1	-	1	-
CO 2	2	2	-	2	2	-	-	1
CO 3	2	1	1	2	1	-	-	-
CO4	1	1	-	2	2	1	-	-
CO5	2	1	-	2	1	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSCELE203				
Course Title	SPACE ELECTRONICS				
Type of Course	DSC				
Semester	III				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4hours	-		4
Pre-requisites	1. NIL				
Course Summary	The course provides a comprehensive overview of various aspects of astronomy, planetary science, space weather, and the history of human space exploration. It covers topics such as the characteristics of the Sun and Earth, the Earth-Moon system, eclipses, planetary science, space weather phenomena, and the historical advancements in space exploration technology. Students will gain a deep understanding of the solar system, including the Sun's composition and behaviour, Earth's structure and atmosphere, the Moon's phases and orbits, and the dynamics of space weather. Additionally, they will explore the history of human endeavours in space, from early ground-based observations to modern advancements in rocketry, satellites, spacecraft, and communication systems.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Sun and Earth**	**12**
	1	Basic measurements and interpretations.	
	2	The sun-sun atmosphere, radio output from sun, sun as an emitter of X-ray and cosmic rays, solar wind.	
	3	Earth as a planet- earth's form-earth's interior, magnetic field, earth atmosphere.	
II		**Earth -Moon System and Eclipses**	**12**
	4	Moon's physical nature, phases of moon, retardation of the moon transits, moon's orbits, tides.	
	5	Eclipse-types-eclipse year, saros, duration of total lunar eclipse, ecliptic limit.	
III		**Planetary Science**	**12**
	6	Exploration of the solar system.	

	7	Evolution of atmosphere	
	8	Terrestrial planet-outer planet-comets-asteroids- other solar system.	
IV	**Space Weather**		**12**
	9	What Is Space Weather? -Solar Activity-The Solar Wind-Aurora-Auroral Substorms-Co-rotating Interaction Regions (CIRs)-Solar Flares.	
	10	Co-rotating Interaction Regions (CIRs)-Solar Flares	
	11	The Ionosphere-Solar Energetic Particle Events (SEPs)-Other Sources of Energetic Particles	
	12	Coronal Mass Ejections and Geomagnetic Storms-Halo -Magnetic Storms and Sub Storms-Very Intense Storms	
V	**History of Human Space Exploration**		**12**
	13	History of Space Exploration – Technology Advancement of Ground-Based Observations Since Galileo- Brief History of Human's Access to Space.	
	14	Recent Technology Progress of Space Exploration- Rocketry- Satellite and Spacecraft- Tracking Telemetry and Control (TT&C) and Communication- Launch and Recovery.	

Text Book:

1. Astronomy structure of the Universe, A.E. Roy and D. Clarke, Adam Hilger Pub
2. Space Science, L.K Harra, Keith O Mason, Imperial College Press.
3. Introduction to Space Science, Ji Wu, Springer Aerospace Technology, Springer, Science Press Beijing.

References

1. Space Physics and Space Astronomy – Michael D Pappagiannis (1972), Gordon and
2. Breach Science Publishers Ltd.
3. Introductory Course on Space Science and Earth's environment-Degaonkar (Gujarat University, 1978)
4. Electronics for Space , Jaime Alberto Estela Gutierrez , Elektor International Media (November 1, 2018)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the study of sun earth system	U	PSO-1, 4
CO-2	Describer the earth moon system	R, U	PSO-1, 4
CO-3	Identify the basic ideas of planetary science	U, Ap	PSO-1, 4

CO-4	Discuss the ideas of space weather	U, Ap	PSO-1, 4
CO-5	Discuss the history of human space explorations	U, Ap	PSO-1, 4,6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Space Electronics

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1; PSO-1, 4	U	F, C	L	-
2	CO-2	PO-1,4; PSO-1, 4	R, U	F, C	L	-
3	CO-3	PO-1,3; PSO-1, 4	U, Ap	F, C	L	-
4	CO-4	PO-1,4; PSO-1, 4	U, Ap	F, C	L	-
5	CO-5	PO-4,6; PSO-1, 4,6	U, Ap	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO4	PSO6	PO1	PO3	PO4	PO6
CO 1	2	1	-	2	-	-	-
CO 2	2	1	-	2	-	2	-
CO 3	2	1	-	2	1	-	-
CO 4	2	1	-	2	-	1	-
CO 5	1	1	2	-	-	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSEELE200				
Course Title	**Management for Start-ups**				
Type of Course	**DSE**				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	Nil				
Course Summary	This course is to equip technicians/ scientists/engineers of tomorrow with essential management skills to navigate technical and leadership roles effectively. Students here will explore core management principles, project management techniques, and strategies for leading and motivating teams within an organizational context in order to develop their competencies to begin their own firms, first as start-ups and thereby developing to becoming entrepreneurs and job providers of tomorrow.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Management**:	12
	1	Meaning, definition, scope and importance of management	
	2	management and administration	
	3	levels of management – management as a science, art and profession	
	4	Henry Fayol‘s principles of management	
	(conceptual framework only of all the topics)		
II		**Planning and Organizing**	12
	5	Meaning and objectives of planning,	
	6	Types of plans	
	7	Steps in planning	
	8	Limitations of planning	
	9	Concept and significance of organizing	
	10	Types – Formal and Informal, line and Staff, Functional	
	11	Centralisation and decentralization	
	12	Delegation of authority	
	(Conceptual framework only of all the topics)		

III	**Staffing, Directing and Controlling**		**14**
	13	Importance of staffing	
	14	Sources of Recruitment and selection	
	15	Training and Development of recruits	
	16	Meaning and elements of direction	
	17	Meaning of controlling	
	18	Steps in controlling	
	19	Methods of establishing control	
	(Conceptual framework only of all the topics)		
IV	**Entrepreneurial Competencies**		**10**
	20	Concept of entrepreneurship	
	21	Characteristics of a successful entrepreneur	
	22	Qualities and skills of a successful entrepreneur	
	23	Classification of entrepreneurs	
V	**Introduction to Start-ups**		**12**
	24	Different types of business start-ups	
	25	Steps in establishing a business	
	26	Business environment analysis	
	27	Idea generation	
	28	Sources of finance for start-ups	
	(Conceptual framework only of all the topics)		

Text Books:

1. Nair, KGC; Dipa and James, Biji, Principles of Management, Chand Books, Trivandrum

2. Abraham, M M, Business Management, Prakash Publications

3. Ibrahim, Arish, Principles of Management, Edudrive Publishers, Trivandrum

4. Santosh, V S; Nair, KGC; Krishnan, Dipa S, Systematic Approach to Methodology and Perspectives of Business Education, Chand Books, Trivandrum

Reference Books:

1. Donnel, Koontz O, Principles of Management, Tata Mc Graw Hill, Publishing Co, New Delhi.

2. Prasad, L M , Principles and Practice of Management, Sultan Chand and Sons, New Delhi

3. Bhatia, R C, Business Organisation and Management, Ane Books Pvt Ltd, New Delhi

4. Tripathi, P C & Reddy, P N, Principles of Management, TMH.

5. Chandran, Kailas Sree, Management for Engineers, Sourabhya Technical Publications, Trivandrum

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss managerial functions like planning, international aspect of management and concepts related to management of a start-up/ industry/ establishment	U	PSO-5
CO-2	Demonstrate the roles, skills and functions of management such as directing, leadership and to communicate effectively with co-workers and peers	An	PSO-5,6
CO-3	Analyze effective application of knowledge of practical principles of management to diagnose and solve organizational problems and to develop optimal managerial decisions.	An	PSO-7,8
CO-4	Demonstrate the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.	U, An	PSO -6,7
CO-5	Create ideas for developing start-ups and different steps in establishing a business	C	PSO-8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Management for Start-ups

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PO-1	U	C	L	-
2	CO2	PO-4	An	F	L	-
3	CO3	PO-2	An	C	L	-
4	CO4	PO-2	U, An	F, C	L	-
5	CO5	PO-5	C	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO5	PSO6	PSO7	PSO8	PO1	PO2	PO4	PO5
CO 1	1	-	-	-	1	-	-	-
CO 2	1	2	-	-	-	-	1	-
CO 3	-	-	1	1	-	1	-	-
CO 4	-	1	1	-	-	1	-	-
CO 5	-	-	-	2	-	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSEELE201				
Course Title	Introduction to AI				
Type of Course	DSE				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites					
Course Summary	The course aims to introduce the fundamental principles of intelligent systems to the students. This involves ideas about the characteristics of intelligent system, knowledge representation and machine learning basics. The course helps the learner to understand about the self-learning systems along with some of their typical application in emerging scenario.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction**	**12**
	1	What is Artificial Intelligence (AI) ? The Foundations of AI, History of AI, Applications of AI.	
	2	Intelligent Agents – Agents and Environments,	
	3	Good behaviour: The concept of rationality, nature of Environments	
	4	Structure of Agents, Types of Agents.	
II		**Problem Solving**	**12**
	5	Problem solving agents, Well defined Problem	
	6	Real-world problems – Traveling Salesperson Problem, Robot Navigation	
	7	Search Strategies- Uninformed search and Informed search.	
III		**Knowledge Representation**	**12**
	8	Types of Knowledge to Represent in AI, Categories of Knowledge Representation Schemes, Properties of Knowledge Representation, Approaches to Knowledge Representation	
	9	Ontological Engineering	
	10	Representation and reasoning about objects, relations, events, actions, time and space	
IV		**Machine Learning**	**12**
	11	Definition -Applications - Processes involved in Machine Learning.	
	12	Forms of learning-Supervised Learning, Unsupervised Learning and Reinforcement Learning	
V		**Future and Scope of AI**	**12**

	13	Future of AI- AI in Healthcare, Education, Agriculture	
	14	Generative AI- Definition, Benefits, Limitations, and Issues	
	15	Generative AI tools - Chat GPT, Google Bard, and DALL-E.	

Text Books

1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition. Prentice Hall.

References

1. Nilsson N.J., Artificial Intelligence - A New Synthesis, Harcourt Asia Pvt. Ltd.
2. Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill
3. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India).

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the fundamental concepts of Artificial Intelligence	U	PSO-1,3,7
CO-2	Illustrate uninformed search technique for problem solving in intelligent systems.	R, U	PSO-4,5
CO-3	Represent AI domain knowledge using logic systems and inference techniques for reasoning in Intelligent systems.	U, Ap	PSO-1,2
CO-4	Differentiate different forms of Machine Learning techniques.	R, U	PSO-7,8
CO-5	Use of AI in different fields and Apply Generative AI tools.	R, U, Ap	PSO-2,7,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Introduction to AI

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,6; PSO-1,3,7	U	F, C	L/T	-
2	CO-2	PO-1,2; PSO-4,5	R, U	F, C	L/T	-
3	CO-3	PO-1,3; PSO-1,2	U, Ap	F, C	L/T	-
4	CO-4	PO-3,6; PSO-7,8	R, U	F, C	L/T	-
5	CO-5	PO-6,7,8; PSO-2,7,8	R, U, Ap	F,C	L/T	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO2	PSO3	PSO 4	PSO 5	PSO 7	PSO 8	PO 1	PO 2	PO 3	PO 6	PO 7	PO 8
CO 1	2	-	1	-	-	2	-	1	-	-	2	-	-
CO 2	-	-	-	2	1	-	-	2	2	-	-	-	-
CO 3	1	2	-	-	-	-	-	1	-	1	-	-	-
CO 4	-	-	-	-	-	2	1	-	-	1	1	-	-
CO 5	-	1	-	-	-	1	2	-	-	-	2	1	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSEELE202				
Course Title	BASIC INDUSTRIAL ELECTRONICS				
Type of Course	DSE				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	--	4
Pre-requisites	1. UK1DSCELE100 OR 2. UK1DSCELE101				
Course Summary	Basic knowledge of power electronics and industrial electronics will be gained				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Basics of Power electronics**	**13**
	1	The power electronic System, Power switch, Choice of power switch,	
	2	power conditioner, analysis of power converter operation, application of power electronics	
	3	Basic electrical concepts power, relation between powers, power factor, percentage of voltage regulation.	
	4	Transformer basic principle, Types of transforms, Testing transformers Basic principle of electric machines, motor and generators	
II		**AC Fundamentals**	**8**
	5	AC power systems: single phase and three phase.	
	6	Generation of alternating voltages and currents	
	7	Equations of AC voltage and current, Simple wave forms, concept of time period, frequency, amplitude and phase, Peak value and RMS value of amplitude,	
	8	AC through resistance inductance and capacitance	
III		**Power Electronics devices**	**15**
	9	Power Devices: Need for semiconductor power devices	
	10	Power diodes, Enhancement of reverse blocking capacity	
	11	Introduction to family of thyristors.	
	12	Silicon Controlled Rectifier (SCR): structure, I-V characteristics, Turn-On and Turn-Off characteristics	
	13	Diac and Triac: Basic structure, working and V-I characteristic of, application of a Diac as a triggering device for a Triac.	

	14	Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics	
IV	**Electrical vehicle fundamentals**		**12**
	15	EV Concept Engineering Philosophy	
	16	Electric propulsion	
	17	Energy Sources, Energy Management, System Optimisation	
	18	Introduction to electric vehicle batteries, The Pb-Acid Battery, The NiMH Battery, The Li-ion Battery, The Li-Polymer Battery	
	19	Fuel cell technology, Choice of battery type for electric vehicle	
V	**Basic Building blocks**		**12**
	20	Concept of rectifier bridge IC,	
	21	Basic concept of FET, MOSFET,	
	22	Different type of MOSFET	

Text Books:

1. Introduction to power electronics – Denis Fewson, Arnold.
2. Practical Troubleshooting of Electrical Equipment and Control Circuits Mark Brown Pr.Eng, Dip EE, B.Sc (Elec Eng.)
3. A textbook of Electrical Technology, B L Theraja and A K Theraja, S.Chand

References

1. Electric Vehicle Battery Systems - Sandeep Dhameja
2. Modern Electric Vehicle Technology - C.C. Chan and K.T. Chau
3. Build Your Own Electric Vehicle Seth Leitman - Bob Brant

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basic concept of electronics devices using high power	R, U	PSO-1,2
CO-2	Discuss the concept current power distribution system	R, U, A	PSO-1,2
CO-3	Demonstrate the specific electronic devices used in power system-based industry and technology	R, U, A, An	PSO-1,3,5
CO-4	Discuss knowledge of applications in the industry	R, U, A	PSO-1,7
CO-5	Identify the basic knowledge of electronics other than high power devices	R, U	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Basic Industrial Electronics

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,2	R, U	F, C	L	-
3	CO-3	PO-1,7; PSO-1,3,5	R, U	F, C	L	-
4	CO-4	PO-1,7,8: PSO-1,7	R, U, Ap	F, C	L	-
5	CO-5	PO-1,8, PSO-1,4	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO7	PO1	PO3	PO 7	PO 8
CO 1	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**
CO 2	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**-**
CO 3	**2**	**-**	**3**	**-**	**3**	**1**	**-**	**2**	**-**
CO 4	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**2**	**2**
CO 5	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**2**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3DSELE203				
Course Title	Embedded systems & IOT (part 1)				
Type of Course	DSE				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. NIL				
Course Summary	Embedded Systems will give the skills to design and manufacture embedded system products of the future which will help the learners towards better employability. This course teaches the fundamentals of embedded system design and the internet of things using a building block approach, which allows one to visualize the requirements of an embedded system and then to design it efficiently.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Overview of Embedded Systems Book 1(Chapter 1)**	**12**
	1	Defenition, Embedded Vs General computing system, History	4
	2	Classification of Embedded systems- small scale, medium scale & large scale embedded systems.	4
	3	Major applications of embedded systems.	4
II		**Typical Embedded System Book 1(Chapter 2)**	**12**
	4	Elements of an embedded system	3
	5	Core of the embedded system-categories general purpose vs ASIP, Microcontrollers, architecture types, DSP's	3
	6	Memory-Types	3
	7	Memory Selection for embedded systems.	3
III		**Introduction to IOT Book 2(Chapter 1)**	**12**
	8	Definition & characteristics of IoT, Definition in various perspectives	2
	9	Things in IoT, IoT Functional blocks	2
	10	Smart and Hyper Connected Devices	2
	11	IoT conceptual framework	2
	12	IOT architectural view	2

	13	Major Components of IoT Systems.	2
IV	**Internet Connectivity Principles Book 2(Chapter 4)**		**12**
	14	Internet based communication, Internet Protocols	2
	15	Internet Protocol Version 4	2
	16	Internet Protocol Version 6	3
	17	TCP/IP suite	2
	18	TCP ,UDP	3
V	**Examples of IoT Book 2(Chapter 3)**		**12**
	19	Smart Home, Home Automation Software,Smart Cities	4
	20	Web connectivity for connected devices network using gateway	4
	21	SOAP, REST, http, RESTFUL and WEBSOCKETS .	4

Books for study

1) Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition.
2) Internet of things Architecture and Design Principle, Raj Kamal,MGH

References

3. David E. Simon, An Embedded Software Primer, Pearson Education Asia, First IndianReprint 2000.
4. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers Elsevier 3ed, 2008

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain the concepts of embedded systems.	U	PSO-2,3,4
CO-2	Describe the elements of an embedded system	R, U	PSO-2,3,4
CO-3	Describe the principles of IOT	U	PSO-2,3,4
CO-4	Recognise various internet protocols and its use in IOT	U,R,A	PSO-2,3,8
CO-5	Describe & analyse various examples of IOT	U,R,An	PSO-3,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course Embedded systems & IOT (part 1)
Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
CO-1	PO1,PSO2,3,4	U,R	F, C	L	-
CO-2	PO1,PSO2,3,4	U,R	F,C	L	-
CO-3	PO1,PSO2,3,4	U	F,C	L	-
CO-4	PO1,PSO2,3,8	U,R,A	F,C,A	L	-
CO-5	PO1,PSO3,4,8	U,R,A	F,C	L	-

F- Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO2	PSO3	PSO4	PSO8	PO1
CO 1	3	2	2	-	1
CO 2	3	2	2	-	1
CO 3	2	2-	2	-	1
CO 4	2	3	-	1	1
CO 5	-	1	2	2	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3VACELE200				
Course Title	Professional Ethics for Technicians and Scientists				
Type of Course	**VAC**				
Semester	III ·				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2	4
Pre-requisites	Nil				
Course Summary	To enable students to create awareness on ethics and human values which are necessary for maintaining work-life balance, especially for those in the technical world				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Module 1: Human Values**		**6**
	1	Morals, Values and ethics	
	2	Integrity, academic integrity, work ethics, service learning	
	3	Civic virtue, respect for others, living peacefully	
	4	Caring, sharing, honesty, courage, cooperation and commitment	
II	**Module 2: Engineering ethics and Professionalism**		**6**
	5	Sense of engineering ethics, variety of moral values	
	6	Types of inquiry, moral dilemmas, moral autonomy	
	7	Kohlberg's theory, Gilligan's theory, Profession and Professionalism	
	8	Models of professional roles, theories about right action	
	9	Uses of ethical theories	
III	**Module 3: Engineering and Social experimentation**		**6**
	10	Science and engineering as experimentation	
	11	Codes of ethics	
	12	Plagiarism	
	13	A balanced outlook on law	
	14	Case study on challenges – Bhopal gas tragedy	
IV	**Module 4: Responsibilities and rights of technicians and scientists**		**6**
	15	Collegiality and loyalty	
	16	Managing conflict	
	17	Respect for authority	
	18	Collective bargaining	
	19	Professional rights, employee rights and IPR discrimination	

V	**Module 5: Global ethical issues**		**6**
	20	Environmental, business and computer ethics	
	21	Role in technological development	
	22	Technicians and scientists as managers	
	23	Technicians and scientists as expert witnesses and advisors	
	24	Moral leadership	
PRACTICALS – Students should do at least three Case study and submit the report (30)			
I	1.	A technician discovers a design flaw in a product that could pose a safety risk but is pressured by management to meet a tight deadline. How can the technician uphold their integrity and ensure the product's safety?	
	2.	A technician observes a colleague taking excessive breaks and leaving early, potentially impacting project progress. How can he address this concern while maintaining professional relationships and upholding work ethic within the team?	
	3.	An engineering project aims to provide clean water to a remote village. However, cultural differences and communication challenges arise. How can engineers/ technicians approach this service-learning opportunity with respect and ensure a successful outcome?	
	4.	A technician witness's corruption within a government agency responsible for approving infrastructure projects. How can he exercise civic virtue and report the corruption while protecting themselves and their career?	
	5.	A team leader displays a discriminatory attitude towards a team member based on their background. How can other team members promote a culture of respect and inclusivity in the workplace?	
II	1.	A new engineering project has the potential to revolutionize a specific industry, but also raises concerns about potential environmental impact and job displacement. How can technicians consider the different "senses" of professional ethics (caring, justice, etc.) when evaluating this project?	
	2.	A technician is pressured to use a cheaper but less reliable material in a product. They know this could lead to safety issues but fear losing their job if they object. How can they navigate this moral dilemma while upholding ethical principles and protecting their career?	

	3.	A project team primarily composed of men prioritizes efficiency and speed over user needs. How can technicians, considering Gilligan's theory of ethics focused on care and relationships, encourage the team to prioritize user well-being alongside project goals?	
	4.	A technician observes a colleague engaging in unethical behavior. Should they prioritize loyalty to their profession (reporting the behavior) or loyalty to the colleague (remaining silent)? How can the concept of professionalism guide their decision?	
	5.	A new technology can benefit an engineering company financially but might also have negative environmental consequences. How can engineers balance potential self-interest (company profit) with the public interest (environmental protection)?	
III	1.	A new material is proposed for a construction project with limited data on its long-term durability. How can engineers/ technicians ensure they act as responsible experimenters by gathering sufficient data and minimizing risks to the project and public safety?	
	2.	A technician discovers a research paper with valuable data relevant to their project. How can they ethically use this information by properly citing the source and avoiding plagiarism?	
IV	1.	Two technicians on a team disagree on the best approach for a project. How can they maintain collegiality and loyalty while effectively communicating their viewpoints and working together to find a solution?	
	2.	A technician identifies safety concerns with a project but their supervisor dismisses them. How can he respectfully raise their concerns and advocate for safety improvements, considering potential avenues like collective bargaining (if applicable) for support?	
	3.	A technician learns of a potential environmental violation by their company. They are bound by a confidentiality agreement. How can they navigate this situation, balancing the need to protect confidential information with the responsibility to expose wrongdoing?	

	4.	A technician is offered a consulting job by a company that competes with their current employer. This new company might benefit from his knowledge of their current employer's projects. How can he identify and manage this potential conflict of interest?	
	5.	A technician witnesses a colleague falsifying data in a project report. How can they address this occupational crime and report it appropriately, protecting themselves from retaliation while upholding ethical standards?	
	6.	A technician experiences pressure to work excessive overtime without additional compensation. How can they advocate for their professional rights and fair treatment as an employee while fulfilling their job responsibilities?	
V	1.	A new construction project could potentially harm a protected ecosystem. How can engineers/ technicians, considering environmental ethics, develop sustainable design solutions that minimize environmental impact?	
	2.	A company is pressured to cut corners on safety features in a product to meet tight deadlines and maximize profit. How can technicians working for this company promote ethical business practices and prioritize safety over profit?	
	3.	A team is developing a new AI-powered software that might have the potential for bias against certain user groups. How can technicians ensure ethical development of the software, mitigating bias and promoting fairness in its algorithms?	
	4.	New technologies like autonomous vehicles raise ethical concerns about safety and responsibility. How can technologists play a vital role in the development of such technologies, prioritizing ethical considerations alongside technological advancement?	
	5.	A technician is called upon to serve as an expert witness in a legal case related to a technical failure. How can he ensure their testimony is objective, unbiased, and based on sound engineering principles?	

Text Books

1. Sindhu R Babu, Nizar Hussain, VR Hareendra Kumar, Suresh Subramoniam, Professional

Ethics, Owl Books, Kerala, 2021
2. Kailas Sree Chandran, Professional Ethics, Sourabhya Technical Publications, Trivandrum
3. Deepak Benjamin and Tintu P Joseph, Professional Ethics, Pentex Book Publishers and Distributors, Kollam
4. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
5. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states, 2005.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the core values that shape the ethical behaviour of a professional	R, U	PSO-5, 7
CO-2	Adopt a good character and follow an ethical life	R, U	PSO-5, 7
CO-3	Explain the role and responsibility in technological development by keeping personal ethics	R, U	PSO-5, 7
CO-4	Solve moral and ethical problems through exploration and assessment by established experiments	R, U	PSO-5, 7
CO-5	Apply the knowledge of human values and social values to contemporary ethical values and global issues	R, U	PSO-5, 7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create
Note: 1 or 2 COs/module

Name of the Course:Professional Ethics for Technicians and Scientists
Credits: 2:0:1 (Lecture:Tutorial:Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO1	PO-1,5,8	R, U	F, C	L	P
2	CO2	PO-1,5,8	R, U	F, C	L	P
3	CO3	PO-1,5,8	R, U	F, C	L	P
4	CO4	PO-1,5,8	R, U	F, C	L	P
5	CO5	PO-1,5,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO5	PSO7	PO1	PO5	PO8
CO 1	1	2	2	1	2
CO 2	1	2	2	1	2
CO 3	1	1	2	2	2
CO 4	2	2	1	2	2
CO 5	2	2	2	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK3VACELE201				
Course Title	RENEWABLE ENERGY SOURCES				
Type of Course	**VAC**				
Semester	III				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites					
Course Summary	This course provides an in-depth exploration of renewable energy sources, focusing on their technological, economic, and environmental aspects. Students will learn about various renewable energy technologies, including solar, wind, hydroelectric, geothermal, and biomass, and how they contribute to sustainable energy systems. The course also covers the integration of renewable energy into the existing power grid, policy frameworks, and future trends in the renewable energy sector				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Energy Sources and Availability (Book 1, 1.4 Book 2 , 1.1-1.3,1.5,1.6**		**6**
	1	Energy Resources – Classification and types of energy Resources	
	2	Energy sources and their availability	
	3	Indian and Global Energy resources	
	4	Environment aspects of Energy	
II	**Solar Energy (Book 1, 2.2,2.3.1 ,2.6,3.2,5.10-5.13)**		**6**
	5	Introduction , Solar Constant, Solar Radiation Beam and Diffuse Radiation	
	6	Solar Radiation Measurements	
	7	Principle of conversion of Solar radiation into heat	
	8	Applications of Solar Energy- Solar Furnace ,Solar Cooking , Solar Green House, Solar Production of Hydrogen	
III	**Wind Energy (Book 1 6.1-6.2 ,6.5-6.7,6.12-6.13,6.16)**		**6**
	9	Introduction-Basic Principle of wind energy conversion	
	10	Basic components of wind energy conversion system (WECS)	
	11	Classification of WECS-Advantages & Disadvantages of WECS	
	12	Energy Storage -Applications of wind energy. Environmental Aspects	
IV	**Alternative Energy Sources (Book 1:7.1-7.4 , Book 2:10.1-10.3 ,13.1-13.3**		**6**
	13	Introduction - biomass conversion technologies	
	14	Photosynthesis –Biogas Generation	
	15	Origin of Tides- Tidal Energy-Tidal Power Plant	
	16	Introduction-Ocean Thermal Energy Conversion and Conversion system	

V	**Emerging Technologies (Book 1: Chapter 10 & 11)**		**6**
	17	Fuel Cell-principle of operation –classification- conversion efficiency and losses - applications,	
	18	Hydrogen energy; Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only),	
	19	hydrogen energy storage and utilization, applications of hydrogen energy, problem associated with hydrogen energy	
		PRACTICAL (Any five)	**30**
		(1) Solar panel efficiency testing under different lighting conditions (e.g., direct sunlight, diffused lightshade) (2) Investigating the effect of tilt angle on solar panel output (3) Comparing the efficiency of different types of solar panels (monocrystalline, polycrystalline, thin-film) (4) Building a small wind turbine and measuring its power output at different wind speeds. (5) Studying the effect of blade design (number of blades, blade angle) on wind turbine efficiency. (6) Investigating the relationship between wind speed and electrical output in wind turbines. (7) Investigating the efficiency of different types of water wheels or turbines (8) Testing the efficiency of different biomass fuels (e.g., wood pellets, agricultural waste) in a biomass stove or boiler (9) Investigating the decomposition rate and methane production in anaerobic digesters using different organic materials (10) Studying the process of biofuel production from sources like algae or vegetable oil (11) Building a simple geothermal heat pump system and measuring its heating or cooling capacity (12) Investigating the temperature gradient in the ground at different depths (13) Testing the performance of different types of batteries (e.g., lithium-ion, lead-acid) in storing renewable energy (14) Angle of a Prism using Spectrometer (15) Study of Fraunhofer lines using Spectrometer (16) Characteristics of a PN junction diode (17) Characteristics of a Zener diode (18) Zener diode as a Voltage Regulator (19) Investigating the efficiency and capacity of super capacitors for energy storage (20) Studying the optimization of hybrid systems for maximum energy output and reliability (21) Analyzing the economics and environmental benefits of hybrid renewable energy solutions	

Text Books:

1. Non Conventional Energy Sources by G D Rai , Khanna Publications (6th Edition)

2.`Non Conventional Energy Resources by G S Sawhney , PHI Learning Pvt Ltd (6th Edition)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the environmental aspects of renewable energy resources. In Comparison with various conventional energy systems, their prospects and limitations.	U	PSO-9
CO-2	Identify the principles of renewable energy conversion systems.	R, U	PSO-9
CO-3	Demonstrate Energy conservation policies	U, Ap	PSO-9
CO-4	Participate in accelerating India's economy by gaining appropriate employment, becoming entrepreneurs and creating appropriate knowledge.	E,C	PSO-9
CO-5	Explore society's present needs and future energy demands.	An,E,C	PSO-3, 9

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: RENEWABLE ENERGY SOURCES

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO1, PSO-9	U	F, C	L	
2	CO-2	PO2 , PSO-9	R, U	F,C	L	P
3	CO-3	PO-1PSO-9	U, Ap	F, C	L	P
4	CO-4	PO-1,PSO-9	E,C	F,C	L	
5	CO-5	PO 3 ,6 PSO-3 ,9	An,E,C	F, C	L	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO-3	PSO-9	PO1	PO2	PO3	PO6
CO 1	-	1	3	-	-	-
CO 2	-	2	-	2	-	-
CO 3	-	2	1	-	-	-
CO 4	-	3	1	-	-	-
CO 5	1	3	-	-	3	3

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSCELE200				
Course Title	Introduction to Analog and Digital communication				
Type of Course	**DSC**				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	NIL				
Course Summary	An introduction to analog and digital communication course provides a comprehensive understanding of the fundamental principles and technologies used for transmitting and receiving information. It covers the basics of analog communication systems, including continuous-time signals, modulation techniques for audio and visual data (AM, FM, PM), and the concept of noise. The course then delves into digital communication, exploring concepts like sampling, quantization, digital modulation techniques, and basic channel coding for error correction. This knowledge equips students to grasp the fundamental differences between analog and digital communication, analyse their strengths and limitations, and paves the way for further studies in advanced communication systems like mobile communication, fibre optics, and digital signal processing.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Communication System**		**9**
	1	Communication system, Block diagram of a communication system, Bandwidth	
	2	Modulation, Need for modulation, Various modulation schemes.	
	3	Amplitude Modulation: Introduction, AM signals and spectra, Power relations	
	4	Block diagram of an AM transmitter, Block diagram of a Superheterodyne receiver.	
II	**SSB and FM Modulation**		**9**
	5	SSB Modulation, Principles, Balanced Modulators	
	6	Angle modulation- FM spectrum, modulation index, FM Transmitter and Receiver, Phase modulation	
	7	Study of various modulation schemes: Comparison of various modulation schemes	
	8	Angle modulation, amplitude limiters, pre-emphasis and de-emphasis.	

III	**Introduction to Digital Communication**		**8**
	9	Pulse modulation – Sampling theorem, Nyquist Rate, Aliasing	
	10	Pulse Amplitude Modulation (PAM): Block diagram, Generation of PAM (Flat top sampling)	
	11	Pulse Width Modulation, Pulse Position Modulation (block diagram and waveform).	
IV	**Pulse Code Modulation**		**7**
	12	PCM: Block diagram, PCM transmitter and receiver	
	13	Differential Pulse Code Modulation, Block diagram and working of DPCM	
	14	Delta Modulation, Block diagram and working of delta modulation	
V	**Multiplexing and Modulation Techniques**		**12**
	15	TDM and FDM (explanation and block diagram only).	
	16	Digital Modulation Techniques: Introduction	
	17	ASK, FSK and PSK (waveform only), QPSK (transmitter and receiver).	
Practical			**30**
	1	Study of AM generator using AD534 or AD633 multiplier Integrated circuit - Double side band suppressed carrier and double side band double side band full carrier – plot the waveforms of modulating signal, carrier wave and modulated signal – calculate modulation index.	
	2	Study of Frequency Modulator using IC555 – design - draw the waveforms of the baseband signal, carrier wave, and modulated signal – calculate frequency deviation.	
	3	Realization of Pulse Amplitude Modulator and Demodulator using CD4016 Integrated circuit - Natural PAM – design - draw the waveforms of the baseband signal, sampling pulse wave, and modulated signal – verify Nyquist rate condition and aliasing condition	
	4	Realization of Pre-emphasis and De-emphasis using passive components – design – plot characteristics curve.	
	5	Study of Mixer Circuit – design a frequency converter circuit to produce an output of 455 KHz using discrete components from two input waveforms - measure output frequency	
	6	Realization of delta modulator circuit using Integrated circuits - design – plot waveforms	
	7	Study of BASK Modulator using Integrated circuits (4016, 7404) – design – draw the inputs and output waveforms.	
	8	Study of BFSK Modulator circuit – design – plot the waveforms at the inputs and output.	
	9	Study of BPSK Modulator (using 4016, 741 and 7404), – design – plot the waveforms of input and output.	

Text books

1. George Kennedy, Communication System, TMH.
2. Thankachan, Anish P, Analog Communication Engineering, Phoenix, Kollam
3.. Simon Haykin, Communication systems, 4/e, John-Wiley & sons.
4. Bernard Sklar, Digital Communication, 2/e, Pearson Education, 2001

References

1. Dennis Roody & John Coolen, Electronic Communication, 4/e. PHI. 2. Leon W.Couch II, Digital and Analog Communication Systems, 6/e, Pearson Education.
2. Harold Kolimbris, Digital Communication Systems, 1/e, Pearson Education, 2000.
3. Sam Shanmugham, Digital and Analog Communication systems, Wiley India.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the requirements and the protocols employed in the fundamental components in a communication system	R, U	PSO-1,2
CO-2	Explain AM and FM communication system	U	PSO-1,2
CO-3	Discuss digital communication system	U	PSO-1,2
CO-4	Compare different digital modulation scheme	U	PSO-1,2
CO-5	Describe about multiplexing techniques	U	PSO-1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Introduction to Analog and Digital communication

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,2,3 PSO-1,2	R, U	F, C	L	P
2	CO-2	PO-1,2,3 PSO-1,2	U	F, C	L	P
3	CO-3	PO-1,2,3 PSO-1,2	U	F, C	L	P
4	CO-4	PO-1,2,3 PSO-1,2	U	F, C	L	P
5	CO-5	PO-1,2,3 PSO-1,2	U	F,C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PO1	PO2	PO3
CO 1	1	2	2	2	1
CO 2	2	1	2	2	1
CO 3	1	2	1	2	2
CO 4	1	1	2	1	2
CO 5	2	1	2	1	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSCELE201				
Course Title	Mathematics for Electronics				
Type of Course	**DSC**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites					
Course Summary	The course "Mathematics for Electronics" delves into essential mathematical concepts crucial for understanding and analyzing electronic systems. The five modules covered include Linear Algebra, focusing on determinants and matrices to model and solve systems of linear equations; Vector Algebra, exploring the mathematics behind vectors and their applications in electronic circuit analysis; Differentiation, highlighting techniques to find rates of change; Integration, covering methods to calculate areas; and Integral Transforms, emphasizing Fourier and Laplace transforms as powerful tools for signal processing and system analysis in electronics. Through these modules, students gain a strong foundation in mathematical techniques vital for success in electronic engineering and related fields.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Vector Algebra [Book 1, Chapter 3]**		**8**
	1	Vectors - addition and subtraction of vectors, section formulae	3
	2	Product of two vectors - scalar or dot product - vector or cross product	2
	3	Product of three or more vectors - Scalar product of three vectors - vector product of three vectors	3
II	**Differentiation [Book 2, Chapter 2]**		**10**
	4	Tangent lines and rates of change - The derivative function	2
	5	Introduction to techniques of differentiation - product and quotient rules	3
	6	Derivative of trigonometric functions	2
	7	The chain rule	3
III	**Integration [Book 2, Chapter 3]**		**10**
	8	An area of the area problem	1
	9	The indefinite integral	2
	10	Integration by substitution, Integration by parts	3
	11	The definite integral, Properties of definite integrals, Finding area under curve using integration	4

IV	**Integral Transforms [Book 1, Chapter 21, 22, 23]**		**20**
	12	Laplace transform: Definition - Transforms of Elementary functions - Properties of Laplace transforms - Transforms of periodic functions - Inverse Laplace functions	7
	13	Fourier transform: Introduction - Definition - Fourier integral theorem - Fourier transform - Properties of Fourier trasforms - Inverse Fourier transform	7
	14	Z transform - Intoduction - Definition - Some standard Z-transforms - Linearity property- Damping rule - Some standard results	6
V		**Linear Algebra -Determinants and Matrices [Book 1, Chapter 2]**	**12**
	15	Determinants	2
	16	Properties of Determinants	3
	17	Matrices - Matrices operations - Related matrices (transpose of a matrix, adjoint of a square matrix)	4
	18	Rank of matrix and invertible matrices (preliminary ideas)	3

Books for study

1. Higher Engineering Mathematics, Dr. B.S.Grewal, 42/e, Khanna Publishers.
2. Calculus by H.Anton, I. Bivens and S. Davis, 10/e, Wiley, 2012

Reference:

1. Advanced Engineering Mathematics, Erwin Kreyzig, 10/e. Wiley, 2011
2. Linear Algebra, David C. Lay, Pearson Education.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the basic concepts of vector algebra	R,U	PSO-1,4
CO-2	Explain the basic ideas of differentiation	R, U	PSO-1,4
CO-3	Associate the basic ideas of integration and its physical meaning	R, U	PSO-1,4
CO-4	Solve electronic systems using integral transforms	R, U, Ap	PSO-1,4
CO-5	Demonstrate systems of linear equations using matrices and determinants.	R, U	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Mathematics for Electronics

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,2; PSO-1,4	R,U	F, C	L	-
2	CO-2	PO-1,2; PSO-1,4	R, U	F, C	L	-
3	CO-3	PO-1,2; PSO-1,4	R, U	F, C	L	-
4	CO-4	PO-1,2,6: PSO-1,4	R, U, Ap	F, C	L	-
5	CO-5	PO-1,2, PSO-1,4	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO4	PO1	PO2	PO6
CO 1	2	1	1	2	-
CO 2	2	2	1	2	-
CO 3	2	2	2	2	-
CO 4	3	3	2	3	3
CO 5	2	1	1	2	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSCELE202				
Course Title	Semiconductor Devices.				
Type of Course	**DSC**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. UK1DSCELE100				
Course Summary	The course covers the fundamentals of Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs), including biasing, stability factors, small signal models, and amplifier circuits. It delves into feedback amplifiers, exploring concepts of positive and negative feedback, various topologies, and practical applications. Additionally, the course introduces Metal-Oxide-Semiconductor FETs (MOSFETs), discussing types, working principles, and characteristics. It concludes with an overview of power devices like Thyristors, UJTs, and DIACs, emphasizing their operations, structures, and characteristics. Through theoretical concepts and practical examples, students gain a comprehensive understanding of transistor operation, amplifier design, and the use of power devices in electronic circuits.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**BJT**	**12**
	1	Biasing of BJTs: Transistor biasing circuits	
	2	Stability factors	
	3	DC analysis of BJTs	
	4	Hybrid equivalent circuit	

II	**FET**		**12**
	5	Biasing of JFETs	
	6	FET Amplifier: Principle of operation – Small signal model	
	7	Typical amplifier circuits – high frequency effects	
	8	Comparison of BJT & FET amplifiers.	
III	**Feedback Amplifiers**		**12**
	9	Feedback Amplifiers: Concept of positive and negative	
	10	Characteristics negative feedback amplifiers	
	11	Different types of feedback topologies	
	12	Applications	
IV	**MOSFET**		**12**
	13	MOSFET: Types of MOSFET	
	14	Working of depletion Type MOSFET	
	15	Enhancement type MOSFET, VI characteristics	
	16	Complementary MOSFET	
V	**Introduction to power Devices**		**12**
	17	Operations, structure and VI characteristics of Thyristors	
	18	UJT and SCR	
	19	DIAC and TRIAC	

Text Books

1. Principles of Electronics, V.K. Mehta and Rohit Mehta,S.Chand
2. Basic Electronics, B.L. Theraja and A.K. Theraja, S.Chand

Text for Reference

1. Electronic Devices and Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson
2. Electronic Devices and Circuits, David A. Bell, Prentice-Hall
3. Feedback Control of Dynamic Systems, Gene F. Franklin, J. Da Powell, and Abbas Emami-Naeini, Pearson
4. MOSFET Modeling for Circuit Analysis and Design, Huifen Huang and Shengbo Eben Li KA Publishers

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Design biasing circuits for BJTs, considering stability factors and using hybrid equivalent circuits for DC analysis.	U,An	PSO 2,3
CO-2	Describe the biasing of JFETs, analyze FET amplifiers based on their small signal models, and evaluate high-frequency effects in typical amplifier circuits.	U	PSO 2,3
CO-3	Explain the concept of positive and negative feedback in amplifiers, analyze the characteristics of negative feedback amplifiers, and identify different feedback topologies and their applications.	U,An	PSO 2,3,5
CO-4	Describe the types of MOSFETs, analyze the working principles of depletion-mode and enhancement-mode MOSFETs, and interpret their VI characteristics, including complementary MOSFETs.	U,An	PSO 2,3,5
CO-5	Explain the operations, structures, and VI characteristics of power devices such as Thyristors, UJT, SCR, DIAC, and TRIAC, and analyze their applications in electronic circuits	U,An	PSO 3,4,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Semiconductor Devices.

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 1,2	U,An	C, P	L	-
2	CO-2	PO 2,3	U	F,C	L	-
3	CO-3	PO 1,2	U,An	F,C	L	-
4	CO-4	PO 3,6	U,An	C,P	L	-
5	CO-5	PO 3,6	U,An	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO2	PSO3	PSO4	PSO 5	PSO7	PO1	PO2	PO3	PO6
CO 1	1	1	-	-	-	1	1	-	-
CO 2	2	1	-	-	-	-	2	1	-
CO 3	2	1	-	1	-	2	1	-	-
CO 4	2	1	-	1	-	-	-	1	2
CO 5	-	1	1	-	2	-	-	1	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSEELE200				
Course Title	Introduction to mobile communication				
Type of Course	**DSE**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	NIL				
Course Summary	The mobile communication course delves into the fundamental principles and technologies that enable seamless wireless communication on the go. It explores the evolution of mobile systems, the cellular concept for efficient spectrum utilization, and the challenges of mobile radio propagation like fading. This course will give insight in to the digital modulation techniques, channel coding for error correction, and multiple access schemes like FDMA, TDMA and CDMA that allow efficient sharing of resources amongst multiple users. The course equips students to understand the trade-offs and limitations in mobile systems, analyse advanced technology and gain a foundation for further studies in areas like 5G and beyond, network design, and performance optimization of mobile communication systems.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Wireless Communication**		**7**
	1	Introduction to wireless networks, examples of wireless communication systems, examples of mobile radio systems	
	2	Cellular telephone systems	
	3	Differences between wireless and fixed telephone networks, PSTN	
II	**Radio Transmission**		**10**
	4	Radio Transmission techniques- Simplex, Half duplex, Full duplex	
	5	Frequency division duplexing, Time division duplexing limitations in wireless networking, evolution of mobile radio communications	
	6	Mobile Radio Propagation: Free space loss, Fading, Doppler shift.	
	7	Overview of Multiple Access Techniques for Wireless Communications: FDMA, TDMA, CDMA	

III	**Cellular Concept**		**8**
	8	Cellular Concept. Operational Channels- Forward voice channel, Reverse voice channel, Forward control channel, Reverse control channel.	
	9	A basic cellular system, Frequency reuse	
	10	Channel assignment strategies -fixed and dynamic	
	11	Handoff strategies, Prioritizing Handoffs, Practical Handoff Considerations	
IV	**Cellular Systems**		**7**
	12	Capacity of cellular systems, Methods to improve Coverage and Capacity in Cellular Systems	
	13	Cell Splitting- permanent and dynamic, Sectoring	
	14	Repeaters for range extension, micro cell zone concept. How mobile call is actually made	
	15	An overview of the Indian telecom industry and regulatory body.	
V	**GSM**		**13**
	16	Traffic routing in wireless networks- circuit switching and packet switching	
	17	Global System for Mobile (GSM), GSM services and features	
	18	GSM system architecture, GSM radio subsystems.	
		Practical	30
		Project: Comparing Mobile Network Performance in Different Environments Objective: Analyse and compare the performance of different mobile network technologies (e.g., 2G, 3G, 4G) in various environments (urban, suburban, rural). Materials: 1. Smartphone with access to different mobile networks (preferably dual SIM) 2. Network signal strength measurement app (e.g., OpenSignal, Network Cell Info Lite) 3. Data speed measurement app (e.g., Speed test by Ookla) 4. GPS tracking app (optional) Methodology: 1. Define Test Locations: Choose three distinct locations: urban (high cell density), suburban (moderate cell density), and rural (low cell density). 2. Data Collection: At each location, record the following data for each mobile network technology: 1. Signal strength (dBm) 2. Data download speed (Mbps) 3. Data upload speed (Mbps) 4. (Optional) GPS coordinates 3. Data Analysis: 1. Compare the average signal strength, download speed, and upload speed across different network technologies and locations.	

		2. Analyse the impact of environmental factors on network performance (e.g., cell density, distance from cell towers). 3. Visualize the collected data using charts and graphs. Expected Outcomes: 1. The project should demonstrate that signal strength and data speeds generally decrease from urban to rural environments. 2. Different mobile network technologies may exhibit varying performance depending on the environment. 3. The analysis will provide insights into the limitations and strengths of different mobile networks in diverse scenarios	

Textbooks

1. T. S. Rappaport, Wireless Communications: Principles and Practice, 2/e, Pearson.
2. William C.Y. Lee, Mobile Cellular Telecommunications, Analog and Digital Systems, MGH.
3. Advanced Electronic Communication System, Wayne Tomasi, Pearson

References

1. Jochen Schiller Mobile Communications, 7/e, Pearson Education, 2003.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe about wireless networks and an overview of cellular telephone system	U	PSO-1,2
CO-2	Classify different radio transmission techniques and explain concept of multiple access techniques	R, U, An	PSO-1,6,7
CO-3	Understand the basic cellular system	U	PSO-1,2,7
CO-4	Generalize the methods to improve the coverage and capacity of cellular telephone system	U	PSO-1, 2, 6
CO-5	Describe the concept of GSM. Construct the ideas of various traffic routing techniques	R, U, An	PSO-1,2,3,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Introduction to mobile communication

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,3,7 PSO-1,2	U	F, C	L	P
2	CO-	PO-1,2,3,4 PSO-1,6,7	R, U, An	F, C	L	P
3	CO-3	PO-1,2,3 PSO-1,2,7	U	F, C	L	P
4	CO-4	PO-2,3,4 PSO-1,2,6	U	F, C	L	P
5	CO-5	PO-1,2,7 PSO-1,2,3,7	R, U, An	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 6	PSO 7	PO1	PO2	PO3	PO4	PO7
CO 1	2	2	-	-	-	2	-	2	-	1
CO 2	2	-	-	2	2	1	2	1	1	-
CO 3	1	2	-	-	2	1	2	1	-	-
CO 4	2	2	-	1	-	-	1	2	1	-
CO5	3	2	1	-	2	1	2	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSEELE201				
Course Title	**Introduction to Robotics**				
Type of Course	DSE				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2	5
Pre-requisites					
Course Summary	This gives the fundamental concepts of Robotics, robot kinematics, sensors used in robotics and finally robotic applications				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**ROBOT BASICS**	**12**
	1	Robot-Evolution-Basic concepts	
	2	Robot configurations-cartesian, cylinder, polar and articulate	
	3	Robot wrist mechanism	
	4	Precision, accuracy and repeatability of robot	
	5	Degrees of Freedom	
	6	Links, Joints, End effectors	
	7	Link and Joint Parameters.	
II		**ROBOT KINEMATICS**	**9**
	8	Basics of direct and inverse kinematics,	
	9	Robot trajectories	
	10	2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation.	
III		**ROBOT Sensors**	**6**
	11	Sensors in robot – proximity sensor-range sensor-visual sensor-Auditory sensor-Touch and Slip sensor-Force and Torque sensors.	
IV		**Actuators and Drives**	**9**
	12	Mechanical actuators, Electrical actuators, Hydraulic and Pneumatic actuator	
	13	Electrical drives: DC, AC, brushless, servo and stepper motors	
		Grippers: Different types- mechanical grippers , vacuum cups, magnetic grippers	
V		**ROBOT APPLICATIONS**	**9**
	14	Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Défense, Disaster management	
	15	Micro and Nanorobots, Future Applications.	

		Lab experiments:	**30**
	1	Determination of maximum and minimum position of link	
	2	Verification of transformation (position and orientation) with respect to gripper and world coordinate system	
	3	Estimation of accuracy, repeatability and resolution	
	4	Robot Programming and simulation for pick and place	
	5	Robot Programming and simulation for colour identification	
	6	Robot Programming and simulation for machining (cutting, welding)	
	7	Robot Programming and simulation for writing practice	
	8	Robot Programming and simulation for any industrial process (Packaging, Assembly)	
	9	Robot Programming and simulation for multi process	
	10	Robot programming and simulation for Shape identification	

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.

2. K. K.Appu Kuttan, Robotics, I K International, 2007.

3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.

4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.

5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.

6. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the evolution and components of a robot	U	1,2
CO-2	Demonstrate robot configurations and parameters	R, U	1,3
CO-3	Characterise Robot kinematics and trajectories	U, Ap	1,2
CO-4	Discuss various sensors and actuators used in robots	U	1,4
CO-5	Discuss different industrial applications of robots	U,Ap	1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Introduction to Robotics

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1.	CO-1	PO-1,2; PSO-1,2	U	F,C	L	p
2.	CO-2	PO-1,2; PSO-1,3	R, U	F,C	L	p
3.	CO-3	PO-1,2; PSO-1,2	U, Ap	F,C	L	p
4.	CO-4	PO-1,2; PSO-1,4	U	F,C	L	p
5.	CO-5	PO-1,2; PSO-1,2	U,Ap	F,C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PO1	PO2
CO 1	1	1	-	-	1	1
CO 2	2	-	2	-	1	2
CO 3	1	-	-	2	2	3
CO 4	1	-	-	1	1	2
CO 5	2	1	-	-	3	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSEELE202				
Course Title	Advanced Concepts of Industrial Electronics				
Type of Course	DSE				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. UK1DSCELE100/UK1DSCELE101/UK1DSCELE102 2. UK3DSEELE202				
Course Summary	Advanced concept of power electronics and Industrial electronics. Application of power electronics				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Power electronics Devices**	**8**
	1	Principle of operation of SCR, Static characteristics of SCR	
	2	Turn on and off methods of Thyristor ratings	
	3	The programmable unijunction transistor	
II		**DC-DC converter**	**9**
	4	Introduction, DC choppers	
	5	Buck Converter, Boost Converter, Buck Boost converter	
	6	Flyback converter, Synchronous and Bi-directional converter	
	7	Application of DC-DC converter	
III		**Inverters**	**10**
	8	Introduction, Single phase voltage source inverter: Half bridge VSI	
	9	PWM Technique (concept only), square wave modulation technique	
	10	Current source inverter	
	11	Performance comparison of PWM, AVI and CSI	
	12	Harmonics reduction LC filter and OTT filter	
	13	Halfwave AC Voltage Regulator	
	14	Heat sinks: Heat transfer, Thermal Resistance and Thermal Model	
IV		**Spice - Power electronics Electric power**	**10**
	15	Introduction, Element values, Element models, Output variable, Spice Output commands	
	16	Format of output file, Format of circuit files	
	17	Defining output variables, voltage and current sources	
	18	Behavioral device modeling, passive elements	

	19	Dot commands, DC-DC converter, PWM inverter, Controlled Rectifiers.	
V	**Safety Measures**		**8**
	20	Earthing	
	21	Safety measures while handling high voltage	
	22	Lighting protecting devices, surge protectors.	
		Lab experiments: 1. Models of resistor, capacitor, inductor, energy sources (VCVS, CCVS Sinusoidal source, pulse, etc) 2. Transformer, Models of DIODE, BJT, FET, MOSFET, etc. 3. Simulation of circuits with BJT using spice (Schematic entry of circuits using standard packages. 4. Analysis- transient (AC, DC) 5. Rectifiers 6. Integrator & Differentiator 7. Diode Characteristics. 8. SCR Characterstics 9. FET Characteristics. 10. LC filter 11. Astable Multivibrator 12. Zener regulator 13. DC-DC converters 14. PWM	**30**

Text Books:

1. Introduction to power electronics – Denis Fewson, Arnolnd, Publisher: Oxford University Press
2. A text book of Electrical Technology, B L Theraja and A K Theraja, Publisher: S Chand & Co Ltd
3. Modern Electric Vehicle Technology - C.C. Chan and K.T. Chau, Publisher: Oxford University Press
4. Build Your Own Electric Vehicle Seth Leitman - Bob Brant Publischer Oxford University Press

References:

1. Practical Troubleshooting of Electrical Equipment and Control Circuits Mark Brown Dinesh Patil-Paperback ISBN: 9780750662789
2. Electric Vehicle Battery Systems - Sandeep Dhameja, Publisher: Newnes
3.Power Electronics Handbook (Academic Press Series in Engineering) Muhammad H. Rashid, Academic Press (2001)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basic power semiconductor devices	R, U	PSO-1,2
CO-2	Demonstrate the basic required circuits used in industrial purpose	R, U, A	PSO-1,2
CO-3	Apply specific circuits used in industrial power systems	R, U, A, An	PSO-1,2,4
CO-4	Identify the software used to draw and analyse electronic circuits	R, U	PSO-1,4,6
CO-5	Identify devices used in home power systems	R, U, A	PSO-1,7,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Advanced Concepts of Industrial Electronics

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,2	R, U	F, C	L	-
3	CO-3	PO-1,7; PSO-1,2,4	R, U	F, C	L	-
4	CO-4	PO-1,7: PSO-1,4,6	R, U, Ap	F, C	L	P
5	CO-5	PO-1,7, PSO-1,7,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping COs with POs/PSOs

	PSO1	**PSO2**	**PSO4**	**PSO6**	**PSO7**	**PSO 8**	**PO1**	**PO3**	**PO 7**
CO 1	2	2	-	-	-	-	1	1	-
CO 2	2	2	-	-	-	-	1	1	-
CO 3	1	1	3				1		2
CO 4	1	-	2	2	-	-	1	-	1
CO 5	1	-	-	-	2	3	1	-	2

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4DSEELE203				
Course Title	Embedded systems & IOT (Part II)				
Type of Course	DSE				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1. UK3DSELE203				
Course Summary	With this course students will learn the basic building blocks of Embedded System, Input/output Interfacing and Bus Communication with processors.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Embedded Controllers Book1(chapter 1), Book2(chapter 2),**		**10**
	1	Components of embedded system hardware–Software embedded into the system –Embedded Processors	
	2	PIC microcontrollers - introduction, architecture of 16F877A (block diagram explanation only)	
	3	Device overview , Memory organization , instruction sets, ,Registers Special features of CPU, Interrupts.	
II	**Typical Embedded System Book2(chapter 2),**		**12**
	4	I/O Ports, Serial Interfaces- USART, SPI, I2C, counter/timer, PWM module	
	5	ALP examples	
	6	Introduction to Embedded C programming	
	7	Programming peripherals(UART, Timers, Counters etc) using ALP &C	
III	**Interfacing Book2**		**6**
	8	Interfacing PIC with LED,LCD,	
	9	Interfacing Relay,Stepper Motor, Temperature Sensor	

	10	Interfacing Program Examples in C.	
IV	**IoT Development tools Book 3,Book 4,Book5**		**8**
	11	Sensors, Actuators, and Smart Objects, Sensor Networks, Interoperability in IoT,	
	12	Introduction to Arduino - Pin configuration arduino uno and architecture, Device and platform features, Concept of digital and analog ports.	
	13	Input Output - Pins Configuration, Pull-up Resistors, Functions - pinMode() , digitalWrite() , analog Read() , analog Write() and Arduino Interrupts. Time Functions - delay(), delay.Interfacing - UART, Serial monitor. Interfacing an LCD to Arduino, Arduino LCD Library,Humidity Sensor, Temperature Sensor ultrasonic sensor	
V	**IoT Platforms Book 3,Book 4**		**9**
	14	Sensors and Control Units, Implementation,	
	15	Communication Module, Software, Middleware,	
	16	Operating Systems (OS)Firmware, Development Tools and Open-source Framework for IoT	
		PRACTICALS	**30**
		Experiments with PIC 16F877(can be done with MP LabIDE/Hitec C/MikroC/ CCS C etc) 1. LED blinking 2. Interfacing push button 3. Relay interfacing 4. DC motor interfacing 5. Stepper motor interfacing **Experiments with Arduino** 6.Traffic light using LED's 7.Obstacle detection using IR sensor 8.Servo motor control 9. LCD interfacing 10.Measure distance using Ultrasonic Sensor & display the value on an LCD.	

Text books

1 .Internet of things Architecture and Design Principle, Raj Kamal , McGraw Hill; Standard Edition

2. PIC Microcontroller and Embedded Systems: Using Assembly And C –Mazidi, Pearson

3. Designing the Internet of Things -- Adrian McEwen, Hakim Cassimally, John Wiley & Sons

4. Internet of Things Principles and Paradigms –Rajkumar Buyya , AmirVahid Dastjerdi, Morgan Kaufmann Publishers In.

5. Arduino for Dummies by John Nussey, John Wiley & Sons

References

1. Arduino-Based Embedded Systems : By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury, CRC Press.
2. Arduino Made Simple by Ashwin Pajankar, BPB publishers.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recognise the hardware & software components of an embedded system	R, U	PSO-3,2
CO-2	Explain the construction, addressing modes and instructions sets of PIC micro controller	R, U	PSO-3,2
CO-3	Demonstrate experiments with I/O systems used in embedded systems.	R, U,Ap	PSO-3,2,8
CO-4	Design embedded systems using Arduino	R, U,Ap,C	PSO-3,2,8
CO-5	Analyse various IOT platforms	R, U,Ap	PSO-3,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Embedded systems & IOT (part 2)

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO6,7; PSO2,3	R, U,An	F, C	L	P
2	CO-2	PO1, 6;, PSO2,3	R, U,Ap	F, C, P	L	P
3	CO-3	PO1,2; PSO2,3,8	R, U,Ap	F, C, P	L	P
4	CO-4	PO1,2,; PSO 2,3,8	R, U,Ap	F, C, P	L	P
5	CO-5	PO1; PSO2,3	U,An	F, C,	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO2	PSO3	PSO8	PO1	PO2	PO6	PO7
CO 1	1	2	-	-	-	1	1
CO 2	1	2	-	1	-	2	-
CO 3	3	3	1	1	2	-	-
CO 4	3	3	2	1	2	-	-
CO 5	2	1	-	2	-	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓			✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4VACELE200				
Course Title	Life Skills for Technicians and Scientists				
Type of Course	**VAC**				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hrs	-	2hrs	4
Pre-requisites	Nil				
Course Summary	Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personal skills by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Module 1: Overview of Life Skills**		**6**
	1	Meaning and Significance of Life Skills	
	2	Self-awareness. Empathy, Critical Thinking, Decision making, Problem Solving, Interpersonal relationships, coping with stress and emotion	
	3	Life skills for professionals – positive thinking, right attitude, attention to detail, learning skills, research skills, setting and achieving goals	
	4	Leadership, motivation, personality development, IQ, EQ, SQ	
II	**Module 2 Self Awareness, Stress Management and Coping with emotions**		**6**
	5	Self-awareness, coping with stress and emotions, human values	
	6	Tools and techniques of self-awareness – Questionnaires, journaling, reflective qns, meditation, mindfulness	
	7	Stress management – reasons and effects, identifying stress, the four "A's" of stress management, Gratitude training	
	8	Coping with emotions – identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques	
III	**Module 3: Problem solving skills for the 21st century**		**6**
	9	Imagination, intuition, experience, sources of creativity, lateral thinking, myths of creativity, critical thinking vs creative thinking, convergent and divergent thinking	
	10	Steps in problem solving – 6 thinking hats, Mind mapping, Forced connections	
	11	Analytical thinking, numeric, symbolic, Graphical reasoning	
IV	**Module 4: Group and team dynamics for technicians and scientists**		**6**
	12	Introduction to groups – formation, cycle, thinking	
	13	Clarifying Expectations, Problem solving, Consensus	
	14	Dynamics technique, Group Vs Team	

	15	Team dynamics, Virtual teams	
V	**Module 5: Leadership**		**6**
	16	Leadership framework, entrepreneurial and moral leadership	
	17	Vision, cultural dimension, growing as a leader, turnaround leadership	
	18	Managing diverse stakeholders, crisis management	
	19	Types of leadership, traits, styles	
	20	VUCA leadership, Levels of leadership	
		Practical Classroom Activities	30
		Verbal Communication (Any four)	
	1.	Effective communication and presentation skills	
	2.	Different kinds of communication; Flow of communication, communication networks, Types of barriers, Miscommunication	
	3.	Introduction to presentation and group discussion	
	4.	Learning styles: Visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method	
	5.	Note taking skills: outlining, non-linear note taking methods, Cornell notes, three column notes taking	
	6.	Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition	
	7.	Time management: auditing, identifying time wasters, manage distractions, calendars and checklists; Prioritizing – Goal setting, SMART goals; Productivity tools and apps; Pomodoro technique	
		Non-Verbal (Any One)	
	1.	Nonverbal communication and Body language: Forms of non-verbal communication; interpreting body language cues;	
	2.	Kinesics; Proxemics; Chronemics	
	3.	Effective use of body language	

	4.	Communication in multi-cultural environment	

Text Books:

1. Life Skills for Engineers, Complied by ICT Academy of Kerala, McGraw Hill Education (India) Private Ltd., 2016
2. Life Skills for Engineers by Remesh S and Vishnu RG, Ridhima Publications, Trivandrum, 2019
3. Life Skills by Deepak Benjamin and Tintu P Joseph, Pentex Publishers, Kollam, 2021

References:

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd. Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
3. Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company
4. John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify different life skills required in personal and professional life	U	PSO-8
CO-2	Develop an awareness of the self and apply well defined techniques to cope with emotions and stress	R, U	PSO- 8
CO-3	Explain the basic skills of problem solving and demonstrate these through presentations	Ap	PSO-5, 8

CO-4	Discuss the basics of teamwork and leadership through group discussions.	Ap	PSO-5, 8
CO-5	Use the concept of team work to produce quality output.	R,U,Ap	PSO-5, 8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Life skills for Technicians and Engineers

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1, 8	U	F, C	L	P
2	CO-2	PO-1,2	R, U	F, C	L	P
3	CO-3	PO-1,2,8	Ap	F, C	L	P
4	CO-4	PO-1,2,5,8	Ap	F, C	L	P
5	CO-5	PO-1,2,5,8	R,U,Ap	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO5	PSO8	PO1	PO2	PO5	PO8

CO 1	-	1	1	-	-	1
CO 2	-	2	1	1	-	-
CO 3	1	2	1	1	-	1
CO 4	1	1	1	2	1	1
CO 5	1	2	1	2	2	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓

CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4VACELE201				
Course Title	SPACE EXPLORATION FUNDAMENTALS				
Type of Course	VAC				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites					
Course Summary	The course provides a comprehensive overview of various aspects of astronomy, planetary science, space weather, and the history of human space exploration. It covers topics such as the characteristics of the Sun and Earth, the Earth-Moon system, eclipses, planetary science, space weather phenomena, and the historical advancements in space exploration technology. Students will gain a deep understanding of the solar system, including the Sun's composition and behaviour, Earth's structure and atmosphere, the Moon's phases and orbits, and the dynamics of space weather. Additionally, they will explore the history of human endeavours in space, from early ground-based observations to modern advancements in rocketry, satellites, spacecraft, and communication systems.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Sun and Earth**	**6**
	1	Basic measurements and interpretations.	
	2	The sun-sun atmosphere, radio output from sun, sun as an emitter of X-ray and cosmic rays, solar wind.	
	3	Earth as a planet- earth's form-earth's interior, magnetic field, earth atmosphere.	
II		**Earth -Moon System and Eclipses**	**5**
	4	Moon's physical nature, phases of moon, retardation of the moon transits, moon's orbits, tides.	
	5	Eclipse-types-eclipse year, saros, duration of total lunar eclipse, ecliptic limit.	
III		**Planetary Science**	**6**
	6	Exploration of the solar system.	
	7	Evolution of atmosphere	

	8	Terrestrial planet-outer planet-comets-asteroids- other solar system.	
IV	**Space Weather**		**7**
	9	What Is Space Weather? -Solar Activity-The Solar Wind-Aurora-Auroral Substorms-Co-rotating Interaction Regions (CIRs)-Solar Flares.	
	10	Co-rotating Interaction Regions (CIRs)-Solar Flares	
	11	The Ionosphere-Solar Energetic Particle Events (SEPs)-Other Sources of Energetic Particles	
	12	Coronal Mass Ejections and Geomagnetic Storms-Halo -Magnetic Storms and Substorms-Very Intense Storms	
V	**History of Human Space Exploration**		**6**
	13	History of Space Exploration – Technology Advancement of Ground-Based Observations Since Galileo- Brief History of Human's Access to Space.	
	14	Recent Technology Progress of Space Exploration- Rocketry- Satellite and Spacecraft- Tracking Telemetry and Control (TT&C) and Communication- Launch and Recovery.	
PRACTICALS			30
	1	Solar Radiation Measurement: Experiment: Build a solar panel voltage measurement circuit. Objective: Measure the voltage output of a solar panel under varying light conditions (e.g., different times of day, shading). Equipment: Solar panel, multimeter, adjustable light source (e.g., lamp), shading materials. Procedure: Place the solar panel under the light source and measure its voltage output using the multimeter. Repeat the measurement with different light intensities and shading conditions.	
	2	Magnetic Field Detection: Experiment: Construct a simple magnetometer circuit. Objective: Detect changes in magnetic field strength. Equipment: Hall effect sensor, operational amplifier, power supply, voltmeter. Procedure: Connect the Hall effect sensor to the amplifier circuit and power supply. Place the sensor near magnets of varying strengths and orientations and measure the output voltage using the voltmeter.	

	3	Timing Circuit: Experiment: Design a basic circuit using 555 timer IC. Objective: Understand pulse-width modulation (PWM). Equipment: 555 timer IC, resistors, capacitors, LED, power supply, oscilloscope. Procedure: Connect the components according to the 555-timer datasheet to generate a blinking LED output. Use the oscilloscope to observe the waveform and adjust the circuit parameters to vary the blink rate.	
	4	Temperature Sensor Calibration: Experiment: Calibrate a thermistor-based temperature sensor. Objective: Relate sensor resistance to temperature. Equipment: Thermistor, resistor, mustimeter, temperature source (e.g., water bath), thermometer. Procedure: Connect the thermistor in series with a resistor to form a voltage divider circuit. Measure the output voltage at different temperatures using the mustimeter and reference temperature readings from the thermometer to calibrate the sensor.	
	5	Communication Signal Strength Measurement: Experiment: Measure signal strength using an RF signal detector. Objective: Understand signal attenuation with distance. Equipment: RF signal detector, transmitter (e.g., walkie-talkie), measuring tape. Procedure: Set up the transmitter and receiver at a fixed distance. Use the RF signal detector to measure the signal strength at different distances and record the readings.	

Text Book:

1. Astronomy structure of the Universe, A.E. Roy and D. Clarke, Adam Hilger Pub
2. Space Science, L.K Harra, Keith O Mason, Imperial College Press.
3. Introduction to Space Science, Ji Wu, Springer Aerospace Technology, Springer, Science Press Beijing.

Refrences

1.Introduction to Ionosphere and magnetosphere- Ratcliffe (CUP, 1972)
2.The Physics of Atmospheres-Houghton (Cambridge University Press)
3.Introduction to Ionospheric Physics-Henry Rishbeth &Owen K. Garriot (Academic Press, 1969)
4.Space Science –Louise K. Harra& Keith O. Mason(Imperial College Press,London, 2004)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the sun earth system	U	PSO-1, 4
CO-2	Discuss the Earth-Moon system	R, U	PSO-1, 4
CO-3	Discuss planetary systems	U, Ap	PSO-1, 4
CO-4	Discuss space weather	U, Ap	PSO-1, 4
CO-5	Identify human space explorations	U, Ap	PSO-1, 4,6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Space Exploration Fundamentals

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1; PSO-1, 4	U	F, C	L	P
2	CO-2	PO-1,4; PSO-1, 4	R, U	F, C	L	**P**
3	CO-3	PO-1,3; PSO-1, 4	U, Ap	F, C	L	P
4	CO-4	PO-1,4; PSO-1, 4	U, Ap	F, C	L	P
5	CO-5	PO-4,6; PSO-1, 4,6	U, Ap	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO4	PSO6	PO1	PO3	PO4	PO6
CO 1	2	1	-	2	-	-	-
CO 2	2	1	-	2	-	2	-
CO 3	2	1	-	2	1	-	-
CO 4	2	1	-	2	-	1	-
CO 5	1	1	2	-	-	1	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

- **Mapping of COs to Assessment Rubrics :**

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4SECELE200				
Course Title	Advanced 3D Printing & PCB Design				
Type of Course	SEC				
Semester	IV				
Academic Level	200 – 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	1. UK1DSCELE100				
Course Summary	These courses would be suitable for students of all levels, from beginners to experienced professionals. They would be especially beneficial for students who are interested in pursuing a career in electronics engineering, product design, or manufacturing				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**PCB Fundamentals:**		**6**
	1	PCB Advantages, components of PCB, Electronic components, ,	
	2	Microprocessors and Microcontrollers, IC's, Surface Mount Devices (SMD).	
	3	Classification of PCB - single, double, multilayer and flexible boards, Manufacturing of PCB	
	4	PCB standards. Schematic diagram, General, Mechanical and Electrical design considerations,	
II	**Schematic & Layout Design:**		**6**
	5	Layout Planning: General rules of Layout, Resistance, Capacitance and Inductance, Conductor Spacing,	
	6	Supply and Ground Conductors,	
	7	Component Placing and mounting, Component Placing and mounting, Cooling requirement and package density, Layout check	
	8	Component Placing and mounting, Cooling requirement and package density, Layout check	
III	**Printing PCB**		**4**
	9	Net list, creating components for library, Tracks, Pads, Vias, power plane, grounding,	
	10	Photo resists, wet film resists, Coating process for wet film resists, Exposure and further process for wet film resists,	
	11	Dry film resists Introduction, Etching machine, Etchant system	

	12	Principles of Solder connection, Solder joints, Solder alloys, Soldering fluxes. Soldering, De soldering tools and Techniques	
IV	**3D PRINTING**		**9**
	13	Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.	
	14	CAD Data formats, Data translation, Data loss, STL format	
	15	Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology	
	16	Process, Process parameter, Process Selection for various applications.	
	17	Polymers, Metals, Non-Metals, Ceramics	
	18	Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.	
	19	Process Equipment- Design and process parameters	
V	**Application Domains**		**5**
	20	Governing Bonding Mechanism Common faults and troubleshooting	
	21	Inspection and testing Defects and their causes Process Design	
	22	Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools	
		PRACTICALS	
		ELECTRONIC CIRCUITS AND PCB DESIGNING (LAB) (HARDWARE AND CIRCUIT SIMULATION SOFTWARE) 1. Verification of Thevenin's theorem 2. Verification of Superposition theorem 3. Verification of Maximum power transfer theorem. 4. Half wave Rectifier – without and with shunt capacitance filter. 5. Centre tapped full wave rectifier – without and with shunt capacitance filter. 6. Zener diode as voltage regulator – load regulation. 7. Design and study of voltage divider biasing. 8. Designing of an CE based amplifier of given gain 9. Designing of PCB using artwork, its fabrication and testing. 10. Design, fabrication and testing of a 9 V power supply with zener regulator	**15**
		3D PRINTING 1. 3D Modelling of a single component. 2. Assembly of CAD modeled Components 3. Exercise on CAD Data Exchange. 4. Generation of .stl files. 5. Identification of a product for Additive Manufacturing and its AM process plan. 6. Printing of identified products on an available AM machine. 7. Post processing of additively manufactured products. 8. Inspection and defect analysis of the additively manufactured product. 9. Comparison of Additively manufactured products with conventional manufactured counterparts.	**15**

Text Books:

1. Printed circuit Board – Design & Technology by Walter C. Bosshart, TataMcGraw Hill.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGraw Hill Publisher
3. Walter C.Bosshart "PCB DESIGN AND TECHNOLOGY" Tata McGraw Hill Publications, Delhi. 1983
4. Clyde F.Coombs "Printed circuits Handbook" III Edition, McGraw Hill.

References

1. Lan Gibson, David W. Rosen and Brent Stucker, ―Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing‖, Springer, 2010.
2. Andreas Gebhardt, ―Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing‖, Hanser Publisher, 2011.
3. Khanna Editorial, ―3D Printing and Design‖, Khanna Publishing House, Delhi.
4. CK Chua, Kah Fai Leong, ―3D Printing and Rapid Prototyping- Principles and Applications‖, World Scientific, 2017.
5. J.D. Majumdar and I. Manna, ―Laser-Assisted Fabrication of Materials‖, Springer Series in Material Science, 2013.
6. L. Lu, J. Fuh and Y.S. Wong, ―Laser-Induced Materials and Processes for Rapid Prototyping‖, Kulwer Academic Press, 2001.
7. Zhiqiang Fan And Frank Liou, ―Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy‖, InTech, 2012.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate basic components needed for electronic circuits and design	R, U	PSO-1,2
CO-2	Demonstrate the drawing the complete PCB design	R, U,A	PSO-1,3
CO-3	Discuss the printing of PCB	R, U,A,C	PSO-1,3,7
CO-4	Describe the basic and advanced concepts of 3D printing in complete	R, U	PSO-1,4,7
CO-5	Demonstrate systems and analyse the applications of 3D printing	R, U	PSO-1,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Advanced 3D Printing & PCB Design

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,3	R, U	F, C	L	P
3	CO-3	PO-1,7; PSO-1,3,7	R, U	F, C	L	-
4	CO-4	PO-1,7,8:PSO-1,4,7	R, U, Ap	F, C	L	P
5	CO-5	PO-1,8, PSO-1,4,8	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO 8	PO1	PO3	PO 7	PO 8
CO 1	1	2	-	-	-	-	1	1	-	-
CO 2	1	-	2	-	--	-	1	1	-	-
CO 3	1	-	1	-	2	-	1	-	1	-
CO 4	1	-	-	2	3	-	1	-	1	-
CO 5	1	-	-	1	-	1	1	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK4SECELE201				
Course Title	**Safety Engineering**				
Type of Course	SEC				
Semester	IV				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	Nil				
Course Summary	At the end of the course, the student will be able to Understand the principles of safety management. They can conduct safety audit and write audit reports effectively in auditing situations. Have knowledge about sources of information for safety promotion and training and familiarize with evaluation of safety performance. The practical training is to equip the student to recognize various safety gears, investigation procedures, various statutory forms and permits. They will also compute safety indices from accident data and predict threats to safety and environment. Design work permits and training modules on safety in industry and society				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction and Needs of Safety**		**6**
	1	Introduction- Safety- Goals of safety engineering. Need for safety. Safety and productivity.	
	2	Definitions: Accident, Injury, Unsafe act, Unsafe Condition	
	3	Dangerous Occurrence, Reportable accidents	
	4	Theories of accident causation	
II	**Introduction to Safety Organisation**		**6**
	5	Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety	
	6	Safety policy. Safety Officer- responsibilities, authority.	

	7	Safety committee- needs, types, advantages.	
	8	Accident prevention Methods	
	9	Engineering, Education and Enforcement	
III	**Safety Education and Training**		**6**
	10	Importance of Safety Education & Training, Various training methods, Effectiveness of training, Behaviour oriented training.	
	11	Communication- purpose, barrier to communication.	
	12	Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5s of housekeeping.	
	13	Work permit system- objectives, hot work and cold work permits.	
IV	**Monitoring Safety Performance**		**6**
	14	Personal protection in the work environment, Types of PPEs, Personal protective equipment- respiratory and non-respiratory equipment. Standards related to PPEs.	
	15	Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate.	
	16	Cost of accidents - Computation of Costs- Utility of Cost data.	
	17	Plant safety inspection, types, inspection procedure.	
V	**Accident Investigation and Reporting**		**6**
	18	Accident investigation- Basics- Man- Environment and Systems.	
	19	Process of Investigation -Tools-Data Collection- Handling witnesses- Case study.	
	20	Accident analysis - Analytical Techniques	
	21	System Safety-Change Analysis	
		PRACTICALS	**30**
	1	Study of personal protective equipment	
	2	Assessment of the safety performance of an industry and classification of accidents	
	3	Safety assessment of a construction site	
	4	Environmental impact assessment and environmental audit	
	5	Accident Reporting – Exercises	
	6	Job safety analysis – Exercises	

	7	Safety audit – Exercises, e.g., Labs, workshops, academic, administrative and residential	
	8	Calculation of cost of accidents	
	9	Preparation of work permits	
	10	Preparation of a training module on any topic of safety for a target audience	

TEXT BOOKS

1. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York,1969 4th Edition
2. Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.
3. Akhil Kumar Das," Principles of Fire Safety Management" Eastern Economy Edition, 2020

REFERENCES:

1. John V. Grimaldi and Rollin H. Simonds. (1989) Safety management, All India Traveller Book Seller, Delhi.
2. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, New Delhi.
3. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
4. Ted S. Ferry Modern accident investigation and analysis, John Wiley & Sons, Hoboken, N.J. (1988).
5. Alan Waring Safety management system. Chapman & Hall, England. (1996).
6. National Safety Council Accident prevention manual for industrial operations. Chicago, (1982).
7. Chandran, Kailas Sree, Industrial Safety engineering, Sourabhya Technical Publications, Trivandrum, 2023

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the functions and activities of safety engineering department.	U	PSO-1
CO-2	Demonstrate a safety audit and prepare a report for the audit.	R, U	PSO-2
CO-3	Interpret the importance of safety education and training	U, E	PSO-4,6
CO-4	Estimate the accident cost using supervisors report and data.	An, Ap	PSO-5
CO-5	Identify various agencies, support institutions and government organizations involved in safety analysis, safety training and promotion	R, U, Ap	PSO-6,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Safety Engineering

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO1	PO-1	U	F, C	L	-
2	CO2	PO-2	R, U	P	L	P
3	CO3	PO-4,6	U, E	F	L	P
4	CO4	PO-5	An, Ap	P	L	P
5	CO5	PO-6	R, U, Ap	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO4	PSO5	PSO6	PO1	PO2	PO4	PO5	PO6
CO 1	1	-	-	-	-	1	-	-	-	-
CO 2	-	1	-	-	-	-	1	-	-	-
CO 3	-	-	1	-	2	-	-	2	-	-
CO 4	-	-	-	2	-	-	-	-	1	-
CO 5	-	-	-	-	2	-	-	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSCELE**300**				
Course Title	Microprocessor and Microcontroller				
Type of Course	DSC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	This course helps the students to understand microprocessor and microcontroller and their applications, This course provides solid foundation on the fundamentals of microprocessors architecture as well as the assembly language programming and interfacing the external devices to the microprocessor/microcontroller according to the user requirements thus enabling to create novel products and solutions for real time problems.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to microprocessors and microcontrollers**		**6**
	1	Introduction and microprocessors and microcontrollers.	
	2	Basic architecture and functioning principles, CISC and RISC architecture	
	3	Importance of microprocessors and microcontrollers in embedded systems	
II	**Architecture and programming of Intel 8086 microprocessor**		**12**

	4	Introduction to Intel 8086 microprocessor.	
	5	Architecture and pin organization of Intel 8086 microprocessor	
	6	EU and BIU, Min/Max mode signals.	
	7	Register organization, Memory segmentation and physical address calculation.	
	8	Instruction set of Intel 8086, Instruction format and addressing modes.	
	9	Assembly language programming concepts: data movement, arithmetic and logical operations, branching, and looping. Simple programs.	
III	**Interfacing with Intel 8086 Microprocessor**		**8**
	10	Interrupts and interrupt handling mechanism	
	11	Introduction to Interfacing ICs 8255, 8259. Interfacing of 8086 with LED and switch.	
	11	Serial communication using RS 232.	
	12	Interfacing with ADC, Features and familiarization of ADC IC0808.	
IV	**Intel 8051 Microcontroller**		**10**
	13	Introduction to Intel 8051 microcontroller. Internal architecture and functional units.	
	14	Registers, I/O ports, Memory organization and addressing modes.	
	15	Instruction set overview for 8051 microcontrollers	
	16	Assembly language programming for 8051	
	17	Timer/Counter module in 8051	
V	**Applications of 8051**		**9**
	18	Interrupt structure and programming in 8051.	
	19	Interfacing of 8051 with I/O devices like LED, switch, motor.	
	20	Analog-to-digital conversion using 8051	
	21	Temperature measurement system using 8051.	
	22	Serial communication interfaces- USART, SPI, I2C	
		Practical session	**30**

		8086/8051 Assembly programming 1. Arithmetic operations (Addition, subtraction, multiplication and division) of two 8/16 bit numbers 2. Sorting of arrays in ascending and descending order. 3. Biggest/smallest of two numbers 4. Block transfer 5. BCD to Binary conversion 6. Simple interfacing programs for input output devices such as LED and Switch. 7. Delay generation	

Text books

1. Intel Microprocessors: Architecture, Programming, and Interfacing, Barry B. Brey, Pearson Prentice Hall.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Mazidi, and RolinMcKinlay, Pearson
3. The 8051 Microcontroller:Architecture programming and applications"by Kenneth Ayala,3/e,Thomson publishing.
4. Microprocessors and Microcontrollers, N. Senthil Kumar, Oxford Publishing
5. Microprocessors and Interfacing, Douglas V.Hall, TMH, New Delhi

References

1. Microprocessor Architecture, Programming, and Applications with the 8085/8080, Pearson Ramesh S. Gaonkar
2. Embedded Systems: Architecture, Programming, and Design, Raj Kamal, Mc Graw HIill
3. Nagoorkani, "Microprocessors and Microcontrollers" 2e, McGraw Hill Education India, 2012
4. https://onlinecourses.nptel.ac.in/noc21_ee18

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Develop the idea of microprocessor and microcontroller and their applications.	R,U, An, E	PSO-4
CO-2	Illustrate the architectural features of 8086 and identify the functional blocks.	R, U	PSO-4
CO-3	Develop assembly programming ideas and create simple programmes	R, U, Ap, C	PSO-1,2,4,8
CO-4	Create the concept of Interfacing and applications of interfacing ICs	U, Ap	PSO-4,8

CO-5	Illustrate the architectural features of 8051 and create simple assembly language programmes.	R, U, Ap, C	PSO-1,2,4,8
CO-6	Demonstrate the real world applications of 8051 microcontroller.	U, Ap, C	PSO-3,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Microprocessor and Microcontroller

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge category	Lecture (L) / Tutorial T)	Practical (P)
1	CO-1	PO-7/PSO-4	R, U, An ,E	F	L	p
2	CO-2	PO-7/PSO-4	R, U	F	L	p
3	CO-3	PO-7/PSO-1,2,4,8	R, U, Ap, C	P	L	P
4	CO-4	PO-7/PSO-4,8	U,Ap	C	L	P
5	CO-5	PO-7/PSO-1,2,4,8	R, U, Ap, C	P	L	P
6	CO-6	PO-7/PSO-3,4,8	R,U, Ap, C	C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitiv

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO8	PO7
CO 1	-	-	-	2	-	2
CO 2	-	-	-	3	-	2
CO 3	1	2	-	3	3	2
CO 4	-	-	-	2	2	2
CO 5	1	2	-	3	3	2
CO 6	-	-	1	2	3	3

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓			✓
CO 5	✓			✓
CO 6	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSCELE301				
Course Title	FIBRE OPTICS AND OPTICAL COMMUNICATION				
Type of Course	DSC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites	NIL				
Course Summary	The fibre optics and optical communication course delves into the principles and technologies that revolutionized modern communication. It covers the physics of light propagation in optical fibres, different fibre types and their characteristics, signal attenuation and dispersion mechanisms. You'll explore light sources like lasers and LEDs, photo detectors for signal reception, and optical amplifiers to boost signal strength. The course delves into modulation techniques for digital data transmission over optical fibres, advanced concepts like wavelength division multiplexing (WDM) for increased capacity, and system design considerations. This knowledge equips students to understand the advantages and limitations of fibre optic systems, analyse their performance, and gain a foundation for further studies in areas like high-speed data networks, optical communication system design, and emerging technologies in optical fibre communication.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Optical Communication**	**12**
	1	Optical Communication-advantages and applications of optical fibres	
	2	Light propagation in fibres and characteristics, Critical angle, Total internal reflection.	
	3	Classification of Fibres: Single mode and multimode Fibres	
	4	Step index and Graded index Fibre, Refractive Index profile.	
II		**Attenuation and Losses**	**12**
	5	Acceptance angle, Numerical aperture - Mode field diameter, Cut off wavelength	
	6	Signal degradation in optical fibres	
	7	Attenuation in single mode and multimode fibres	
	8	Absorption loss, scattering loss, Bending loss.	

III	**Dispersion**		**12**
	9	Dispersion – Material dispersion, Waveguide dispersion, Bandwidth limitation	
	10	Optic fibre couplers: types of couplers	
	11	Fibre to fibre joints: Splicing techniques- Fusion splice, V groove splice	
	12	Optical fibre connectors -Structure of a connector.	
IV	**Communication System**		**12**
	13	Optical Communication System	
	14	Optical transmitter (block diagram), optical receiver (block diagram)	
	15	Point to point transmission systems, modulation	
	16	Transmission system limits and characteristics	
V	**Sources and Detectors**		**12**
	17	Optical sources and detectors: light production, LEDs, characteristics	
	18	Lasers, DFB lasers, photoconductors, photodiodes, and phototransistors	
	19	Optical amplifiers- SOAs, basics of WDM.	

Text books

1. G. Keiser, Optical Fibre Communications, 3/e, MGH 2000
2. John M senior, Optic Fibre Communication, PHI.
3. Introduction to fibre optics, Ajay Ghatak and K Thyagarajan, McGraw Hill

References

1. R. Dutton, Understanding Optical Communications, Prentice Hall, 1999.
2. D K Myabaev & L L Scheiner, Fiber Optics Communications Technology, Pearson Education, 2001.
3. G.P. Agrawal, Fiber Optic Communication, John Wiley & Sons
4. J H Franz & V.K Jain, Optical Communication, Narosa Publishing House, 2001.
5. Subir Kumar Sarkar, Optical Fibre and Fibre Optic Communication, S Chand & Co. Ltd.
6. Djafer K Mynbaev, Fibre Optic Communication technology, Pearson Education

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Recognize the basic principles of optics transmitting light on a fibre. Classification of optical fibres	U	PSO-1,2
CO-2	Identify and understand the signal degradation in optical fibres	R, U	PSO-1,2
CO-3	Discuss the optical fibre couplers, splicing techniques, and optic fibre connectors	U	PSO-1,3
CO-4	Explain optical communication transmitter and receiver	U	PSO-1,2
CO-5	Demonstrate the optical sources and detectors	U	PSO-1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: FIBRE OPTICS AND OPTICAL COMMUNICATION

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial(T)	Practical (P)
1	CO-1	PO-1,2 PSO-1, 2	U	F, C	L	-
2	CO-2	PO-1,2 PSO-1,2	R, U	F, C	L	-
3	CO-3	PO-1,3 PSO-1,3	U	F, C	L	-
4	CO-4	PO-1,2 PSO-1,2	U	F, C	L	-
5	CO-5	PO-1 PSO-1	U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PO1	PO2	PO3
CO 1	1	1	-	2	1	-
CO 2	2	1		1	1	-
CO 3	2	-	2	2	-	1
CO 4	1	1	-	1	1	-
CO 5	2		-	2		

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSCELE302				
Course Title	Electronic Instrumentation				
Type of Course	DSC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours			4
Pre-requisites	NIL				
Course Summary	The course in Electronic Instrumentation provides a comprehensive introduction to the fundamental principles and concepts essential for measuring and analysing electronic signals. Students will learn about various measurement systems, transducers, signal conditioning techniques, and instruments such as oscilloscopes and signal generators. Through hands-on experiments and theoretical study, students will develop the skills necessary to select, operate, and troubleshoot electronic instruments effectively. Emphasis is placed on understanding the importance of precision and accuracy in measurements, as well as the ethical and economic considerations involved in electronic system design. Overall, the course equips students with a solid foundation in electronic instrumentation, preparing them for various applications in fields such as engineering, research, and development.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Electronic Instrumentation**		**12**
	1	Introduction to Electronic Instrumentation: Overview of instrumentation.	
	2	General Measurement system	
	3	Characteristics, Definitions	

II	**Transducers**		**12**
	4	Different types of Transducers,Potentiometric Transducer, Semiconductor Strain Gauge, Variable Reluctance	
	5	LVDT, Capacitive Pressure, Piezoelectric, Photomultiplier Tube, Photo- voltaic Cell	
III	**Bridges and Amplifiers**		**12**
	6	Signal conditioning (concept only)	
	7	Bridges-Wheatstone, Maxwell,Hays,Schering	
	8	Amplifiers- Instrumentation, Chopper	
IV	**Recording instruments and Signal Generators**		**12**
	9	Recorders- Potentiometric Recorder, Basic X- Y Recorder, Magnetic Recorder	
	10	Signal generators- Introduction, Sine and Square Wave only	
	11	Multimeter	
V	**Cathode Ray Oscilloscope and Analysers**		**12**
	12	Introduction, Block Diagram, Introduction to Digital Storage Oscilloscope, Applications	
	13	Analysers-Logic, Spectrum(Block Diagram discription only)	

Text books

1. Sawhney, A K, Electrical & Electronic Measurement & Instrumentation, Dhanpat Rai &Sons.

2. Kalsi, H.S. (2019). Electronic Instrumentation and Measurements. 4th ed. McGraw Hill .

References

1. Bell, David A, Electronic Instrumentation and Measurements,Oxford University Press India; Third edition

2. Hellfric & Cooper, Modern electronic instrumentation & measuring technique, PHI.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss fundamental concepts	U,R	PSO-1
CO-2	Differentiate between various transducers and types of operating principles and characteristics.	U,Ap,An	PSO-4
C	Demonstrate signal conditioning concepts.	U	PSO-2,3
CO-4	Discuss various types of recorders and their applications, signal generator principles and applications.	U,Ap	PSO-2
CO-5	Identify oscilloscope basics and advantages.	U,An	PSO-2,8,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Electronic Instrumentation

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,2 PSO-1	U,R	F	L	-
2	CO-2	PO-2,4 PSO-4	U, Ap, An	C	L	-
3	CO-3	PO-1,2 PSO-2,3	U	P,C	L	-
4	CO-4	PO-1,2 PSO-2	U, Ap	P	L	-
5	CO-5	PO-1,2 PSO-2,8,7	U, An	P,M	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO8	PO1	PO2	PO4
CO 1	3	-	-	-	-		3	2	-
CO 2	-	-	-	3	-	-		2	3
CO 3	-	3	3	-	-	-	3	2	-
CO 4	-	3	-	-	-	-	2	2	-
CO 5	-	1	-	-	1	2	-	1	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSEELE300				
Course Title	ELECTROMAGNETIC THEORY				
Type of Course	DSC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1. NIL				
Course Summary	This course enables us to understand the fundamentals of Electrostatics and Magnetostatics. It covers static and dynamic electric and magnetic fields and their interaction. Major topics include Electromagnetic Waves, Transmission Lines, Waveguides, and Antenna fundamentals.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Review of Vector Analysis**	**12**
	1	Vector algebra, dot product, cross product	
	2	Vector field & scalar field	
	3	The Del operator, gradient, divergence, curl	
	4	Physical interpretation of gradient, divergence, curl	
	5	Review of rectangular, cylindrical and spherical co-ordinate systems and transformation equations (No derivations required)	
	6	Integral theorems- Divergence Theorem, Stokes Theorem	
II		**Electrostatics:**	**12**
	7	Coulomb‘s law	
	8	Electric field intensity, electric potential due to point charge	
	9	Gauss Law	
	10	Poisson‘s equation, Laplace equation	
	11	Overview of capacitance, dielectrics and dielectric polarization. Electrostatic energy stored in electric fields (derivation).	
	12	Boundary conditions for interface of two dielectrics & conductor- dielectric interface.	
III		**Magnetostatics**	**12**
	13	Magnetic flux, Flux density, magnetic field Intensity	
	14	Faraday‘s Law of Magnetic Induction	
	15	Biot-Savart‘s Law	
	16	Ampere‘s circuital (work) law	
	17	Energy stored in magnetic field.	
	18	Magnetic vector potential	

	19	Boundary conditions for magneto static fields	
IV	**Maxwell's Equations**		**12**
	20	Inconsistency of Ampere 's circuital law	
	21	Conduction current and displacement Current	
	22	Maxwell 's equations- differential and integral form, word statement and interpretation	
	23	Poynting theorem and Poynting vector	
	24	Uniform Plane waves- Solution for free space condition	
	25	Intrinsic impedance.	
	26	Concepts of TE, TM and TEM waves	
V	**Antenna Basics**		**12**
	27	Basic Antenna Concepts – Dipole antenna	
	28	Basic Antenna Parameters –Radiation Pattern , Beamwidth , Radiation Power Density , Radiation Intensity , Directivity , Antenna Efficiency and Gain , Polarization	

Text Book:

1. Applied Electromagnetic field theory with applications -B.Premlet - Phasor Books

2. Engineering Electromagnetics – Haytt (McGraw-Hill Education)

Reference Books:

1. Elements of Electromagnetics--Matthew N. O. Sadiku (Oxford University Press)
2. Electromagnetic Field Theory and Transmission Lines--G. S. N. Raju (Pearson Education)

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the fundamentals of Electrostatics and Magnetostatics hence get the insight of the characteristics of materials and their interactions with electric and magnetic fields	U	1,2
CO-2	Demonstrate the application of Vector Differential and Integral operators in Electromagnetic Theory.	U	1,2
CO-3	Interpret Maxwell's equations in differential and integral forms, both in time and frequency domains.	Ap	1,4
CO-4	Describe the complex ε, μ, and σ, plane waves	U, An	1,3
CO-5	Describe the concept of TE, TM, TEM waves	U	1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: ELECTROMAGNETIC THEORY

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial(T)	Practical (P)
1.	CO-1	PO-1,2; PSO-1,2	U	F,C	L	-
2.	CO-2	PO-1,2; PSO-1,2	U	F,C	L	-
3.	CO-3	PO-1,2; PSO-1,4	Ap	F,C	L	-
4.	CO-4	PO-1,2; PSO-1,3	U, An	F,C	L	-
5.	CO-5	PO-1,2; PSO-1,2	U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO 4	PO1	PO2
CO 1	1	1	-	-	1	1
CO 2	2	3	-	-	1	2
CO 3	1	-	-	1	1	2
CO 4	1	-	2		1	2
CO 5	1	1	-	-	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSEELE301				
Course Title	AI & MACHINE LEARNING				
Type of Course	DSE				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	UK3DSEELE201				
Course Summary	This course enables to understand the fundamentals of Artificial Intelligence and Machine Learning				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Soft Computing**	**12**
	1	Introduction to Soft Computing	
	2	soft computing vs hard computing	
	3	Fuzzy Computing	
	4	Neural Computing	
	5	Genetic Algorithms	
	6	Applications of soft computing	
	7	Introduction to fuzzy sets and systems-crispness, vagueness, uncertainty and fuzziness	
	8	Basics of fuzzy sets, membership function	
II		**Introduction to Neural Networks**	**12**
	9	Introduction to Neural Networks - Applications	
	10	Biological Neuron	
	11	Evolution of Neural networks	
	12	Basic Terminologies in neural networks-Weights, Bias, Activation function, Threshold	
	13	Typical architecture of Artificial Neural Networks –Perceptron	
	14	Training a perceptron, Multilayer perceptron, Back-propagation Algorithm	
III		**Genetic Algorithms**	**12**
	15	Basic Concepts of Genetic Algorithms (GA), Biological background	
	16	Creation of Off springs, Working Principle	
	17	Encoding, Selection, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator	

IV	**Learning algorithms**		**12**
	18	Supervised Learning-Classification	
	19	Logistic Regression	
	20	K-Nearest Neighbours	
	21	Support Vector Machine	
	22	Decision Tree	
	23	Random Forest	
	24	Clustering - Discovering clusters	
	25	Types of Clustering: Hierarchical, Agglomerative Clustering, Divisive clustering, Partitional Clustering - K-means clustering	
V	**Deep Learning**		**12**
	26	Basic overview of Deep Learning	
	27	Ensemble Learning, Role of AI in daily life	

TEXT BOOKS:

1. S. N. Sivanandam and S. N.Deepa, Principles of soft computing – John Wiley & Sons, 2007.
2. Timothy J. Ross, Fuzzy Logic with engineering applications , John Wiley & Sons, 2016.

REFERENCE BOOKS:

1. N. K. Sinha and M. M. Gupta, Soft Computing & Intelligent Systems: Theory & Applications-Academic Press /Elsevier. 2009.
2. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.1998
3. R. Eberhart and Y. Shi, Computational Intelligence: Concepts to Implementation, Morgan Kaufman/Elsevier, 2007.
4. Driankov D., Hellendoorn H. and Reinfrank M., An Introduction to Fuzzy Control-Narosa Pub., 2001.
5. Bart Kosko, Neural Network and Fuzzy Systems- Prentice Hall, Inc., Englewood Cliffs, 1992.
6. Goldberg D.E., Genetic Algorithms in Search, Optimization, and Machine Learning-Addison Wesley, 1989.
7. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
8. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
9. Michael Nielsen, Neural Networks and Deep Learning, 2018.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe Soft Computing	U	1,2
CO-2	Discuss the concepts of Neural Networks	U	1,2
CO-3	Demonstrate concepts of Genetic Algorithm	U	1,4
CO-4	Analyse various learning algorithms	U, An	1,3
CO-5	Identity Deep Learning concepts	U	1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: AI & MACHINE LEARNING

Credits: 4:0:0 (Lecture: Tutorial: Practical)

No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1.	CO-1	PO-1,2; PSO-1,2	U	F,C	L	-
2.	CO-2	PO-1,2; PSO-1,2	U	F,C	L	-
3.	CO-3	PO-1,2; PSO-1,4	U	F,C	L	-
4.	CO-4	PO-1,2; PSO-1,3	U, An	F,C	L	-
5.	CO-5	PO-1,2; PSO-1,2	U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PO1	PO2
CO 1	1	1	-	-	1	1
CO 2	2	3	-	-	1	2
CO 3	1	-	-	1	1	2
CO 4	1	-	2	-	1	2
CO 5	1	1	-	-	2	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		
CO 6	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSEELE302				
Course Title	Industrial Electronics - Machines and Systems				
Type of Course	DSE				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	-
Pre-requisites	UK4DSEELE202				
Course Summary	Applications of power electronics with knowledge of machines and systems used in the industry				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**UPS**	**12**
	1	Online UPS, Offline UPS Types, Reliability of UPS system	
	2	Batteries for UPS System Capacity of the battery, efficiency of the battery	
	3	SMPS: types and block diagram of SMPS	
	4	High Voltage DC transmission system	
II		**Special Machines**	**12**
	5	Servo motors, AC Servo motors	
	6	Radar position control system	
	7	Stepper motors: Permanent Magnet stepper motor, Drive circuit	
	8	DC Machines, Induction Machines (Concept only)	
III		**Home Appliance**	**12**
	9	RF heating, Induction heating concept and working,	
	10	Advantage and disadvantage of induction heating, application	
	11	Application of dielectric heating, comparison	
	12	SMPS welding, electronic lamp ballast, battery charger	
	13	Emergency lighting system	
	14	Static DC/AC circuit breaker	
	15	Flasher circuit.	
IV		**Renewable Energy**	**12**
	16	Wind energy system, wind power technology, wind farms	
	17	Size of wind turbines, horizontal axis and vertical axis	
	18	Pitch and stall aerodynamic power control	
	19	Maximum power point tracking (MPPT) control	
	20	Wind Energy conversion system, power converters	

V	**Teacher specific module**		**12**
	21	Winding of Transformers	
	22	MMF distribution	
	23	Factors	

Text Book:

1. Introduction to power electronics – Denis Fewson, Pulischer Oxford University
2. Principles of electric machines – PC Sen, Publisher: John Willey and Sons
3. Practical Troubleshooting of Electrical Equipment and Control Circuits Mark Brown and Dinesh Patil, Publisher: Newnes
4. Modern Electric Vehicle Technology - C.C. Chan and K.T. Chau Bob Brand Publisher

References:

1. A text book of Electrical Technology, B L Theraja and A K Theraja, S Chand & Co Publisher.
2. Electric Vehicle Battery Systems - Sandeep Dhameja, publisher:Newnes
3. Build Your Own Electric Vehicle Seth Leitman - Bob Brant publisher

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the devices used industry and home	R, U	PSO-1,2,3
CO-2	Discuss the special type of machines and circuits in industry, home and projects	R, U, A, An	PSO-1,3
CO-3	Demonstrate the technical concept of systems used at home and industry	R, U, A, An	PSO-1,4
CO-4	Discuss the basic details of Renewable energy sources	R, U	PSO-1,5
CO-5	Demonstrate knowledge of winding transformers	R, U	PSO-1,7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Industrial Electronics - Machines and Systems
Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2,3	R,U	F, C	L	-
2	CO-2	PO-1,3,7; PSO-1,3	R, U,Ap	F, C	L	-
3	CO-3	PO-1,3,7; PSO-1,4	R, U,Ap	F, C	L	-
4	CO-4	PO-1,6 PSO-1,5	R, U	F, C	L	-
5	CO-5	PO-1,8, PSO-1,7	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO7	PO1	PO3	PO6	PO 7	PO 8
CO 1	**1**	**2**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**
CO 2	**1**	**-**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**2**	**-**
CO 3	**2**	**-**	**-**	**2**	**-**	**-**	**1**	**2**	**-**	**2**	**-**
CO 4	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**-**	**-**
CO 5	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**8**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSEELE303				
Course Title	Embedded Systems & IoT -III				
Type of Course	DSE				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	UK4DSEELE203				
Course Summary	This course exposes students to the foundations of how an operating system interacts with a computer and user computing. The fundamentals of how processes are produced and controlled using OS are covered. The course includes embedded processor ARM architecture, and numerous IoT communication protocols and technologies to familiarize learners with current IoT developments.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**REVIEW OF OPERATING SYSTEMS**		**12**
	1	Basic Principles - Operating System structures	
	2	System Calls – Files – Processes – Design and Implementation of processes – Communication between processes (concepts only)	
	3	Introduction to Distributed operating system	
	4	Issues in distributed systems states, events, clocks-Distributed scheduling-Fault& recovery.	
II	**INTRODUCTION TO ARM PROCESSORS**		
	5	A brief history of the ARM,ARM family variations	**12**

	6	ARM simplified block diagram, General purpose registers in ARM, instructions, simple programming examples.	
	7	ARM memory map-The SFR's-Program counter-Memory space allocation ,ARM CPSR	
	8	ARM pipelines and CPU evolutions ,CPU Enhancements	
III	**IoT –ARCHITECTURE**		
	9	Node Structure - Sensing, Processing, Communication, Powering, Networking – Topologies	**12**
	10	Layer/Stack architecture	
	11	IoT standards, Cloud computing for IoT	
	12	Bluetooth, Bluetooth Low Energy, beacons.	
IV	**PROTOCOLS AND WIRELESS TECHNOLOGY FOR IOT** BOOK 3		**12**
	13	**Protocols:** NFC, RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe Wired vs. Wireless communication	
	14	GSM, CDMA, LTE, GPRS	
	15	**Wireless technologies for IoT:** WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBeeSmart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems.	
V	**CASE STUDY**		
	16	Home Automation, smart cities, Smart Grid, Electric vehicle charging, Environment, Agriculture,Productivity Applications	**12**

Text books

1. Silberschatz,Galvin,Gagne, Operating System Concepts,6th ed,John Wiley,2003
2. ARM Assembly Language Programming & Architecture,Muhammad Ali Mazidi , Microdigitaled.com
3. Internet of Things: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti Universities Press 2015

References

1. Steve Furber, ARM system on chip architecture, Addision Wesley
2. Internet of things Architecture and Design Principle, Raj Kamal, MGH
3. Internet of Things. Principles and Paradigms, Rajkumar Buyya, Amir Vahid Dastjerdi, MK

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Expose the students to the fundamentals of interaction of OS with a computer and User Computation.	R,U	PSO-4,8
CO-2	Develop more understanding on the concepts of ARM Architecture, programming and analyze the function of the memory Management unit.	R, U,An	PSO-3,4,5,8
CO-3	Develop more understanding on the concepts of IOT and its present developments.	R,U,An	PSO-4,8
CO-4	Acquire knowledge about different platforms and Infrastructure for IOT.	R,U,An	PSO-4,8
CO-5	Demonstrate the art of implementing IOT for smart applications and control.	U,An,Ap	PSO-3,4,5,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Embedded Systems & IoT -III

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO6,PSO4,8	U,R	F, C	L	-
2	CO-2	PO1,PO2,PSO3,4,5,8	U,R, An	F,C,P	L	-
3	CO-3	PO1,PSO4,8	U,R	F,C	L	-
4	CO-4	PO1,PO6,PSO4,8	U,R, An	F,C, An	L	-
5	CO-5	PO1,PSO3,4,5,8	U,R, An	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO3	PSO4	PSO5	PSO8	PO1	PO2	PO6
CO 1	-	2	-	1	1	-	2
CO 2	1	2	1	1	1	1	-
CO 3	-	1	-	8	1	-	-
CO 4	-	2	-	1	1	-	1
CO 5	1	2	1	1	1	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5DSEELE304				
Course Title	Network Analysis				
Type of Course	DSE				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites					
Course Summary	This course is designed with the objective of expanding student's knowledge in network analysis beyond the basic topics. It includes advanced topics in network analysis and network synthesis concepts. This course would help students to explore more advanced concepts in the analysis of complex networks.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Network Theorems**	**12**
	1	Energy sources: Voltage and current sources - dependent sources and independent sources –	
	2	Kirchhoff's Laws (using resistance only) - KCL and KVL -Node and mesh analysis (using resistance only)	
	3	Network Theorems (using resistance only) - Superposition theorem - Thevenin's Theorem - Norton's theorems - Maximum power transfer theorem	
II		**Transient and Steady State Analysis**	**12**
	4	AC analysis of RC, RL and RLC circuits, time constant.	
	5	Laplace Transform in the Network Analysis: Initial and Final conditions	
	6	Transformed impedance and circuits	
	7	Transient analysis of RL, RC, and RLC networks with impulse and step and inputs	
III		**S -Domain analysis**	**12**
	8	The concept of complex frequency,	
	9	Network functions for the one port and two port	
	10	Poles and Zeros of network functions,	
	11	Significance of Poles and Zeros, Time domain response from pole zero plot.	

	12	Stability criteria - Routh Hurwitz Criteria	
IV	**Two Port Network**		**12**
	13	Short circuited admittance, open circuited impedance, hybrid parameters and transmission parameters. (Problems)	
V	**Resonance**		**12**
	14	Resonance: Series resonance, bandwidth, Q factor and Selectivity	

Text Books

1. Roy Choudhary, Networks and Systems, New Age International, 2/e, 2013.

2. Sudhakar and Shyam Mohan, Circuits and Networks- Analysis and Synthesis, TMH, 3/ e,2006

References

1. Van Valkenburg, Network Analysis, PHI, 3/e, 2011

2. Franklin F. Kuo, Network Analysis and Synthesis, Wiley India, 2/e, 2012.

3. Umesh Sinha, Network Analysis & Synthesis, Satya Prakashan, 7/e, 2012.

4. Ghosh, Network Theory – Analysis & Synthesis, PHI, 2013.

5. B.R.Gupta and Vandana Singhal, Fundamentals of Electrical Networks, S.Chand, 2009.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Apply various network theorems for simplifying electric circuits and networks	U, Ap	PSO-1,2
CO-2	Determine Transient and Steady state response for RL,RC and RLC circuits	An	PSO-1,4
CO-3	Apply poles and zeros to determine stability of a network.	U, Ap	PSO-1,4
CO-4	Demonstrate two port networks, parameters and analysis of two port networks.	U, Ap	PSO-1,2.4
CO-5	Discuss the concept of Resonance in Electrical networks	U	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Network Analysis

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,2; PSO-1,2	U,Ap	F, C	L	-
2	CO-2	PO-1,2; PSO-1,4	An	F, C	L	-
3	CO-3	PO-1,2; PSO-1,4	U,Ap	F, C	L	-
4	CO-4	PO-1,2; PSO-1,2.4	U, Ap	F, C	L	-
5	CO-5	PO-1,2; PSO-1,4	U	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Correlation Level

-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Mapping COs with PSOs and POs

	PSO1	PSO2	PSO 4	PO 1	PO 2
CO 1	2	2	-	1	2
CO 2	2	-	1	2	3
CO 3	1	-	2	1	2
CO 4	2	1	2	1	2
CO 5	2	1	1	2	1

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5SECELE300				
Course Title	**Solar Technology & Security Systems**				
Type of Course	SEC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	NIL				
Course Summary	The course containing the complete knowledge of solar power system and home/site security systems installations				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to solar systems**		**4**
	1	Basics of electricity: ohm's law (voltage, current & resistance), series and parallel connection, measuring instruments, dc power, ac power, energy, earthing	
	2	Basic Principles of Solar Energy Conversion, Types and Modules	
	3	Solar Cell, Absorption Air Conditioning, Need and Characteristics of Photovoltaic (PV) Systems, PV Models and Equivalent Circuits, and Sun Tracking Systems	
II	**Solar panel basics**		**6**
	5	PV System Configurations: On-grid, Off-grid, and Hybrid Systems, Solar plant with smart sensors for maximum energy harvesting	
	6	Type of PV module technology: Introduction Crystalline technology, Thin film technology Bi-facial technology	
	7	PV module parameters, efficiency of PV module	
	8	Open circuit voltage and short circuit current	
III	**Installation of Solar panel**		**8**
	9	PV System Design- Site Assessment, Measuring Area, Slope, and Azimuth	
	10	Solar Resource Analysis, System Sizing, Design, and Performance Estimation Solar Monitoring and Controls	
	11	PV System Components and Configurations- Inverters, Charge Controllers, PWM technology and MPPT Technology basics-block diagrams	
	12	Selection and sizing of AC and DC Cable	
	13	Different kinds of battery technology - Tubular, SMF, Li-ion Battery	
	14	Eating mechanism, Surge protector devices: SPDT, RCCB	

	15	String inverter Sizing Your System with PV Watts	
	16	SAST, DAST (Dual axis solar tracking system	
	17	Closed loop solar tracking system'	
IV	**Home security systems**		**6**
	18	Introduction, Basic security measures, Burglar resistant devices, Exit alarms, Locking mechanism, Types of intrusion alarm systems	
	19	Detectors, Photo electric and infrared detectors, PIR detectors, ultrasonic detectors, Proximity detectors, bridge type proximity detector.	
	20	Power failure alarms, intrusion alarms,	
V	**Security Systems**		**6**
	21	CCTV security systems, camera types, Introduction to voice recognition,	
	22	Biometrics, Biometrics architecture, commonly used biometrics methods Finger print: Face recognition system Challenges of face recognition Iris scan	
	23	Keystroke dynamics, Dynamic signature verification, Speech/voice recognition Voice recognition system Voice recognition technique	
		Practicals	30
		1. Full wave bridge circuit with filter using IC 2. Voltage regulator using LM 317 3. Regulator for battery charging 4. Stepper motor interface 5. Servo motor interface 6. Geared DC motor interface 7. PIR based security systems 8. Voltage sensor-based system 9. Current sensor-based system 10. Light sensing circuit 11. Intrusion detection using Microwave based sensor 12. Arduino based voice recognition system	

Text books

1. Security systems simplified- Steven Hampton, Paladin Press
2. An Integrated Approach to Home Security and Safety Systems- Sonali Goyal, Neera Batra: CRC Press, Year: 2021

Reference Books:

1. Khan, Non-Conventional Energy Sources, Tata McGraw Hill.
2. Sukhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill.
3. Boyle, Renewable Energy: Power for a Sustainable Future, Oxford.
4. Kothari, Singal and Ranjan, Renewable Energy Sources and Emerging Technologies, PHI.
5. Jayakumar, Solar Energy Resource Assessment Handbook (2009).
6. Balfour, Shaw and Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basics of solar power systems	R, U	PSO-1,4
CO-2	Understand the basic concept of solar panels	R, U,A	PSO-1,3
CO-3	Get the complete knowledge of solar power system installation	R, U,A,C	PSO-1,3,7
CO-4	Get the basic details of home security systems	R, U	PSO-1,4,7
CO-5	Get the advanced knowledge and application home security system	R, U,A	PSO-1,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Solar Technology & Security Systems

Credits:2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,4 PSO-1,4	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,3	R, U	F, C	L	P
3	CO-3	PO-1,7; PSO-1,3,7	R, U	F, C	L	P
4	CO-4	PO-1,7,8: PSO-1,4,7	R, U, Ap	F, C	L	P
5	CO-5	PO-1,8, PSO-1,4,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Correlation Levels

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Mapping COs with PSOs and POs

	PSO1	PSO3	PSO4	PSO7	PSO 8	PO1	PO4	PO3	PO 7	PO 8
CO 1	**1**	**-**	**3**	**-**	**-**	**1**	**1**	**-**	**-**	**-**
CO 2	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**
CO 3	**1**	**1**	**-**	**2**	**-**	**1**	**-**	**-**	**1**	**-**
CO 4	**1**	**-**	**3**	**2**	**-**	**1**	**-**	**-**	**1**	**2**
CO 5	**1**	**-**	**1**	**-**	**2**	**1**	**-**	**-**	**-**	**1**

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK5SECELE301				
Course Title	Disaster management				
Type of Course	SEC				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2	4
Pre-requisites	Nil				
Course Summary	The course is intended to provide a general concept to technicians/ scientists/engineers of tomorrow, in the dimensions of disasters caused by nature and human activities with emphasis on disaster preparedness, response and recovery. This course will provide basic conceptual understanding of disasters, approaches of Disaster Management and to build skills to respond to disaster. This course will help to develop initial capacity in disaster risk reduction in professionals and Suggest strategies for dealing with disasters.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Module 1 Concepts of disaster**		**6**
	1	Introduction on Disaster	
	2	Natural Disasters	
	3	Man-made Disasters	
	4	Causes, effects and practical examples for all disasters.	
	(conceptual framework for all the topics)		
II	**Module 2 Risk and Vulnerability Analysis**		**6**
	5	Risk and Vulnerability	
	6	Development for Vulnerability Reduction	
	7	Disaster Preparedness	
	8	Role of Information, Education, Communication, and Training.	
	9	Role of Government, International and NGO Bodies.	
	10	Role of Engineers on Disaster Management.	
	(Conceptual framework only of all the topics)		
III	**Module 3: Consequences and impact of disasters**		**6**
	11	Flood	
	12	Cyclones	
	13	Tsunamis	
	14	Earthquakes and landslides	
	15	Volcanic eruption	

	16	Desertification	
	17	Drought and salinity ingress	
	(Conceptual framework only of all the topics)		
IV	**Module 4: Role of Information Technology in Disasters**		**6**
	18	Disaster management Information System	
	19	Role of Communication in Disasters	
	20	Types of communication in case of disasters	
	22	HAM radio, Satellite, Video Conferencing and Electronics devices	
V	**Module 5: Rehabilitation and Reconstruction**		**6**
	22	Damage Assessment	
	23	Post Disaster effects and Remedial Measures	
	24	Creation of Long-term Job Opportunities	
	25	Long-term Counter Disaster Planning	
	26	Role of Educational Institute	
		(Conceptual framework only of all the topics)	
		PRACTICAL	**30**
		1. CPR 2. Soil quality measurement 3. Gas and air quality measurement 4. Experiment for smoke and fire modelling 5. Study and comparison of personal protective equipment 6. Study on the method of refilling of different portable extinguishers-Water, DCP and Foam based 7. Application of BIM (Building Information Modelling) software for designing and drafting building fire protection systems 8. Study and demonstrate different types of knots, bend and hitches used in fire fighting and disaster management 9. Communication and Early Warning Systems in Disaster Management 10. Training/Field Visits to Disaster Sites/Vulnerable Areas/ DM Centres/Institutes & Presentation (3 to 5 Days) 11. Sanitation and Hygiene 12. Students should prepare a Disaster Response Plan (Any type)	

Text Books

1.Dr. Mrinalini Pandey Disaster Management Wiley India Pvt. Ltd.
2.Tushar Bhattacharya Disaster Science and Management McGraw Hill Education (India) Pvt. Ltd.
3. Shailesh Shukla, Shamna Hussain Biodiversity, Environment and Disaster Management, Unique Publications

4. Jagbir Singh, Disaster Management: Future Challenges and Opportunities K W Publishers Pvt. Ltd
5. Mukta Girdhar, Natural Disasters, Amy publication, Dariyaganj, New Delhi, 2019.

Texts for reference

1. David Alexander, "Natural Disasters", Research Press, New Delhi, 1993
2. Nick Carter. W., "Disaster Management - A Disaster Manager's Handbook". Asian Development Bank, Philippines. 1991.
3. Andharia J. Vulnerability in Disaster Discourse, JTCDM, Tata Institute of Social SciencesWorking Paper No. 8, 2008.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the need and significance of studying disaster management	U	PSO-5
CO-2	Apply and practice disaster risk reduction activities according to the nature of disasters.	Ap	PSO-5,6
CO-3	Discuss the impact of Disasters on environment	An	PSO-6, 7,8
CO-4	Demonstrate the role of Information Technology in Disaster Management	U, An	PSO -6,7
CO-5	Identify ideas for developing start-ups and different steps in establishing a business	C	PSO-8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Disaster management

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial L	Practical (P)
1	CO1	PO-1	U	C	L	-
2	CO2	PO-4	Ap	F	L	P
3	CO3	PO-2	An	C	L	P
4	CO4	PO-2	U, An	F, C	L	P

5	CO5	PO-5	C	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO5	**PSO6**	**PSO7**	**PSO8**	**PO1**	**PO2**	**PO4**	**PO5**
CO 1	1	-	-	-	1	-	-	-
CO 2	1	2	-	-	-	-	1	-
CO 3	-	1	1	1	-	1	-	-
CO 4	-	1	1	-	-	1	-	-
CO 5	-	-	-	2	-	-	-	-

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSCELE300				
Course Title	LINEAR INTEGRATED CIRCUITS				
Type of Course	DSC				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites					
Course Summary	The course covers the fundamentals of Operational Amplifiers (OP-AMP) and their applications in electronic circuits. It includes the study of OP-AMP characteristics, basic amplifier circuits, filters, waveform generators, voltage regulators, and various OP-AMP applications. Practical sessions include hands-on experience with OP-AMP circuits such as amplifiers, oscillators, and multivibrators using IC 741 and 555 Timer. Students will gain a comprehensive understanding of OP-AMP theory and practical applications, preparing them for real-world electronic circuit design and analysis.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to OP- AMP**	**9**
	1	Basic Differential Amplifier Circuit	
	2	Operational Amplifiers: block diagram-ideal characteristics-Op amp Parameters-	
	3	Inverting and Non-Inverting Amplifier-Voltage Follower- Summing Amplifier- Differential Amplifier-Instrumentation Amplifier	
	4	Integrator-Differentiator-Typical circuits-Applications.	
		Filters and waveform generators	**9**

II	5	Active filters: Introduction – Low pass, High pass, Band pass, Band Reject, and Notch Filters – Typical circuits.	
	6	Waveform generators: sine wave oscillators- Wien Bridge Oscillator	
	7	Multivibrators (astable and monostable)	
	8	Introduction to Timer-Monostable and Astable Multivibrator using 555.	
III	**Voltage Regulators**		**9**
	9	Basic circuit configuration and characteristics of voltage regulators	
	10	Basic blocks of linear voltage regulator	
	11	Three terminal fixed regulators,	
	12	Variable voltage Regulators (723)	
	13	Introduction to switching regulators (SMPS)	
IV	**Applications of OP-AMP**		**9**
	14	Basic comparator – Characteristics -Typical comparator circuits using op amp	
	15	zero crossing detector	
	16	Window detector.	
	17	Precision Rectifiers (half wave and full wave).	
	18	PLL – block diagram, operating principle, applications	
V	**Converters**		**9**
	19	ADC characteristics, Counter ramp and Successive approximation ADC.	
	20	DAC characteristics, Weighted resistor and R- 2R DAC	
	PRACTICALS		**30**
		1. OPAMP – Non inverting & inverting Amplifier using IC 741 2. Adder & subtractor using IC 741 3. RC phase shift oscillator using IC 741 - design, output waveform 4. Astable Multivibrator using IC 741 - design, output waveform. 5.Mono stable Multivibrator using IC 741 - design, output waveform. 6. Schmitt trigger using IC 741 - design, output waveform. 7. Timer IC 555 – Astable Multivibrator - design, output waveform. 8. Integrators & Differentiators using IC 741- design, waveforms. 9. Precision rectifiers (Half wave & Full wave) using IC 741	

Text Books

1. Gayakwad , Op-Amps and Linear Integrated Circuits , PHI,4/e.2013.
2. Roy Chowdhary, Linear Integrated Circuits, New Age International, 2/e, 2010.

Texts for reference

1. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, TMH, 3/e, 2008 .
2. Botkar, Integrated Circuits, Khanna Publishers,9/e,2003.
3. George Clayton & Steve Winder, Operational Amplifiers, Elsevier.
4. Salivahanan and Kanchana Bhaskaran, Linear Integrated Circuits, TMH, 2008.
5. Electronics Lab Manual, VOL-2,Fifth Edition, K A Navas

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Infer the characteristics of operational amplifiers and its effect on output and their compensation techniques.	U, Ap	PSO-1,2
CO-2	Elucidate and design the linear and no linear applications of an opamp and special application ICs	U, Ap, An	PSO 2,3
CO-3	Explain and compare the working of multi vibrators using special application IC 555 and general-purpose op-amp.	Ap, An	PSO 5
CO-4	Discuss the concept of voltage regulators and design a simple regulator circuit using special IC ‘s	U, Ap	PSO 1
CO-5	Apply the concept of active filters, analyze its frequency response and design of simple first order butterworth filters	U, An, Ap	PSO 1

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: LINEAR INTEGRATED CIRCUITS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO 3	U, Ap	C,P	L	P
2	CO-2	PO 1	U, Ap, An	C,P	L	P
3	CO-3	PO 5	Ap, An	C,P	L	P
4	CO-4	PO 1	U, Ap	C,P	L	P
5	CO-5	PO 1,2	U, An, Ap	C,P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO5	PO1	PO2	PO3	PO5
CO 1	1	1	-	-	-	-	1	-
CO 2	-	2	1	-	2	-	-	-
CO 3	-	-	-	1	-	-	-	1
CO 4	2	-	-	-	1	-	-	-
CO 5	1	-	-	-	1	1	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSCELE301				
Course Title	BIOMEDICAL ENGINEERING				
Type of Course	DSC				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 Hours	-		4 Hours
Pre-requisites	.				
Course Summary	The Biomedical Engineering course explains the application of engineering principles to solve health and health care problems. The course is having an introduction of different biomedical equipment and its principle of working.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Human Physiological Systems & Bio Potential Electrodes and Transducers**	**12**
	1	Introduction, Cells and their structure, the human cell, cell as a bioelectric generator	
	2	Transport of ions through the cell membrane, the excitable cell, resting and action potential	
	3	Propagation of action potentials	
	4	Design criteria of medical instruments, components of the bio-medical instrument system	
II		**Bio Potential Recorders**	**12**
	5	Characteristics of a recording system, writer and pen damping effects	
	6	The ECG Amplifier, basic characteristics of ECG recorder, Electrocardiography, Lead systems for recording ECG,	
	7	Brief introduction to Electroencephalography; Electromyography (basic theory only).	
III		**Radio diagnosis and Imaging Systems**	**12**
	8	Principles of medical imaging, X-ray, CT Scan, Ultrasound, MRI (Machine block diagram explanation only)	

	9	Brief introduction to thermography and thermal imaging (basic theory only).	
	10	Operation Theatre Equipment (I) Introduction, Pacemakers and their pacing modes, ventilators & defibrillators	
	11	Diathermy- short wave, microwave and ultrasonic types	
	12	Therapeutic effect of heat.	
IV			**12**
	13	Introduction to electrical safety, Radiation safety instrumentation	
	14	Physiological effects due to 50Hz current passage, Micro current and Macro current shocks and their hazards	
	15	Devices to protect against electrical hazards (basic theory only).	
V			**12**
	16	Electromyography (EMG) – Recording setup, Determination of conducting velocities in motor nerves.	
	17	Electro retinography (ERG) and Electrooculography (EOG)	
	18	Kidney Machine – Renal function, Dialysis, Haemodialysis, Peritoneal Dialysis	
	19	Infant Incubator	

Text Books

1. Arumugam, M, Biomedical Instrumentation, Anuradha Agencies, Chennai, 2009
2. L. Cromwell, F. J. Weibell, and L. A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education, Delhi, 1990
3. J. J. Carr and J. M. Brown, *I*ntroduction to Biomedical Equipment Technology, 4th ed., Pearson Education, Delhi, 2001

Reference books

1. J. G. Webster, Medical Instrumentation Application and Design, 3rd ed., John Wiley & Sons,N.Y., 1998
2. R. S. Khandpur, Handbook of Biomedical Instrumentation, 2nd ed., Tata McGraw Hill, New Delhi
3. Agrawal, A, Modern Diagnostics, National Book Trust, India, 2001

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basic knowledge of physiology.	U	PSO7
CO-2	Explore the occurrence of potential and operation of cardiovascular measurements	,U An	PSO2
CO-3	Understand the basic knowledge on respiratory and Pulmonary measurements.	U, An, E	PSO8
CO-4	Describe the methods used for monitoring the Patients.	U, Ap	PSO4
CO-5	Explain the working of different biomedical equipments	U, An	PSO7

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture(L)/ Tutorial (T)	Practical (P)
1	CO 1	PO5	U	F,C	L	-
2	CO2	PO3,5	U, An	F,C,P	L	-
3	CO3	PO1,2	U ,An ,E	F,C	L	-
4	CO4	PO1,2	U, Ap	F,C,P	L	-
5	CO5	PO2,8	U, An	F,C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Note: 1 or 2 COs/module

Name of the Course: LINEAR INTEGRATED CIRCUITS

Credits: 3:0:1 (Lecture: Tutorial: Practical)

Mapping of COs with PSOs and POs:

	PSO2	PSO4	PSO7	PSO8	PO1	PO2	PO3	PO5	PO8
CO 1	-	-	2	-	-	-	-	2	1
CO 2	1	2	-	-	-	-	2	1	-
CO 3	-	-	-	2	1	2	-	-	-
CO 4	-	2	-	-	2	1	-	-	-
CO 5	-	-	1	-	-	1	-	-	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	-	-	✓
CO 2	✓	-	-	✓
CO 3	✓	✓	-	✓
CO 4		-	-	✓
CO 5	✓	✓	-	✓

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSCELE302				
Course Title	DIGITAL SIGNAL PROCESSING				
Type of Course	**DSC**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	NIL				
Course Summary	This course provides a comprehensive understanding of Signals and Systems, focusing on discrete-time signals and systems, Fourier Transform, Digital Signal Processing (DSP) systems, and realization techniques for both Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) systems. Students will delve into topics such as Discrete Fourier Transform (DFT) and its properties, Circular Convolution, and the Fast Fourier Transform (FFT) algorithms. The course also covers filter design concepts, comparing analog and digital filters, and practical methods for designing IIR and FIR filters. By the end of the course, students will have the knowledge and skills to analyze and design digital signal processing systems and filters effectively.				

Detailed Syllabus:

Module	Unit	Content	Hrs
	Signals and Systems		**12**
	1	Discrete Time Signals and Systems	
	2	Elementary of Discrete Time Signals, Discrete sequences	

I	3	Discrete Systems and their classifications and properties.	
	4	Digital Signal Processing Systems: Block Diagram - Applications – Advantages - Limitations.	
II		**Realisation of Systems**	**12**
	5	Realization of IIR and FIR systems : Block Diagram representation of LTI systems	
	6	Realization of IIR systems - Direct form I, Direct form II	
	7	Cascade representation and Parallel representation.	
	8	Realization of FIR systems - Direct form representation and Cascade representation.	
III		**DFT and IDFT**	**12**
	9	Discrete Fourier Transform: Properties of DFT- Periodicity, Linearity, Time Reversal	
	10	Time Shifted sequences, Circular Convolution	
	11	Computation of DFT	
	12	Circular Convolution using DFT-IDFT method	
	13	Circular Convolution using the Graphical method.	
	14	Inverse Discrete Fourier Transform (IDFT)	
	15	Computation of IDFT.	
IV		**FFT**	**12**
	16	Fast Fourier Transform : Introduction - FFT Algorithms(Radix 2 only)	
	17	Signal flow graph for 8-point DIT radix-2 FFT(Butterfly Diagram)	
	18	Computation of 8 point DFT using radix-2 DIT-FFT	
	19	Signal flow graph for 8-point DIF radix-2 FFT	
	20	Computation of 8 point DFT using radix-2 DIF-FFT.	
		Filters	**12**
	21	Filters : Comparison between Analog and Digital filters	
	22	Design of analog Butterworth Low Pass Filters	

V	23	Comparison between FIR and IIR filters	
	24	IIR Filter Design by Impulse Invariance,	
	25	Bilinear Transformation	
	26	General study of FIR filter design(comparison study only).	

Text book:

1.Digital signal processing – A. Nagoor kani ,RBA publications.
2. Digital signal processing – Anand kumar ,PHI Publications.

Texts for reference

1. Digital signal processing – Salivahan,vallavaraj and gnanapriya ,TMH Publications.
3. Digital Signal Processing – Rabiner & Gold, PHI
4. Digital Signal Procesing – Oppenheim & Ronald W Schafer, PHI

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss discrete-time signals and systems, Fourier transform, and digital signal processing applications	U	PSO 1,2
CO-2	Realise IIR and FIR systems using block diagrams	Ap	PSO 3,4
CO-3	Apply Discrete Fourier Transform and circular convolution	Ap	PSO 3,4,5
CO-4	Implement FFT algorithms	Ap	PSO 3,4,5
CO-5	Design analog and digital filters	Ap	PSO 4,5,6

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Digital Signal Processing

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO 1,2	R,U	C	L	-
2	CO-2	PO 2,3	Ap	P	L	-
3	CO-3	PO 3	Ap	P	L	-
4	CO-4	PO 3,6	Ap	P	L	-
5	CO-5	PO 1,4,6	Ap	C, P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO6
CO 1	2	1	-	-	-	-	2	1	-	-	-
CO 2	-	-	2	1	-	-	-	2	1	-	-
CO 3	-	-	2	1	1	-	-	-	2	-	-
CO 4	-	-	2	1	1	-	-	-	1	-	2
CO 5	-	-	-	1	1	1	1	-	-	1	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSE ELE 300				
Course Title	NANO ELECTRONICS				
Type of Course	DSE				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites	UK4DSEELE201				
Course Summary	The NanoElectronics course delivers an idea in the field of nanotechnology for electronic components and research on improvements of electronics such as display, size, and power consumption of the device for practical use. This includes research on memory chips and surface physical modifications on electronic devices. The course covers the characterization of materials ,Nano electronics applications, Nano devices and the process of Nanolithography.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction and Fabrication of Nanomaterials**		**12**
	1	Introduction to Nanoelectronics	
	2	Impacts, Limitations of conventional Microelectronics.	
	3	Introduction to methods of fabrication of nano materials- grinding with iron balls, sol gel,	
	4	Fabrication of nano-layers - PVD, CVD, laser ablation, Ion Implantation.	
II	**Classification production and Applications of nano materials**		**12**
	5	Nano Materials-carbon nano materials, nano tubes and nano wires, types of nano tubes and nano wires,	
	6	Production of nano tubes and nano wires, properties and applications of nano tubes and nano wires,	
	7	Graphene, Quantum wells, wires and dots(Qualitative)	
III	**Characterization Of Nano materials**		**12**
	8	Introduction to characterization tools of nano materials	
	9	Principle and working of STM, AFM, SEM, TEM, XRD, PL, IR	
	10	Raman & UV spectroscopy	
IV	**Nano devices**		**12**
	11	Semiconductor Nano devices: Single Electron devices- Nano scale MOSFET , Resonant Tunnelling Transistor – Single Electron Transistors	
	12	Nano robotics and Nano manipulation	

	13	Mechanical Molecular Nano devices – MEMS-NEMS	
V	**Nanolithography**		**12**
	14	Clean room classifications –Nanostructures and devices fabricated by physical techniques –photolithography – positive and negative photoresists – photo mask and mask aligner	
	15	Steps involved in photolithography ,nanolithography – soft lithography – micro contact printing – dip-pen nano lithograph	
	16	Assembly of nanostructures - self-assembly - molecular self-assembly in solutions – self-assembly of nanoparticles	

Text Books

1. B Premlet, Nanoelectronics, Phasor books
2. M. Madou – Fundamentals of Micro fabrication & Nanofabrication, CRC Press LLC, 2002.
3. Jose Maria De Teresa -Nanofabrication IOP Science 2020
4. Chris Mack - Fundamentals Principles of Optical Lithography, The Science of Micro fabrication ,Wiley

References

1. J.M. Martinez-Duart, R J Martin Palma & F Agulle Rueda, Nanotechnology for Microelectronics and Optoelectronics, Elsevier, 2006.
2. T Pradeep, NANO: The Essentials-Understanding Nanoscience and Nanotechnology‖ McGraw-Hill.
3. Poole, Introduction to Nanotechnology, John Wiley, 2006.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Describe the principles of Nano electronics and the processes involved in making Nano components and material.	U	PSO1
CO-2	Explain the advantages of the Nano-materials and appropriate use in solving practical problems.	R, U	PSO1
CO-3	Explain the various aspects of Nano-technology and the processes involved in makingNano components and material.	U, R, Ap,	PSO 7
CO-4	Analyze various techniques for characterizing Nano materials.	U, An,	PSO 8
CO-5	Demonstrate the process of Nanolithography and the steps of photolithography.	U,E,C	PSO 8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Nano Electronics

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO1	PO2	U	F,C	L	-
2	CO2	PO5,6	R,U	F,C	L	-
3	CO3	PO5,6	U,R, Ap	F,C	L	-
4	CO4	PO3,5	U, An,	F,C	L	-
5	CO5	PO3,8	U,E,C	F,C,P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO7	PSO8	PO2	PO3	PO5	PO6	PO8
CO 1	2	-	-	1	-	-	-	-
CO 2	2	-	-	-	-	1	2	-
CO 3	-	2	-	-	-	1	1	-
CO 4	-	-	1		1	2	-	-
CO 5	-	-	1	-	2	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	-	-	✓
CO 2	✓	-	-	✓
CO 3	✓	-	-	✓
CO 4	✓	✓	-	✓
CO 5	✓	✓	-	-

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSEELE301				
Course Title	INDUSTRIAL ROBOTICS				
Type of Course	DSE				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	UK5DSEELE302				
Course Summary	The course enables the learner to acquire knowledge on Robotics and its mechanics				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Robot anatomy and Kinematics**	**12**
	1	configuration of robots, joint notation schemes, work volume,	
	2	introduction to manipulator kinematics	
	3	position representation, forward and reverse transformations of a 2-DOF arm, a 3- DOF arm in two dimension	
	4	homogeneous transformations in robot kinematics, D-H notations	
	5	solving kinematics equations, introduction to robot arm dynamics	
II		**Basic control system models**	**12**
	6	slew motion, joint – interpolated motion and straight line motion, controllers like on/off, proportional , integral, proportional plus integral, proportional plus derivative, proportional plus integral plus derivative,	
	7	Robot trajectories	
	8	2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation.	
III		**Robot motion control**	**12**
	9	Robot motion planning-path planning-Geometric path, Obstacle avoidance-Shortest path, Trajectory planning-Boundary conditions	
	10	Basic robot motions - Point to point control & continuous path control and interpolations	
IV		**Robot cell layouts**	**12**
	11	Robot cell layouts	
	12	multiple robots and machine interface,	

		other considerations in work cell design, work cell control, interlocks, error detection and recovery, work cell controller	
V	**Robot Programming and AI**		**12**
	13	Methods - Languages - Computer control and Robot Software -VAL Language	
	14	AI & Robotics	

Textbooks

1. Fu, K.S., Gonzalez, R.C. and Lee C.S.G. – 'Robotics: Control, Sensing, Vision, and Intelligence' – McGraw Hill, New York, NY – 1987

References

1. R K Mittal and I J Nagrath, 'Robotics and Control', Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.
2. J Craig, 'Introduction to Robotics: Mechanics and Control', Addison-Wesley, Reading, MA, 1989 (second edition).

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss robot notation and position representation	U	1,2
CO-2	Analyse robot kinematics and apply kinematics equations	R, U	1,2
CO-3	Identify basic control system models and transformations	U	1,4
CO-4	Analyse robot motion control	An	1,3
CO-5	Demonstrate robot programming languages	U	1,2
CO-6	Apply AI in robotics	Ap	1,2

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: INDUSTRIAL ROBOTICS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,2; PSO-1,2	U	F,C	L	-
2	CO-2	PO-1,2; PSO-1,2	R, U	F,C	L	-
3	CO-3	PO-1,2; PSO-1,4	U	F,C	L	-
4	CO-4	PO-1,2; PSO-1,3	An	F,C	L	-
5	CO-5	PO-1,2; PSO-1,2	U	F,C	L	-
6	CO-6	PO-1,2; PSO-1,2	Ap	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PO1	PO2
CO 1	1	1	-	-	1	1
CO 2	2	3	-	-	1	3
CO 3	1	-	-	2	1	1
CO 4	1	-	2	-	2	3
CO 5	2	1	-	-	3	4
CO 6	1	2	-	-	1	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6	✓			

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSEELE302				
Course Title	SMART SOLAR POWER SYSTEMS & ELECTRIC VEHICLES				
Type of Course	DSE				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	UK5DSEELE302				
Course Summary	Getting the advanced technical knowledge in solar, EV and entrepreneurship skills inherently while studying the course				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Solar Power Systems**	**10**
	1	Application of Solar Energy Basic components of PV system	
	2	Solar Radiation Geometry	
	3	Solar power prediction System	
	4	Simplified block diagram of Solar system	
II		**Components of Solar power systems**	**12**
	5	Conventional Techniques for MPPT. Solar Energy, MPPT for solar charge controller	
	6	Hybrid based MPPT, AI based MPPT, fuzzy logic control	
	7	Comparison of string inverter vs microinverter, Modeling of MJSC-Based PV System	
	8	Trouble shooting PV system	
III		**EV &AI**	**14**
	9	EV system EV configurations EV parameters, concept EV motors	
	10	HEV system HEV configurations Power flow control	
	11	Chassis and Design of EV: Optimising your EV, Conventions and formulas, Weight factors in EV	
	12	Closed loop model for BLDC motor. PID control,	
	13	Artificial Neural Network-Based Controller	
	14	BLDC Motor Speed Controller With ANN-Based PID Controller	
	15	ANN-Based on PID Controller Advantages of Artificial Intelligence in Electric Vehicle	
IV		**Intelligent Hybrid BMS**	**12**
	16	Energy Storage System (ESS):Li-Ion Battery, Ultra capacitors	
	17	Need for BMS, BMS Components: Architecture, Cell balancing, logic and safety control	

	18	Intelligent Battery Management System, IoT-Based Battery Monitoring System,	
	19	Rule based control, Optimization based control, AI based control, Traffic based control	
	20	Battery Pack Safety, Charging Station, Coupling types, EV component test	
V	**Design considerations of EV**		**12**
	21	Proposed Design Considerations of PMSM for Electric Vehicle	
	22	Fuel Economy, Emissions, and Electric Mileage Calculation	

Text Book:

1. Security systems simplified- Steven Hampton, Steven Hampton.Paladin Press.
2. An Integrated Approach to Home Security and Safety Systems- Sonali Goyal, Neera Batra: CRC Press, Year: 2021

Reference Books:

1. Khan, Non-Conventional Energy Sources, Tata McGraw Hill.
2. Sukhatme and Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw Hill.
3. Boyle, Renewable Energy: Power for a Sustainable Future, Oxford.
4. Kothari, Singal and Ranjan, Renewable Energy Sources and Emerging Technologies, PHI.
5. Jayakumar, Solar Energy Resource Assessment Handbook (2009).
6. Balfour, Shaw and Jarosek, Photovoltaics, Lawrence J Goodrich (USA).

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Understand the basic knowledge and estimate solar power system and its installations	R, U	PSO-1,2
CO-2	Understand and calculate the solar power system components and create power system installations	R, U, A, C	PSO-1,3
CO-3	Acquiring the basic and advanced knowledge of electric vehicles and getting the application of AI in the EV	R, U, A, An	PSO-1,3,4
CO-4	Create Intelligent algorithms for Electric vehicles	R, U, An, C	PSO-1,4,7,8
CO-5	Demonstrate and analyses the systems	R, U,E	PSO-1,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: SMART SOLAR POWER SYSTEMS & ELECTRIC VEHICLES

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,3	R, U	F, C	L	-
3	CO-3	PO-1,7; PSO-1,3,4	R, U	F, C	L	-
4	CO-4	PO-1,7:PSO-1,4,7,8	R, U, Ap	F, C	L	-
5	CO-5	PO-1,8, PSO-1,4,8	R, U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO8	PO1	PO3	PO7	PO8
CO 1	1	2	-	-	-	-	1	1	-	-
CO 2	1	-	2	-	-	-	1	1	-	-
CO 3	1	-	2	3	-	-	1	-	1	-
CO 4	1	-	-	2	2	2	1	-	1	-
CO 5	1	-	-	2	-	2	1	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓	✓		✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSEELE303				
Course Title	Embedded Systems & IOT - IV				
Type of Course	DSE				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites	UK5DSEELE303				
Course Summary	Introduces students to the principles of Python embedded programming. The course covers the idea of using Raspberry Pi to construct Internet of Things applications and embedded systems in automobiles.				

Detailed Syllabus

Module	Unit	Content	Hrs
I		**EMBEDDED PROGRAMMING USING PYTHON**	**15**
	1	Python Programming, Writing Python Programs, typical structure of a Python program	
	2	Variables and Constants, Data types, operators, lists, tuples,	
	3	Decision and Control Statements-**if** statement, **else** statement, **elseif** statement ,**for** loop, while loop	
	4	Functions, object-oriented programming, Running a python program	
	5	LED blinking using Circuit Python , pushbutton in a pull-up circuit, reading the potentiometer values using Circuit Python, temperature sensor interfacing,	
	6	UART programming,I2C Programming, dc motor control ,servo motor control	
II		**AUTOMOTIVE EMBEDDED SYSTEM**	**10**
	7	Concept for electronic engine controls and management-Standards	
	6	Automobile sensors-volumetric, thermal, air-fuel ratio, solenoid ,hall effect-exhaust gas oxygen sensors,	
	7	Advantages of using Electronic engine controls – open and closed loop fuel control; Block diagram of Electronic ignition system and Architecture of a EMS with multi point fuel injection system, Direct injection; programmed ignition- actuators interface to the ECU	
	8	Starter motors and circuits - sensors interface to the ECU. Actuators and their characteristics – exhaust gas recirculation	
III		**Raspberry Pi**	**13**
	9	Raspberry Pi: About the board, Linux on Raspberry	
	10	Booting Raspberry Pi 3, Downloading an Operating System, format an SD card and booting the OS	
	11	Basics of Linux and its use, main features including navigating the file system and managing processes, text based user interface through the shell,	

	12	Overview of the graphic user interface for Raspian Linux distribution.	
IV	**IOT & CLOUD COMPUTING**		**10**
	13	IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs	
	14	Webserver – Web server for IoT, Cloud for IoT, Python web application framework.	
	15	Designing a RESTful web API. Connecting to APIs	
V	**IoT Design using Raspberry Pi**		**12**
	15	IoT Applications based on Pi, LAMP Web-server, GPIO Control over Web Browser	
	16	Creating Custom Web Page for LAMP, communicating data using on-board module	
	17	Home automation using Pi, Node-RED, MQTT Protocol, Using Node-RED Visual Editor on Rpi	

Books for study

1. Programming Microcontrollers with Python, Armstrong Subero , Apress
2. Understanding Automotive Electronics, William Ribbens,6th edn,Elsevier
3. "Programming the Raspberry Pi: Getting Started with Python", Simon Monk, McGraw Hill Professional
4. Internet of Things: A Hands-On Approach" by Arshdeep Bahga and Vijay Madisetti Universities Press 2015

References

1. Christian Hill, Learning Scientific Programming with Python, CAMBRIDGE UNIVERSITYPRESS ,2016.,
2. Ali Emedi, Mehrded ehsani, John M Miller , "Vehicular Electric power system- land, Sea, Airand Space Vehicles" Marcel Decker, 2004.
3. L.Vlacic,M. Parent,F.Harahima,"Intelligent Vehicl Technologies",SAE International,2001.
4. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discover how to use Python to program a microcontroller.	U, Ap	PSO-1,2,4,8
CO-2	Describe the applications of embedded systems in automobiles	U,R	PSO-1,2,4
CO-3	Distinguish the raspberry pi and its configuration	U,R	PSO-1,2,4
CO-4	Describe the use of cloud computing and its use in IOT	U,R,E	PSO-2,3,4
CO-5	Design IOT using Raspberry PI	Ap,C	PSO-1,3,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Embedded Systems & IOT – IV

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO1,6	R, U, An	F, P	L	-
2	CO-2	PO1,6	R, U	F, C	L	-
3	CO-3	PO1,6	R, U, Ap	F, C,P	L	-
4	CO-4	PO1,2	R, U, Ap	F, C,P	L	-
5	CO-5	PO1,2	U, An	F, P	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs

	PSO1	PSO2	PSO3	PSO4	PSO8	PO1	PO2	PO6
CO 1	2	2	-	2	2	1	-	1
CO 2	1	1	-	2	-	1	-	2
CO 3	1	2	-	1	-	1	-	1
CO 4	-	2	2	1	-	1	1	-
CO 5	3	-	2	2	2	1	2	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6DSEELE304				
Course Title	ADVANCED COMMUNICATION SYSTEMS				
Type of Course	DSE				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4
Pre-requisites	NIL				
Course Summary	An advanced communication systems course delves into the theoretical foundations and practical applications of digital communication systems, forming the backbone for advanced wireless technologies. It covers core concepts like waveform and channel coding, baseband and passband communication, modulation and demodulation techniques, and the analysis of modern communication systems. This knowledge equips students to understand the trade-offs, limitations, and design principles behind real-world communication systems, preparing them for further studies and careers in areas like 5G and beyond, network design, and communication system analysis.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Spread Spectrum**	**12**
	1	Spread Spectrum modulation – Principle of spread spectrum modulation	
	2	Pseudo Noise Sequences -Generation of PN sequence- Concept of jamming - Avoidance of jamming	
	3	Direct sequence Spread Spectrum – Block diagram of DSSS transmitter and receiver	
	4	Frequency hopping spread spectrum- Block diagram of FHSS transmitter and receiver. Advantages of spread spectrum modulation	
II		**Satellite Communication**	**12**
	5	Satellite communication: Kepler's law, satellite orbits concept of geo-stationary satellite, frequency bands used	
	6	Earth station transmitter & receiver (block diagram) and transponder	
	7	RADAR (basic block diagram and types).	
III		**Microwaves**	**12**
	8	Introduction to Microwaves: Microwave frequency and band designation, advantages, and applications	
	9	Waveguides, Types of waveguides	
	10	Waveguide couplings, Bends and Corners, Taper and Twists, T junctions, Magic Tees	

	11	Directional Couplers, Isolators, Circulators	
	12	Microwave Tubes: Two cavity Klystron -operation-performance characteristics, applications (mathematical analysis not required)	
IV	**Klystron and Magnetron**		**12**
	13	Reflex klystron- construction-operation-operating characteristics (mathematical analysis not required).	
	14	Magnetrons- cavity magnetron-operation (mathematical analysis not required)- performance characteristics and applications.	
	15	Transferred electron devices. Gunn diode-operation, performance characteristics and applications, Varactor diodes.	
V	**Wireless Technologies**		**12**
	16	Wi-Fi, WiMAX (basic concepts only)	
	17	Bluetooth, NFC, 4G, LTE ,5G (basic concepts only)	
	18	RFID, Zigbee, LoRa (basic concepts only)	

Textbooks

1. Simon Haykin, Communication systems, 4/e, John-Wiley & sons.
2. Theodore S Rappaport and R Michael Buehrer, Wireless Communication -Principles and Practice
3. Microwave and Radar Engineering, Dr. M. Kulkarni, 5th Edition, Umesh Publications, Delhi.
4. Wayne Tomasi: Advanced Electronic Communication systems-PHI,4th edition

Reference

1. Bernard Sklar, Digital Communication, 2/e, Pearson Education, 2001.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Explain spread spectrum techniques. Classification of different spread spectrum techniques	U, An	PSO-1,2,6
CO-2	Classify satellite communication	R, U, An	PSO-1,2,
CO-3	Discuss the operation of various microwave devices	U	PSO-1,5
CO-4	Analyse the working of various microwave amplifier and oscillator	U	PSO-3,6
C0-5	Identify different wireless networking standards	U	PSO-1,5

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: ADVANCED COMMUNICATION SYSTEMS

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1,2,6	U, An	F, C	L	-
2	CO-2	PO-1,3,4	R, U, An	F, C	L	-
3	CO-3	PO-1,4	U	F,C	L	-
4	CO-4	PO-1,2	U	F, C	L	-
5	CO-5	PO-1,3	U	F, C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO5	PSO6	PO1	PO2	PO3	PO4	PO6
CO 1	2	1	-	-	1	2	1	-	-	1
CO 2	2	2	-	-	-	2	-	2	1	-
CO 3	2	-	-	1	-	2	-	-	1	-
CO 4	-	-	2	-	1	2	1	-	-	-
CO 5	2	-	-	2	-	1	-	2	-	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓	-	✓
CO 2	✓	✓	-	✓
CO 3	✓	✓	-	✓
CO 4	✓	✓	-	✓
CO 5	✓	✓	-	-

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6SECELE300				
Course Title	Matlab and its Applications				
Type of Course	SEC				
Semester	VI				
Academic Level	300 – 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	NiL				
Course Summary	Acquire the knowledge of MATLAB and SPICE software				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**MATLAB and simulation variable**	**10**
	1	Introduction to MATLAB – Symbolic Objects Creating Symbolic Math Functions Simplifications and Substitutions Basic Algebraic Operations	
	2	Integral Transforms the Fourier and Inverse Fourier Transforms, Laplace Transformation, Z transformations	
II		**Application of MATLAB**	**10**
	5	Basic MATLAB commands-introduction to vector-matrix-vector matrix operations MATLAB code for-inverse of Matrix-Determinant of Matrix-transpose of matrix. Application of MATLAB in various fields.	
III		**Plotting functions**	**3**
	9	Plotting basic plotting commands-different types of plots-2-D plotting-xlabel-y-label-linewidth-	
IV		**Image processing Application of MATLAB**	**4**
	18	Basic Components of Image processing. Remote Sensing - Target Detection Agriculture and Crop Monitoring- Spectral Landscape Classification Medical Imaging and Diagnosis Environmental Monitoring and Analysis	
V		**Spice**	**3**
	23	Models of resistor, capacitor, inductor, energy sources (VCVS, CCVS, Sinusoidal source, pulse, etc),	
	24	transformer, Models of DIODE, BJT, FET, MOSFET, etc. sub circuits	
		Practicals	30
		Part I - Spice Based 1. Rectifiers 2. Integrator & Differentiator 3. Diode Characteristics.	

		4. BJT Characteristics. 5. FET Characteristics. 6. RC Coupled amplifiers - Transient Analysis and Frequency response. 7. Astable Multivibrators 8. Zener regulator 9. Clipping & Clamping 10. Schmitt Trigger Butterworth approximation. 11. Design of analog low pass, band pass, high pass and band elimination f ilters using Chebyshev approximation. 12. Bode plot of transfer functions	
		PART II - MATLAB Based: Introduction to Matlab, Study of Matlab Functions and Simulation using Simulink. 1. Writing simple programs using Matlab for handling arrays, files, plotting of functions etc. 2. Writing M files for Creation of analog & discrete signals, plotting of signals etc. 3. Filtering of analog & digital signals using convolution 4. Generation of noise signals (Gaussian, Random, Poisson etc) 5. Design of analog low pass, band pass, high pass and band elimination filters using Butterworth approximation. 6. Design of analog low pass, band pass, high pass and band elimination filters using Chebyshev approximation. 7. Bode plot of transfer functions	

Text Books:

1. Getting started with MATLAB: A Quick Introduction for Scientist & Engineers by Rudra Pratap, Oxford University Press

2. MATLAB Programming for Engineers by Stephen J Champ: opensource, CENGAGE

3. A concise introduction to MATLAB by William j Palm Boston : McGraw-Hill

Reference:

1. MATLAB and its Applications in Engineering by Bansal Goel Sharma Pearson Education India

2. A Textbook on MATLAB Programming for Engineering and Science by Ray Dipankar, Shroff Publishers & Distributors Pvt Ltd

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basic structure of MATLAB	R, U	PSO-1,2
CO-2	Implement the MATLAB applications	R, U	PSO-1,2
CO-3	Implement the plotting functions	R, U, A	PSO-1,3,7
CO-4	Identify the image processing applications	R, U	PSO-1,4,8
CO-5	Demonstrate the applications of SPICE software	R, U	PSO-1,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: MATLAB and its Applications

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3	R, U	F, C	L	-
2	CO-2	PO-1,3	R, U	F, C	L	P
3	CO-3	PO-1,7	R, U	F, C	L	P
4	CO-4	PO-1,7,8	R, U, Ap	F, C	L	-
5	CO-5	PO-1,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO7	PSO 8	PO1	PO3	PO7	PO8
CO 1	1	1	-	-	-	-	1	1	-	-
CO 2	1	1	-	-	-	-	1	1	-	-
CO 3	1-	-	1	-	1	-	1	-	1	-
CO 4	1	-	-	1	-	1	1	-	1	1
CO 5	1	-	-	1	-	2	1	-	-	1

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics:

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK6SECELE301				
Course Title	Next Generation networking				
Type of Course	SEC				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	3	2 hours	-	2 hours	4
Pre-requisites	NIL				
Course Summary	Able to understand the basic knowledge of Networking and new generation wireless communication systems				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Basics of Networking**	**6**
	1	Protocol. Protocol Layering- Application layer, Transport Layer, Link Layer, Physical layer, OSI Model. Concepts of Packet Switching, Circuit Switching,	
	2	Network Layer- IPv4 addressing, IPv6 addressing,	
II		**Wireless Networking Fundamentals**	**6**
	3	Router, Hub, Switch, WAN technologies: Point-to-Point (PPP), MPLS, VPNs, Gateways, NAT, and cable/DSL routers	
	4	WLAN Equipment, WLAN Topologies, WLAN Technologies, Infrared Technology, Narrowband Technology, Spread Spectrum Technology	
III		**Modern Wireless network**	**6**
	5	Communication Protocol: Zigbee, LoRa WAN, CAN, I2C and SPI protocol, RFID Security, Security for Wireless Sensor Networks, Security for Vehicular Networks.	
	6	Planning and Design of Wide-Area Wireless Networks	
IV		**Modern Networks**	**6**
	7	Access point, Antenna, channels, Interference, obstacles, signal booster, AP, Using repeater, bridge	
	8	Smart Antenna Techniques, OFDM-MIMO Systems	
	9	Adaptive Modulation and Coding with Time-Slot Scheduler,	
	10	Software-Defined Radio	
V		**Teacher specific Module - Troubleshoot Wireless LAN Performance**	**6**
	11	Data link Layer- Error detection and correction techniques-Parity checks, cyclic redundancy check, Checksum method	
	12	Link layer addressing-MAC addresses	
	13	Radio Design for a Cellular Network Radio Link Design Coverage Planning	

	14	Bell Labs Layered Space Time (BLAST) System	
		LAB Experiments	30
		1. Installing a Wireless Network. Setting Up the Access Point 2. Modifying Wireless Network Adapters, Setting Up a Wireless Mac Network 3. Setting Up Internet Sharing, Securing Your Wireless Home Network, General Internet security, WEP, WAP Performance comparison 4. Setting up I2C circuit, 5. Setting up Bluetooth sensors with Arduino. 6. Setting up LORA based Network 7. Setting up Zigbee network 8. Setup Video Conferencing network	

Text Book:

1. Wireless home networking for dummies- by Danny Briere, Walter R. Bruce III, and Pat Hurley

2. Wireless Communications and Networking – Vijay Garg, Publisher: Amsterdam ; Boston : Elsevier Morgan Kaufmann

Reference:

1. Third Generation Systems and Intelligent Wireless networking – JS Blogh, LS Hanzo, Publisher: John Wiley & Sons, Ltd

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss the basic components of Networking	R, U	PSO-1,2
CO-2	Identify the basic components of Networking devices	R, U	PSO-1,2
CO-3	Discuss details of Modern wireless equipments and systems	R, U, A	PSO-1,3
CO-4	Analyse the modern algorithms	R, U	PSO-1,4,8
CO-5	Implement Networking systems	R, U	PSO-1,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Next Generation networking

Credits: 2:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3	R,U	F, C	L	-
2	CO-2	PO-1,3	R, U	F, C	L	P
3	CO-3	PO-1,7	R, U	F, C	L	P
4	CO-4	PO-1,4,7	R, U, Ap	F, C	L	P
5	CO-5	PO-1,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO8	PO1	PO3	PO4	PO 7	PO 8
CO 1	**1**	**1**	**-**	**-**	**–**	**1**	**1**	**-**	**-**	**-**
CO 2	**2**	**2**	**--**	**-**	**-**	**1**	**1**	**-**	**-**	**-**
CO 3	**1**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**1**	**-**
CO 4	**1**	**-**	**-**	**2**	**2**	**1**	**-**	**1**	**1**	**-**
CO 5	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**1**

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK7DSCELE400				
Course Title	CONTROL SYSTEMS				
Type of Course	**DSC**				
Semester	VII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-	-	4
Pre-requisites	1				
Course Summary	The course introduces different types of systems and enables one to identify a set of algebraic equations to represent and model a complicated system into a more simplified form to interpret different physical and mechanical systems in terms of electrical systems to construct equivalent electrical models for analysis. It employs time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Basic Elements of Control System**	**12**
	1	Open loop and Closed loop system - examples- Concept of feedback - Transfer function, modeling of electrical, translational and rotational mechanical systems	
	2	Block diagram reduction techniques	
	3	Signal flow graph- Mason's gain formula	
	4	Standard test signals,	
	5	Definitions of poles, zeros, order and type	
II		**Analysis of Continuous Time Systems**	**12**
	6	Time domain solution of first order systems - time constant	
	7	Time domain solution of second order systems, natural frequency and damping ratio	
	8	Determination of response for standard inputs using transfer functions	
	9	Steady state error - PD - PI - and PID compensation	
III		**Concept of Stability**	**12**
	10	Absolute, relative and marginal stability, stability analysis	
	11	Routh Hurwitz techniques	
	12	Root locus techniques. Basic properties of Root Loci - Construction of Root Loci and analysis of control system.	

IV	**Frequency Response**		**12**
	13	Bode plot, Polar plot, Nyquist plot - Frequency Domain specifications from plot.	
	14	Compensator Networks: Series, Parallel, Series-Parallel compensation-Lead, Lag and Lead lag compensators	
V	**State Space Analysis**		**12**
	15	Concepts of state, state variables and state model,	
	16	Derivation of state space models from differential equations	
	17	State space models from Transfer function models	
	18	State Transition Matrix and it's Properties	

Text Book:

1. J. Nagrath and M.GopaL "Control System engineering", New Age International Publishers.

References:

1. M.Gopal, "Control System - Principles and Design", Tata McGraw Hill.
2. Benjamin.C.Kuo, "'Automatic Control System", ?111 Edn. Prentice Hall of India, New DeDelhi
3. Norman.S.Nise, "Control System Engineering", 5thEdn Wiley
4. S.K.Bhattacharya, "Control Systems Engineering', 5thEdn. Wiley. 6.Schaum 's Series Book, "Feedback Control Systems".

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form..	R,U,C	PSO-1,2
CO-2	Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept	Ap, U	PSO-1,2
CO-3	Interpret different physical and mechanical systems in terms of electrical systems to construct equivalent electrical models for analysis.	An,E	PSO-2,3
CO-4	Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.	Ap,E	PSO-2,3
CO-5	Formulate different types of analysis in frequency domain to explain the nature of stability of the system.	Ap, An	PSO-1,2

CO-6	Identify the needs of different types of controllers and compensators to ascertain the required dynamic response from the system.	An,E	PSO-3,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: CONTROL SYSTEM

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,2	R,U,C	C, P	L	-
2	CO-2	PO-1,2	Ap, U	C, P	L	-
3	CO-3	PO-1,2	An,E	F,C	L	-
4	CO-4	PO-1,2	Ap,E	C,P	L	-
5	CO-5	PO-1,2	Ap, An	C,P	L	-
6	CO-6	PO-1,2	An,E	F,C	L	-

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PO1	PO2
CO 1	1	1	-	-	1	1
CO 2	2	3	-	-	1	2
CO 3	-	2	1	-	1	2
CO 4	-	3	2		1	2
CO 5	1	1	-	-	2	2
CO 6	-	-	1	3	3	2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4		✓		✓
CO 5		✓		✓
CO 6		✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK7DSCELE401				
Course Title	VHDL				
Type of Course	**DSC**				
Semester	VII				
Academic Level	400 – 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	Students undertaking the VHDL course should have a foundational understanding of digital electronics, including basic logic gates, Boolean algebra, and digital circuit design principles. Additionally, familiarity with programming concepts and languages would be beneficial				
Course Summary	The VHDL course provides a comprehensive overview of hardware design and digital circuitry. It covers fundamental concepts such as digital system design processes, VHDL-based design methodology, and hardware simulation techniques. Subsequent modules explore VHDL language elements, behavioural modeling, subprograms, and packages, along with logic design of digital circuits. Practical sessions in MATLAB & Simulink emphasize signal processing, image processing, and filter design, enhancing students' practical skills in digital system design and simulation.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Hardware Design Environments**		**9**
	1	Concepts of Digital System Design Process, Design automation, Hardware Description Languages	
	2	Hardware Simulation, Oblivious Simulation, Event-driven simulation, Hardware synthesis.	
	3	Design methodology based on VHDL , Elements of VHDL ,Describing components, Packages, Top down design, verification	
II	**Basic Language Elements**		**9**
	4	Identifiers, Objects & Classes	
	5	Data Types	
	6	Operators	

	7	Array attributes, Type attributes, Signal attributes, Entity attributes	
III	**Behavioural Modeling**		**9**
	8	Entity declaration, Architecture Body	
	9	Variable assignment Statement, Signal assignment,Concurrent and Sequential Assignments	
	11	Process statement	
	10	Delta Delay	
	11	Structural Specification of Hardware Inverter model, NAND gate model	
IV	**Subprograms and Packages**		**9**
	12	Subprograms, Functions and Procedures, Subprogram Overloading, Operator Overloading, Conversion functions, Resolution functions	
	13	Packages, Package declaration, Package body	
V	**Logic Design of Digital Circuit**		**9**
	14	Logic Design of Half adder, Full adder,Comparator (1 Bit), Multiplexer(2 bit), Flip-flop(S-R,J-K,D), Counter (4 bit counter,Johnson and Ring),Shift Registers,Introduction to CPLD, FPGA & design with CPLD and FPGA	
Practical Session			30
	15	COMPUTER AIDED DESIGN LAB **MATLAB & SIMULINK** 1. Writing M files for creation of analog and discrete signals, plotting of signals etc. 2. Writing simple programs using MATLAB for handling arrays, files, plotting of functions and generate patterns using mesh plot, waterfall plot etc. 3. Reading an image, convert the image using colour maps, plotting histograms of the image. 4. Edge detection, Gradient calculation of an image 5. Removal of Salt & Pepper noise. 6. Perform contrast stretching on an image. 7. FIR filter design using windowing method. 8 Design of LP, HP, BP and BE filters using Simulink. 9. Steady state and transient state analysis using Simulink. 10. Z-transform 11. Fourier analysis using Simulink. **VHDL** 1. Implementation of logic gates. 2. Implementation of Half adder and Full adder. 3. Implementation of RS, D and JK flip flops 4. Implementation of generic comparator. 5. Construction of 8-bit synchronous counter using subprograms. 6. Design and simulate a digital circuit that can extract data from serial bits by removing start and stop bits.	

Text Book:

1. Navabi, Zainalbedin , VHDL : Analysis and Modelling of Digital Systems J Bhasker, VHDL Primer, 3/e, Pearson Education, India
2. Waverly 3 F, Digital Design-Principles and Practices, 4/e, Pearson Education,2008
3. Roth CH. Digital System Design Using VHDL, Cengage Learning, 2008
4. Perry D. L, VHDL. Programming by Example, 4/e, TMH, 2008.

Reference:

1. Brown S. and Vranesic Z., Fundamentals of Digital Logic with VHDL Design, 2/e, TMH 2008.
2. Pedroni V. A., Circuit design with VHDL, PHI, 2008.
3. Kevin Skahill, VHDL for Programmable Logic Addison & Wesley

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Comprehend understanding of digital system design processes, hardware description languages, and design methodologies, and apply them to hardware simulation, synthesis, and verification using VHDL.	U,Ap	PSO-1,3,7
CO-2	Apply basic VHDL language elements such as identifiers, data types, operators, and attributes in digital system design.	U,Ap	PSO-4,5
CO-3	Conceptualize behavioural modeling in VHDL, including entity declaration, architecture body, and variable and signal assignments, and apply them to design concurrent and sequential assignments using process statements.	U,Ap	PSO-1,2
CO-4	Discuss VHDL subprograms and packages, including functions, procedures, and resolution functions, and apply them to modularize and optimize digital system designs.	U,Ap	PSO-7,8
CO-5	Apply VHDL for logic design of digital circuits such as adders, comparators, flip-flops, counters, and shift registers, and gain familiarity with CPLD and FPGA architectures.	U,Ap	PSO-2,7
CO-6	Apply MATLAB and Simulink tools for signal processing, image processing, filter design, and mathematical analysis, and analyze and evaluate their effectiveness in digital system design and simulation.	AP,An,E	PSO-3,4,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: VHDL

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1/PSO-1,3,7	U,Ap	C	L	-
2	CO-2	PO-1,2/ PSO-4,5	U,Ap	F	L	-
3	CO-3	PO-1,3/ PSO-1,2	U,Ap	C	L	-
4	CO-4	PO-4,7/PSO-7,8	U,Ap	C	L	-
5	CO-5	PO-6,7,8/PSO-2,7	U,Ap	C	L	-
6	CO-6	PO-8/PSO-3,4,8	Ap,An,E	P	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO7	PSO8	PO1	PO2	PO3	PO4	PO6	PO7	PO8
CO 1	2	-	1	-	-	2	-	1	-	-	-	-	-	-
CO 2	-	-	-	2	1	-	-	2	2	-	-	-	-	-
CO 3	1	2	-	-	-	-	-	1	-	1	-	-	-	-
CO 4	-	-	-	-	-	2	1	-	-	-	1	-	1	-
CO 5	-	1	-	-	-	1	-	-	-	-	-	2	1	1
CO 6	-	-	1	2	-	-	3	-	-	-	-	-	-	3

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		
CO 6	✓	✓	✓	

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK7DSCELE402				
Course Title	Digital Image Processing				
Type of Course	**DSC**				
Semester	VII				
Academic Level	400 – 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	4 hours	-		4Hrs
Pre-requisites	NIL				
Course Summary	This Subjects gives the fundamental concept of Digital Image Processing such as grey level transformations and spatial operations and image compressions etc				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Digital image Fundamentals**		**12**
	1	Fundamental Steps in digital image processing, basic relationships between pixels, Contrast, Brightness, Match-Band effect, Perspective Projection. Image Registration, Vector and Matrix operations.	
	2	Color models RGB, CMY and CMYK. Conversion between color models. Color Transformations-Formulation, Color Compliments, Color Slicing.	
II	**Basic grey level Transformations & Image Enhancement operations**		**12**
	3	Basic grey level Transformations	
	4	Image Enhancement operations: Histogram of an image Computation Histogram, Histogram Equalization, Histogram Specification.	
	5	Contrast stretching, Window slicing, Bit extraction, Change Detection	
III	**Spatial operations & Image Restoration**		**12**
	6	Point operations, Spatial domain operations,	
	7	Spatial filtering - Spatial low pass, High pass operations.	
	8	Median filtering,Root filtering, Homomorphic filtering,Inverse filtering, Wiener filtering.	
	9	Noise Modeling	
	10	Morphological image processing: Introduction, reflection, Translation, Erosion and Dilation,Opening and Closing.	
IV	**Image Segmentation**		**12**
	11	Image Segmentation by thresholding	

	12	Region Based segmentation using region growing, Region splitting and Merging.	
	13	Water shed transformation	
	14	Edge Detection technique using gradient operators: Sobel, Robert, and prewitt.	
V	**Image compression Models**		**12**
	15	Lossy and Lossless compression. Introduction to JPEG & JPEG 2000. Image Morphology, Edge Detection	

Text books:

1. Rafel C. Gonzalez, Richard E Woods: "Digital Image Processing" 2/e, Pearson Education

2. Anil K. Jain, Fundamentals of Image Processing, Pearson Education India; First Edition (1 January 2015)

References:

1.Kenneth R Castleman: "Digital Image Processing" 2/e PHI/ Pearson Education.
2.New-introductory digital image processing, : a remote sensing perspective , 4th edn**,** John R. Jensen, Part of: Pearson Series in Geographic Information Science

1.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Demonstrate a comprehensive understanding of the fundamental steps in digital image processing.	U,Ap	PSO-1,3,7
CO-2	Acquire proficiency in working with color models such as RGB, CMY, and CMYK, and demonstrate the ability to convert between them.	U,An,Ap	PSO-4,5
CO-3	Apply basic grey level transformations and performing image enhancement operations such as histogram computation, equalization, and specification.	Ap,U,R	PSO-1,2
CO-4	Discuss spatial operations including point operations and spatial domain filtering.	E,C	PSO-1,2
CO-5	Apply noise modeling and understand its implications in digital image processing.	U,Ap	PSO-2,7,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Digital Image Processing

Credits: 4:0:0 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/ Tutorial (T)	Practical (P)
1	CO-1	PO-1 PSO-1,3,7	U,Ap	F, C	L/T	
2	CO-2	PO-1,2 PSO-4,5	U,An,Ap	F,C	L/T	
3	CO-3	PO-1,3 PSO-1,2	U,R,Ap	F,C	L/T	
4	CO-4	PO-4,7 PSO-7,8	E,C	F,C	L/T	
5	CO-5	PO-4 PSO-2,7,8	U,Ap	F,C	L/T	

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO 1	PS O2	PS O3	PSO 4	PSO 5	PSO 7	PSO 8	PO1	PO2	PO 3	PO4	PO 7
CO 1	2	-	1	-	-	2	-	1	-	-	-	-
CO 2	-	-	-	2	1	-	-	2	2	-	-	-
CO 3	1	2	-	-	-	-	-	1	-	1	-	-
CO 4	-	-	-	-	-	2	1	-	-	-	1	1
CO 5	-	1	-	-	-	1	2	-	-	-	1	-

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓			✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK7DSCELE403				
Course Title	RADAR TECHNOLOGY				
Type of Course	**DSC**				
Semester	VII				
Academic Level	400 – 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2 hours	5
Pre-requisites	1.				
Course Summary	The course provides a comprehensive understanding of radar technology, covering its principles, equations, propagation effects, antenna and transmitter configurations, receiver functions, and imaging considerations. Students will gain knowledge and skills necessary for designing, operating, and analysing radar systems in various applications.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Radar Overview**	**6**
	1	Radar Concept-Physics of EM Waves-Interaction of EM Waves with Matter- Basic Radar Configurations and Waveforms.	
	2	Noise, Signal-to-Noise Ratio, and Detection -Basic Radar Measurements -Basic Radar Functions -Radar Applications.	
II		**Radar Range Equation**	**12**
	3	Introduction- Power Density at a Distance R -Received Power from a Target -Receiver Thermal Noise-Signal-to-Noise Ratio and the Radar Range Equation.	
	4	Multiple-Pulse Effects- Decibel Form of the Radar Range Equation-Average Power Form of the Radar Range Equation.	
	5	Pulse Compression: Intrapulse Modulation-Clutter as the Target-One-Way (Link) Equation- Search Form of the Radar Range Equation-Track Form of the Radar Range Equation.	
III		**Radar Search, Propagation Effects and Mechanisms**	**6**
	6	Radar Search and Overview of Detection in Interference-Introduction, Search Mode Fundamentals, Overview of Detection Fundamentals.	

	7	Propagation Effects -Introduction-Propagation Factor-Propagation Paths and Regions-Atmospheric Attenuation and Absorption.	
	8	Atmospheric Refraction-Turbulence-Exploiting the Ionosphere-Diffraction-Multipath-Skin Depth and Penetration: Transmitting Through Walls.	
IV	**Radar Antennas and Radar Transmitters**		**12**
	9	Basic Antenna Concepts-Aperture Tapers- Effect of the Antenna on Radar Performance -Monopulse-Reflector Antennas- Phased Array Antennas-Array Architectures.	
	10	Transmitter Configurations-Power Sources and Amplifiers-Modulators-Power Supplies - Transmitter Impacts on the Electromagnetic Environment -Operational Considerations.	
V	**Radar Receivers, Radar Imaging**		**9**
	11	Summary of Receiver Types- Major Receiver Functions-Demodulation- Receiver Noise Power -Receiver Dynamic Range-Analog-to-Digital Data Conversion.	
	12	General Imaging Considerations-Resolution Relationships and Sampling Requirements - Data Collection-Image Formation-Image Phenomenology	
PRACTICALS			30
	13	Radar Waveform Generation: Experiment: Build a simple radar transmitter circuit using an oscillator and amplifier. Objective: Understand the generation of radar waveforms. Equipment: Oscillator, amplifier, antenna, oscilloscope. Procedure: Generate radar pulses using the oscillator, amplify them, and transmit through the antenna. Use an oscilloscope to observe the transmitted waveform.	
	14	Signal-to-Noise Ratio Measurement: Experiment: Measure the signal-to-noise ratio (SNR) in a radar system. Objective: Understand the importance of SNR in radar detection. Equipment: Signal generator, noise source, RF detector, multimeter. Procedure: Generate a radar signal using the signal generator. Add noise from the noise source at various levels. Measure the signal and noise power using the RF detector and calculate SNR.	
	15	Radar Range Calculation: Experiment: Calculate radar range using the radar range equation. Objective: Understand the factors affecting radar range. Equipment: Radar system setup, target object, measuring tape. Procedure: Set up the radar system and place a target object at a known distance. Measure the received signal power and calculate the radar range using the radar range equation.	
	16	Pulse Compression Demonstration:	

		Experiment: Implement pulse compression using a simple modulation technique. Objective: Understand the benefits of pulse compression in radar systems. Equipment: Function generator, modulator, amplifier, oscilloscope. Procedure: Generate modulated radar pulses using the function generator. Amplify and transmit the pulses through the radar system. Observe the compressed pulse using the oscilloscope.	
	17	Antenna Radiation Pattern Measurement: Experiment: Characterize the radiation pattern of a radar antenna. Objective: Understand the directional properties of radar antennas. Equipment: Radar antenna, RF source, signal analyzer. Procedure: Rotate the radar antenna while transmitting a continuous wave signal. Measure the received signal strength at different angles using the signal analyzer. Plot the radiation pattern based on the measured data.	

Text Book:

1. Principles of Modern Radar Vol.I, Basic Principles, Mark A. Richards Georgia, James A. Scheer Georgia, William A. Holm Georgia, SciTech Publishing, Inc

References:

1. Introduction to Radar Systems – Merrill I. Skolnik, 3rd Edition Tata McGraw-Hill

2. Radar: Principles, Technology, Applications-Byron Edde, Pearson Education.

3. Principles of Modern Radar: Basic Principles-Mark A. Richards, James A.Scheer, William A. Holm, Yesdee.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Discuss radar principles, configurations, measurements, functions, and applications.	U, Ap	PSO-1,4
CO-2	Comprehend Radar Range Equation and its applications in radar systems.	U, Ap, An	PSO-1,4
CO-3	Analyze search operations, propagation effects, and mechanisms influencing radar performance in various environments.	U, Ap	PSO-4
CO-4	Comprehend radar antenna design, transmitter configurations, and their impacts on radar system performance and operations.	U, Ap, An	PSO-1,4

CO-5	Summarize radar receiver operation, imaging principles, and the processes involved in generating radar images.	U, Ap, An	PSO-1,4

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Radar Technology

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L)/Tutorial (T)	Practical (P)
1	CO-1	PO-1,2; PSO-1,4	U, Ap	F, C	L	P
2	CO-2	PO-1,2,7; PSO-1,4	U, Ap, An	C, P	L	P
3	CO-3	PO-1,2; PSO-4	U, Ap	C, P	L	P
4	CO-4	PO-1,2,6; PSO-1,4	U, Ap, An	C, P	L	P
5	CO-5	PO-1,2,7; PSO-1,4	U, Ap, An	C, P	L5	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs:

	PSO1	PSO4	PO1	PO2	PO6	PO7
CO 1	2	2	2	1	-	-
CO 2	2	2	2	3	-	2
CO 3	-	2	2	2		-
CO 4	2	2	2	3	1	-
CO 5	2	2	2	3		2

Correlation Levels:

Level	Correlation
-	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Project Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		

University of Kerala

Discipline	ELECTRONICS				
Course Code	UK7DSCELE400				
Course Title	Industrial Automation				
Type of Course	**DSE**				
Semester	VII				
Academic Level	400 – 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours/Week
	4	3 hours	-	2	5
Pre-requisites					
Course Summary	Automation is a key component of today's Industrial world. Understand automation technologies and identify advantages, limitations and applications of the same. Develop ability to recognize, articulate and solve industrial problems using automation technologies. Here basics of Automation, PLC-SCADA, Robots & other essential automation systems required are discussed.				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Programmable Logic Controller (PLC) :**	**7**
	1	An overview of PLC, introduction, definitions and history of PLC	
	2	Introduction to SCADA manufacturing and assembly processes PLC	
	3	PLC advantages and disadvantages, overall PLC system	
	4	CPU, PLC, input and output modules, program recording devices	
II		**Programmable logic controllers:**	**9**
	5	PLC programming, Ladder diagram,	
	6	PLC Communication and networking, PLC selection	
	7	PLC Installation, Advantage of using PLC for Industrial automation.	
	8	Application of PLC to process control industries	
III		**Computer Based Industrial Control:**	**10**
	9	Introduction & Automatic Process Control,	
	10	Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA systems & RTU	
	11	Distributed Control System: Functional Requirements	
	12	Overview of DCS software configuration	
	13	DCS communication, DCS Supervisory Computer Tasks,	
	14	HMI: Architecture, types and specifications	
IV		**Automated Manufacturing Systems**	**10**
	15	Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells	

	16	GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation.	
	17	Quality Control Systems: Traditional and Modern Quality Control Methods	
	18	SPC Tools	
	19	Inspection Principles and Practices, Inspection Technologies	
V	**Introduction to Industry 4.0/Smart Manufacturing**		**9**
	20	Overview of Industrial automation using robots: Basic construction and configuration of robot,	
		Pick and place robot, Welding robot.	
		typical architecture of IR4.0,	
		Experiments:	30
		1. Introduction to different PLC programming languages. 2. Relay logic diagram and ladder logic diagram 3. To develop traffic controller logic using ST 2401. 4. To develop water level controller logic using ST 2401. 5. To develop elevator controller logic using ST 2401. 6. To develop NAND & NOR logic using switches and indicators. 7. Control application of relay, solenoid valve, process control valve and motors 8. Logic implementation of traffic control application 9. To develop industrial control systems. 10. Industry Visit : Process Industry , Automation Industry 11. Develop GUI for Plant visited	

Textbooks:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
3. Industrial control handbook, Parr, Newnem
4. Programmable logic controller, Dunning, Delmar
5. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
6. Process Control Instrumentation Technology By. C.D. Johnson, PHI
7. Industrial control handbook, Parr, Newnem

References

1.Programmable logic controller, Dunning, Delmar

2. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers”, 5th Ed., PHI, 2012. 3. John R. Hackworth, Fredrick D. Hackworth Jr., “Programmable Logic Controllers: Programming Methods and Applications”, Pearson,

4.William Bolton, “Programmable Logic Controllers”, 4th Edition, Elsevier.

5.L.A. Bryan and E. A. Bryan, “Programmable Controllers – Theory and implementation,”

6. Richard L. Shell and Ernest L.Hall,Handbook of industrial automation,CRC press 2000.

Course Outcomes

No.	Upon completion of the course the graduate will be able to	Cognitive Level	PSO addressed
CO-1	Identify the automation system, its requirements and architecture	R, U	PSO-1,2
CO-2	Demonstrate DCS, features, configuration, communication, DCS Supervisory Computer Tasks & DCS integration with PLC	R, U	PSO-1,2
CO-3	Apply automation to translate and simulate a real time activity using modern tools	R, U, A,	PSO-1,3
CO-4	Discuss automation system, its requirements architecture, advantages-disadvantages & applications in Industries	R, U,A	PSO-1,4,7
CO-5	Comprehend the digital transformation of the field, delivering real-time decision making, enhanced productivity, flexibility	R, U	PSO-1,4,7,8

R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create

Note: 1 or 2 COs/module

Name of the Course: Industrial Automation

Credits: 3:0:1 (Lecture: Tutorial: Practical)

CO No.	CO	PO/PSO	Cognitive Level	Knowledge Category	Lecture (L) / Tutorial (T)	Practical (P)
1	CO-1	PO-1,3; PSO-1,2	R,U	F, C	L	-
2	CO-2	PO-1,3; PSO-1,2	R, U	F, C	L	P
3	CO-3	PO-1,7; PSO-1,3	R, U	F, C	L	-
4	CO-4	PO-1,7 PSO-1,4,7	R, U, Ap	F, C	L	-
5	CO-5	PO-1,8, PSO-1,4,7,8	R, U	F, C	L	P

F-Factual, C- Conceptual, P-Procedural, M-Metacognitive

Mapping of COs with PSOs and POs :

	PSO1	PSO3	PSO4	PSO7	PSO 8	PO1	PO3	PO 7	PO 8
CO 1	1	2	-	-	-	1	1	-	-
CO 2	2	2	-	-	-	2	2	-	-
CO 3	1	1	-	-	-	1	-	1	-
CO 4	1	-	1	1	-	1	-	1	-
CO 5	1	-	1	1	1	1	-	-	1

Correlation Levels:

Level	Correlation
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Assessment Rubrics:

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Mapping of COs to Assessment Rubrics:

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CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		