Programme	B. Sc. Electronics				
Course Code					
Course Title	ELECTRICAL AND ELECTRONIC FUNDAMENTALS				
Type of Course	**Major**				
Semester	I				
Academic Level	100- 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Physics.				
Course Summary	This course covers the fundamentals of electrical and electronic circuits including DC circuits, AC circuits, semiconductor theory and PN junctions with practical applications explored through laboratory experiments.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand and define key electrical terms, concepts and to identify different types of passive circuit elements and their symbols.	U	C	Instructor-created exams / Quiz
CO2	To develop a foundational understanding of semiconductor materials and acquire the ability to analyze and interpret the characteristics of diodes.	U	P	Assignment / Observation of Practical Skills
CO3	To identify and analyse the fundamentals of AC circuits and DC circuits.	U	C	Practical / Assignment
CO4	To develop communication abilities in ideas and designs effectively through reports, presentations etc.	Ap	C	Seminar Presentation /Assignments
CO5	To demonstrate and solve specific problems or applications based on the skill acquired.	Ap	P	Instructor-created exams / Practical
CO6	To interpret circuit diagrams and schematics to identify components and connections.	U	C	Practical/ Viva Voce/ Discussion

* - Remember (R), Understand (U), Apply (Ap), Analyze (An), Evaluate (E), Create (C)

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hours (45)	Mark (70)
I		**Basic Circuit Concepts**	**14**	15
	1	Electric Charge, Electric Potential and Field, voltage, Current, Work, Power and Energy.	2	
	2	Passive Circuit Elements: Resistor, Capacitor and Inductor, Fixed and Variable Types, Color coding.	2	
	3	Charging and Discharging of Capacitors.	3	
	4	Power Supply: AC and DC, Voltage Source and Current source, Battery.	2	
	5	Series and Parallel Connection of Resistors, Capacitors and Inductors, Voltage division rule and Current division rule.	3	
	6	Basic Laws: Ohm's Law and Kirchhoff's current and voltage Laws, Analysis of simple circuits with dc excitation	2	
		1. Circuits and Networks- Sudhakar and Shyam Mohan 2. Networks and Systems- D Roy Choudhary		
II		**A.C Fundamentals**	**10**	15
	7	Characteristics of Sine Wave	1	
	8	Sinusoidal voltage and current, instantaneous, peak, average and RMS values.	3	
	9	Phasor representation of AC quantities.	1	
	10	Inductive and Capacitive Reactances, Impedance, Self inductance, Mutual inductance, Construction and working principle of Transformer.	1	
	11	V-I Relationship in Resistor, Capacitor and Inductor.	2	
	12	Comparison of Single- phase and Three- phase systems.	2	
		Circuits and Networks- Sudhakar and Shyam Mohan Networks and Systems- D Roy Choudhary		
III		**Semiconductor Theory and PN junction.**	**11**	20
	13	Concept of Energy Bands in Solids, Insulators, Semiconductors and Conductors	1	
	14	Intrinsic and Extrinsic semiconductors, n-type and p-type semiconductors, Fermi Level	2	
	15	Drift and Diffusion current, Mobility, Conductivity, Hall Effect (No derivation)	2	
	16	PN Junction diode: Forward and Reverse biased PN junction	2	
	17	Depletion layer, Diode Equation, V-I characteristics, Knee Voltage, Static and Dynamic resistance, Ideal diode	2	
	18	Zener diode: Breakdown Mechanisms, V-I Characteristics, LED- construction and working, multicolor LED.	2	
		Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky		
IV		**Diode Applications**	**10**	20
	19	Rectifiers: Half wave and Full wave rectifiers, PIV, Capacitor filter, calculation and comparison of ripple factors.	4	
	20	Zener diode as Voltage regulator. Fixed voltage regulator ICs 78XX and 79XX series.	2	
	21	Clippers and Clampers: Positive, Negative and Biased.	3	
	22	Block diagram of Regulated DC Power supply.	1	

	Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky			
V	**Hands-on: Electrical and Electronic Fundamentals**		**30**	
	1	Safety precautions for electrical installations		
	2	Familiarization of measuring instruments		
	3	Application of Kirchoff's laws.		
	4	Characteristics of PN junction Diode.		
	5	Zener diode characteristics		
	6	Voltage regulator using zener		
	7	Rectifiers with Capacitor Filter		
	8	Build a 5 V dc Power supply using 7805		
		Mini Projects based on the above Experiments. Simulation of simple circuits.		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Textbook:	1. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky, Pearson Education Publications. 2. Networks and Systems- D Roy Choudhary.
Reference:	1. Basic Electronics: Solid State, B.L Theraja, S.Chand Publications. 2. Basic Electrical Engineering - Nagsarkar and Sukhija, Oxford University Press 3. Circuits and Networks- A Sudhakar and Shyam Mohan S Palli 4. A Textbook of Applied Electronics by R.S. Sedha, S Chand Publication.
Web Resources:	1. https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields 2. https://www.learnabout-electronics.org 3. Dr. Mahesh B Patil, Department of Electrical Engineering, IIT Bombay: https://youtu.be/IoDoW5kykkw?si=20su7DXd3gMoGNt3

Resources:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	2	1	-	2		-	-	2	-
CO 2	-	2	-	2	-	1	1	1	-	2	1	-
CO 3	1	-	-	2	1	1	1	1	-	2	1	-
CO 4	-	-	2	1	-	2	2	1	-	2	-	-
CO 5	2	2	-	1	-	-	2	-	-	3	2	-
CO 6	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	SEMICONDUCTOR DEVICES AND CIRCUITS				
Type of Course	**Major**				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Physics, Mathematics and semiconductor theory.				
Course Summary	In this course, participants will explore the foundational concepts of semiconductor devices and electronic circuits, delving into topics such as transistors and amplifiers, equipping them with both theoretical knowledge and practical skills essential for designing and analyzing electronic systems in a professional context.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the construction and operation of Bipolar Junction Transistors, Field-Effect Transistors and its configurations.	U	C	Instructor-created exams / Quiz/ Assignment
CO2	To analyze and design single-stage RC-coupled amplifiers.	Ap	P	Practical/ Viva Voce / Seminar
CO3	To understand and analyze the characteristics and parameters of JFET and MOSFET.	U	C	Observation of Practical Skills / assignments
CO4	To Analyze the frequency response characteristics of the single-stage RC-coupled amplifier.	An	P	Practical / Instructor-created exams / Asignments
CO5	To Understand the principles of feedback in oscillators.	U	C	Instructor-created exams / Quiz/assignments
CO6	To interpret circuit diagrams and schematics to identify components and connections	U	C	Viva Voce/Practical/Project

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs 45	Mark (70)
I		**BJT**	**13**	**20**
	1	Bipolar Junction Transistor: Types, Construction and Operation.	3	
	2	CB, CE and CC configurations and Current gains.	3	
	3	Input and Output Characteristics of CE Configuration.	2	
	4	Transistor Biasing, DC load line, Q- point, Bias Stabilization, Voltage Divider Bias.	4	
	5	Hybrid Equivalent Circuit for CE Configuration	1	
Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky,				
II		**FET**	**11**	**20**
	6	JFET: Types, Construction, Operation and Parameters	3	
	7	Drain and Transfer Characteristics	2	
	8	Comparison of JFET and BJT	1	
	9	MOSFET: Types, Construction, Operation	3	
	10	Drain and Transfer Characteristics	1	
	11	Concept of CMOS	1	
Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky				
III		**Amplifiers**	**10**	**15**
	12	Concept of Amplification, Small Signal and Large Signal Amplifiers	1	
	13	Single stage RC coupled Amplifier (CE), Design, Frequency response, voltage and current gain	3	
	14	Multistage Amplifiers: Block Diagram and Voltage Gain	1	
	15	Two Stage RC coupled Amplifier (Circuit diagram only)	1	
	16	Power Amplifiers: Class A, Class B, Class AB, Class C and Class D operation, Types of Distortions in Power Amplifiers, Comparison	4	
Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky				
IV		**Oscillators**	**11**	**15**
	17	Feedback Concept: Positive and Negative feedback in amplifiers. Advantages of Negative Feedback	2	
	18	Types of Feedback Connections	1	
	19	Comparison Between Amplifiers and Oscillators	1	
	20	Principle of Sinusoidal oscillators and Barkhausen Criteria	2	
	21	Phase-shift Oscillator: Circuit, Working principle and Frequency of Oscillation (Derivation Not required)	3	
	22	Transistor as a Switch: Astable Multivibrator	2	

Circuits and Networks- Sudhakar and Shyam Mohan				
V	**Hands-on semiconductor devices and circuits**		**30**	
	1	1. Reading and understanding transistor datasheets. 2. CE Transistor Characteristics 3. JFET Characteristics 4. Design a single stage RC coupled amplifier 5. RC Phase Shift Oscillator 6. Clipping Circuits 7. Clamping Circuits 8. Astable Multivibrator		
	2	Mini Project: Soldering and testing of simple circuits and Hobby circuits for beginners		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Text Books	1. Basic Electronics and Linear Circuits, N.N Bhargava, S.C Gupta, D.C Kulshreshthra McGraw-Hill Education (India) Pvt Limited. 2. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky, Pearson Education Publications. 3. Basic Electronics: Solid State, B. L Theraja, S. Chand Publications. 4. A Textbook of Applied Electronics by R.S. Sedha, S Chand Publications
Web Resources	1. Dr. Mahesh B Patil, Department of Electrical Engineering, IIT Bombay: https://youtu.be/IoDoW5kykkw?si=20su7DXd3gMoGNt3 2. https://www.learnabout-electronics.org

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	3	2	3	-	-	3	2	-	2	-	-
CO 3	3	3	2	3	-	-	3	2	-	2	-	-
CO 4	3	3	2	3	-	-	3	2	-	2	-	-
CO 5	3	2	2	2	2	1	3	2	-	2	2	-
CO 6	3	2	2	2	3	3	2	-	-	3	2	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	FOUNDATIONAL MATHEMATICS				
Type of Course	**Major**				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamental Mathematics Concepts: algebra, matrix, vector				
Course Summary	1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists. 2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc. 3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration .				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions	U	C	Instructor-created exams / Quiz
CO2	To understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	To evaluate partial derivatives, limits, total differentials	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	To evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates	U	C	Instructor-created exams / Home Assignments
CO5	To understand gradient, directional derivatives, divergence, curl and Stokes	Ap	P	One Minute Reflection

	Gauss theorems			Writing assignments
CO6	To analyse discrete-time signals and systems, and find the transfer function of different systems	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Basic Mathematics and calculus**	**15**
	1	LCM and HCF	1
	2	Trigonometry-Sines, Cosines-Sinusoidal wave	1
	3	Solution of Quadratic Equation	3
	4	Calculus -Limits, differentiation,	3
	5	Integration	3
	6	Simple Problems	4
II		**Complex numbers and Matrix**	**11**
	7	Complex numbers, polar- rectangular conversion, Pol/Rec functions on Calculator	1
	8	Exponential and Euler's Theorem	1
	9	Logarithm functions, concept of decibel, Sketch graph of logarithmic function	1
	10	Matrices and determinants, inverse, Rank, Crammer's rule	8
III		**Vector Algebra**	**12**
	11	Fundamentals of vector operations	2
	12	Gradient, divergence and curl	2
	13	Line, surface and volume integrals	1
	14	Statement of Stoke's and Gauss's theorems	1
	15	Statement of Divergence theorems	1
	16	Cross product and Dot product	1
	17	Coordinate systems: differential length, differential area, differential volume	4
IV		**Laplace and Fourier transform**	**10**
	18	Concept of Fourier Series in sine wave	1
	19	Introduction to Laplace and its inverse	2
	20	Properties of Laplace transform	2
	21	Introduction to continuous Time Fourier transform and its inverse	3
	22	Properties of Fourier transform	2
V		**Open Ended Module: Applications of Mathematics in Electronics**	**12**
	1	**Case studies:** 1. Practical problems involving Quadratic equations 2. Plotting Frequency response of an Amplifier 3. Reduction of *n*th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations 4. Prove any five Fourier series properties for discrete time signals	12

		5. Find the input output relationship of an RLC network 6. Find the solution of differential equation using LaPlace transform 7. Find the input output relation in difference equation 8. Find the Transfer function using Z transform **Group Assignment:** properties of Laplace Transform and Z transform	

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	-	-	1	-	-
CO 2	2	3	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	1	-	-	-	-	-	2	-	-	-
CO 4	-	-	2	3	-	-	-	-	-	-	-	1
CO 5	-	1	-	-	-	-	-	-	-	-	1	-
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

References

Text Books:

1.Higher Engineering Mathematics B.S.Grewal, KHANNA PUBLISHERS

Programme	B. Sc. Electronics				
Course Code					
Course Title	DIGITAL ELECTRONICS				
Type of Course	**Major**				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge about basics of number system and basic logic gates				
Course Summary	This course explores about Binary and Hexa-decimal number systems, Boolean algebra, and various digital logic circuits.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To Understand Binary, Hexa-decimal and Decimal Number systems and the ability to convert between them.	U	C	Instructor-created exams / Quiz and Home assignments
CO2	To Understand how to simplify Boolean Expressions Using Theorems and K Map	Ap	P	Practical Assignment / Observation of Practical Skills and Home assignments
CO3	To apply techniques related to the design and analysis of various combinational logic circuits using Logic Gates	Ap	P	Practical Assignment / Observation of Practical Skills and Home assignments
CO4	To create small scale combinational and sequential digital circuits	C	P	Practical Assignment / Observation of Practical Skills
CO5	To understand the principles, parameters and applications of various ADCs	U	C	Instructor-created exams / Quiz
CO6	Demonstrate problem-solving skills by applying knowledge in Digital circuits	C	M	Practical skills/Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)				

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark (70)
I		**Number System and Boolean Algebra**	**12**	
	1	Overview of Decimal, Binary and Hexa-decimal number system	2	
	2	Boolean Algebra and Theorems	2	
	3	SOP, POS, minterm and maxterm	1	**20**
	4	K map and Simplification of Boolean Expressions using K Map	5	
	5	Basic logic gates and Universal property of NAND and NOR Gates	2	
Digital Principles and applications- Paul Malvino and P Leach Digital Fundamentals- Thomas L Floyd				
II		**Combinational Logic Circuits**	**12**	
	6	Adder and Subtractor: Half and Full	2	
	7	Multiplexers (up to 4X1)	2	
	8	De-multiplexers (up to 1X4)	2	**15**
	9	Decoders: 2-4 and 3-8	2	
	10	Encoders:4-2, 8-3 and decimal to BCD	2	
	11	Magnitude comparators - one and two bit	2	
Digital Principles and applications- Paul Malvino and P Leach Digital Fundamentals- Thomas L Floyd				
III		**Sequential Logic Circuits**	**9**	
	12	Latch Vs Flip flop, SR Flip Flop	2	
	13	JK and Master-slave Flipflops	2	
	14	D & T Flipflop, Applications of flip flops	2	**15**
	15	Shift Registers and Applications	2	
	16	Ring and Johnson Counter	1	
Digital Principles and applications- Paul Malvino and P Leach Digital Fundamentals- Thomas L Floyd				
IV		**Counters and Converter**	**12**	
	17	Synchronous UP Counter (Up to 4 bit) - Logic diagram, timing diagram	2	
	18	Asynchronous UP Counter (Up to 4 bit) - Logic diagram, timing diagram	2	
	19	Mod Counters	2	**20**
	20	Decade counter using flip flop and 7490 IC	2	
	21	ADC - Flash Type, Counter type	2	
	22	Successive Approximation ADC, Parameters of ADC	2	
Digital Principles and applications- Paul Malvino and P Leach Digital Fundamentals- Thomas L Floyd				

V	**Hands-on Digital Electronics: Practical Applications and Course Project**		**30**	
	1	Implement the following: 1. Verification of De Morgan's Theorem for 2 variables 2. Universal Property of NAND and NOR Gate 3. Adders: Half and Full 4. Subtractors: Half and Full 5. 8:1 MUX using 74151/Gates 6. 1:8 DMUX using 74138/Gates 7. SR and JK flip flop using NAND 8. Ring and Johnson Counters using D flip flop	20	
	2	Mini project: Build a practical application using Digital ICs	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text Books:

1. Digital Principles and applications- Paul Malvino and P Leach
2. Digital Design M Morris Mano
3. Digital Fundamentals- Thomas L Floyd
4. Digital Principles- R L Tokheim

Web resources:

1. https://archive.nptel.ac.in/courses/108/105/108105132
2. https://www.youtube.com/playlist?list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm
3. https://pages.uoregon.edu/rayfrey/DigitalNotes.pdf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	-	1	2	2	1	3	2	-	-	-	-
CO 2	3	3	2	2	-	1	3	3	-	-	2	-
CO 3	3	3	2	2	1	2	3	3	-	2	2	-
CO 4	3	3	2	2	1	2	3	3	-	2	2	-

CO 5	3	2	2	1	2	-	3	3	-	2	-	-
CO 6	-	-	3	-	3	3	-	3	-	3	-	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	NETWORK ANALYSIS				
Type of Course	**Major**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge about basic mathematics and basics of voltage and current				
Course Summary	This course explores about various theorems used for analysing an electrical network.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand various circuit components of an electrical networks and theorems governing them	U	C	Instructor-created exams / Quiz
CO2	To analyse various electrical networks using theorems	An	P	Practical Assignment / Observation of Practical Skills/assignments
CO3	To analyse networks during the transient state	An	P	Practical Assignment / Observation of Practical Skills/assignments
CO4	To analyse networks excited by an AC source and to calculate power in AC circuits	An	P	Practical Assignment / Observation of Practical Skills/assignments
CO5	To understand the concept of Resonance and BW	U	C	Instructor-created exams / Quiz/assignments
CO6	To synthesize higher order networks using simulation tools	C	M	Viva Voce/Practical/Project

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark (70)
I	**Various Sources and Network Theorems**		**16**	**25**
	1	Voltage and Current sources-Ideal and Practical	1	
	2	Dependent and Independent Sources	1	
	3	Source transformation	1	
	4	KCL and KVL	1	
	5	Mesh and Nodal analysis	4	
	6	Super position theorem	2	
	7	Thevenin's Theorem	2	
	8	Norton's Theorem	2	
	9	Maximum power transfer theorem	1	
	10	Reciprocity theorem	1	
Circuits and Networks- Sudhakar and Shyam Mohan				
II	**DC Transient Analysis**		**8**	**15**
	11	Transient analysis of RL Circuit using differential equations	2	
	12	Transient analysis of RC Circuit using differential equations	2	
	13	Transient analysis of RLC Circuit using differential equations	2	
	14	Transient analysis of RLC Circuit using Laplace transform	2	
Circuits and Networks- Sudhakar and Shyam Mohan				
III	**AC Analysis**		**11**	**15**
	15	V I Relationship in R, L and C	1	
	16	AC Response of RL Circuit using differential equations	2	
	17	AC Response of RC Circuit using differential equations	2	
	18	AC Response of RLC Circuit using differential equations	2	
	19	Complex impedance, Phasor	2	
	20	Power in AC circuit and Power triangle	2	
Circuits and Networks- Sudhakar and Shyam Mohan				
IV	**Resonance**		**10**	**15**
	21	Series Resonance-Frequency bandwidth and Q Factor	5	
	22	Parallel Resonance-Frequency bandwidth and Q Factor	5	
Circuits and Networks- Sudhakar and Shyam Mohan				
V	**Hands-on Network Analysis: Practical Applications and Course Project**		**30**	
	1	Implement the following: 1. Verification of KCL and KVL 2. DC Response of RC and RL circuit using Simulation Tool 3. Frequency Response of High Pass and Low Pass RC circuit 4. Sinusoidal Response of RL and RLC using simulation tool 5. Series resonance-Measurement of resonant frequency, BW and Q 6. Parallel resonance using simulation tool.	20	
	2	Mini Project: Applications of networks and theorems in higher order filters	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45

instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References:

Text Books

1. Networks and Systems- D Roy Choudhary
2. Circuits and Networks- Sudhakar and Shyam Mohan
3. Network Analysis- Van Valkenberg
4. Essentials of circuit analysis-Robert L Boylestad

Web Recourses

1. https://archive.nptel.ac.in/courses/108/105/108105159/
2. https://www.youtube.com/watch?v=duYOtrPE_hg
3. https://www.youtube.com/watch?v=1Uvom_Ci8Yg

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	3	2	3	-	-	3	2	-	2	-	-
CO 3	3	3	2	3	-	-	3	2	-	2	-	-
CO 4	3	3	2	3	-	-	3	2	-	2	-	-
CO 5	3	2	2	2	2	1	3	2	-	2	2	-
CO 6	3	2	2	2	3	3	2	-	-	3	2	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	MICROPROCESSORS AND MICROCONTROLLERS				
Type of Course	**Major**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge of digital electronics and logic circuits is recommended.				
Course Summary	This course provides an introduction to microprocessors and microcontrollers, focusing on the 8085 and 8051 architectures. Students will gain an understanding of microprocessor/microcontroller architecture, instruction sets, programming, and interfacing with peripheral devices. The course includes both theoretical and practical components.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Comprehend and analyse architectures of microprocessor, microcontroller	U	F	Instructor-created exams / Quiz
CO2	Comprehend the memory organization of 8051 microcontroller	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Showcase the skill, knowledge and ability of programming using instruction set	C	P	Seminar Presentation / Group Tutorial Work
CO4	Work with microcontroller and interfaces including general purpose input/ output and timers	U	C	Instructor-created exams / Home Assignments
CO5	Interface 8051 microcontroller with the input and output devices such as LEDs, and keypad	Ap	P	One Minute Reflection Writing assignments

CO6	Comprehend and use peripheral serial communication and the concepts of interrupts in 8051 microcontrollers	C	P	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Introduction to 8085 Microprocessors**	**10**	**20**
	1	Introduction to 8085	2	
	2	Microprocessor bus organizations, data bus, address bus, control bus	2	
	3	Architecture of 8085	4	
	4	8086 microprocessor series (Data bus and address bus only)	2	
	Micro Processors architecture, Programming, and Applications with the 8085: Ramesh Gaonkar			
II		**8051 Microcontroller**	**10**	20
	5	Architecture of 8051 microcontroller	2	
	6	Internal memory RAM organization, Register banks	2	
	7	Byte and bit addressable area, scratch pad	1	
	8	Accumulator, Flags and flag register (PSW)	1	
	9	Program counter and data pointer. Stack and Stack pointer	1	
	10	Special Function Registers (Detailed analysis not required)	1	
	11	8051 Ports and I/O pins, control signals	2	
	Micro Processors and Controllers: Krishnakanth			
III		**8051 Instruction Set:**	**10**	15
	12	Data transfer (internal and external, Arithmetic and Logic, Shifting and Rotating)	2	
	13	Branching/Jump. Bit related instructions and operations	2	
	14	Addressing modes	1	
	15	Stack-Push and POP instruction	1	
	16	Subroutine -Call and return instructions. (A call-Lcall)	2	
	17	Software delay generation, calculation and programs	2	
	The 8051 microcontroller and embedded systems using assembly and C – Kenneth. J. Ayala -CENGAGE Learning			
IV		**8051 Peripherals: Timer and Interrupt**	**15**	15
	16	Interrupt concept - 8051 Interrupts:	3	
	17	interrupt priority -interrupt destination, ISR-IE and IP registers		
	18	software generated interrupts	2	
	19	I/O Ports: Timers - Counters	2	

	20	Serial port interrupt - External interrupt - Reset	2	
	21	Peripheral Interfacing: LED, KEY (Input and Output mode)	3	
	22	Keyboard :2 x 2 Matrix	2	
	The 8051 microcontroller and embedded systems using assembly and C – Kenneth. J. Ayala -CENGAGE Learning The 8051 microcontroller and applications: Ali Mazidi			
V	**Hands-on : Practical Applications, Case Study and Course Project**		**30**	
	1	1. Keil-c Simulator/proteus simulator tool Introduction /8051 kit 2. Addition – 8-bit, 16-bits 3. Subtraction – 8-bit, 16 bits 4. Block data transfer 5. Array addition (multibyte) 6. Logical operators – AND, OR NOT 7. Multiplication & Division 8. I/O ports programming.	20	
	2	Case study: Mini project	3	
	3	Capstone (/Course) Project: Traffic light controller Water level Indicator alarm Remote Room Temperature Monitoring Digital countdown timer-7 segment display)	7	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	-	1	-	-	1	3	-	-	-	-	-

CO 2	2	-	-	1	-	1	2	-	-	-	-	-
CO 3	1	-	2	-	-	-	3	-	-	1	3	3
CO 4	1	-	1	-	-	1	1	-	-	-	2	-
CO 5	2	2	1	-	1	-	1	3	-	-	-	-
CO 6	1	3	2	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

References:

Text Books

1. Microprocessor Architecture Programming and Application with 8085, Ramesh S. Gaonkar, Prentice Hall
2. The 8051 microcontroller and embedded systems using assembly and C, Kenneth. J. Ayala – CENGAGE Learning
3. The 8051 microcontroller and applications, Ali Mazidi

Programme	B. Sc. Electronics				
Course Code					
Course Title	ANALOG ELECTRONICS				
Type of Course	**Major**				
Semester	IV				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic Electronics and Electronic Circuits				
Course Summary	This course explores basics of Op-amp and different applications such as wave form generators, wave shaping circuits, Instrumentation amplifiers etc. Also give the awareness of IC555 and its applications				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understanding of Basic Circuit Components. An introduction to electrical circuit components including ideal operational amplifiers	U	C	Instructor-created exams / Quiz
CO2	To analyze ideal operational amplifier circuits and design basic functions	An	P	Practical Assignment / Observation of Practical Skills
CO3	To design and analyze circuits that use op-amps to generate various waveforms	An	P	Practical Assignment / Observation of Practical Skills
CO4	To analyze and synthesize wave shaping circuits and active filters using operational amplifiers.	An	P	Instructor-created exams / Home Assignments
CO5	Understand the role of op-amps in active filters and wave shaping circuits, including the configurations and characteristics of op-amps that make them suitable for these applications.	Ap	P	Seminar Presentation / Observation of Practical Skills
CO6	To understand the functional characteristics and applications of different analog ICs .	U	C	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction to Op-amp and basic circuits**	**12**
	1	Block Diagram of operational Amplifier	1
	2	Ideal Op-amp, open loop and closed loop, CMRR and Slew rate	3
	3	Inverting and Non-Inverting Amplifier, virtual ground, Gain	2
	4	Voltage Follower	1
	5	Summing and Difference Amplifiers	2
	6	Instrumentation Amplifier	1
	7	Integrator and Differentiator	2
II		**Waveform Generators**	**10**
	8	Basic comparator and its Characteristics	1
	9	Typical comparator circuits using op amp	2
	10	Zero crossing detector and Schmitt trigger	3
	11	Square wave and Triangular wave generators	2
	12	Sinusoidal Oscillators, Phase shift Oscillators	2
III		**Wave shaping circuits and Active Filters**	**8**
	13	Clippers and Clampers	2
	14	First order Butter worth Low pass and High pass Filters	1
	15	Band pass and Band Reject Filters	1
	16	Notch and All pass Filters	1
	17	Digital to Analog Converters	3
IV		**Other Analog ICs**	**15**
	18	Functional block diagram of IC 555 and Pin Diagram	2
	19	Astable and Monostable Multivibrator using IC555and its applications	5
	20	Voltage controlled oscillator (VCO)	2
	21	PLL – Block diagram and Operating principle	2
	22	Parameters and pin out function	2
	23	Variable voltage Regulators (IC 723)	2
V		**Hands-on Analog Electronics:**	**30**
	1	Inverting and Non-Inverting Amplifier	4
	2	Summing and Difference Amplifiers	4
	3	Zero crossing detector and Schmitt trigger	2
	4	Phase shift Oscillator	2
	5	First order Butter worth Low pass and High pass Filters	2
	6	Astable and Monostable Multivibrator using IC555	4
	8	Low Voltage Regulators using IC 723	2
	9	Mini Project based on Op-Amp	10

Reference:

1. Ramakant A. Gayakwad," Op-amp and Linear ICs", Prentice-Hall of India Private LTD.

2. Botkar," Integrated Circuits" Mottershed," Electronic Devices and circuits",

3. Millman & Halkias," Integrated Electronic", Tata McGraw-Hill Publishing LTD.

4. Tobey & Buelsman," Op-amp Design and Application".

5. Integrated Electronics- Milman&Halkias, Mc Graw Hill- Kogakusha (2003)

6. Electronics Fundamental and Applications- J. D. Ryder, Prentice Hall, India, 5th edition (2009)

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	3	-	-						
CO 2	3	2	3	3	-	-						
CO 3	3	2	3	3	-	-						
CO 4	3	2	3	3	-	-						
CO 5	-	1	3	3	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	FIELD THEORY				
Type of Course	**Major**				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Knowledge about foundational mathematics				
Course Summary	This course explores about various laws theorems that governs electromagnetic fields and wave propagation				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO 1	To understand basic concepts of Static electric field and Laws Governing them.	U	C	Instructor-created exams / Quiz
CO 2	To understand Fundamentals of Magneto statics with the Laws Governing static magnetic fields	U	C	Instructor-created exams / Quiz
CO 3	To understand Maxwell's Equations with the physical significance of each equation	U	C	Instructor-created exams / Quiz
CO 4	To analyse electromagnetic phenomena using Maxwell's equation and to understand the characteristics of uniform plane wave.	An	C	Instructor-created exams / Home Assignments
CO 5	To understand various transmission lines, parameters and propagation modes	U	C	Instructor-created exams / Quiz
CO 6	To apply basic concept of EM theory in electronics and communication	Ap	P	Assignment/Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark (70)
I		**Electrostatics**	**10**	**15**
	1	Coulomb's Law	1	
	2	Gauss's Law and Applications	1	
	3	Electric Potential and Field	2	
	4	Capacitance and capacitors and Electrostatic energy	3	
	5	Poisson's and Laplace's Equations	2	
	6	Boundary Conditions	1	
Engineering Electromagnetics- Haytt Elements of Electromagnetics- Mathew O, O. Sadiku				
II		**Magnetostatics**	**12**	**15**
	7	Ohms law, Current and Current density	2	
	8	Kirchhoff's Law and equation of continuity	2	
	9	Biot-Savart's Law	1	
	10	Magnetic Vector potential	1	
	11	Ampere Circuital theorem	1	
	12	Magnetostatic energy	2	
	13	Boundary Condition	3	
Engineering Electromagnetics- Haytt Elements of Electromagnetics- Mathew O, O. Sadiku				
III		**Electromagnetic Field Theory**	**14**	**20**
	14	Faraday's Law	2	
	15	Inconsistency of Ampere Circuital theorem, Conduction and displacement current	3	
	16	Maxwell's Equation, Integral and Differential form and for time varying fields	6	
	17	Poynting Theorem	3	
Electromagnetic Field theory and transmission lines- G S N Raju Elements of Electromagnetics- Mathew O, O. Sadiku				
IV		**Transmission Line Theory**	**12**	**20**
	18	Transmission Line-Twisted, Parallel and coaxial	2	
	19	Modes of transmission and Transmission line equations	6	
	20	Group and phase velocity	1	
	21	Characteristic Impedance,	1	
	22	Reflection co efficient and VSWR	2	
Electromagnetic Field theory and transmission lines- G S N Raju Elements of Electromagnetics- Mathew O, O. Sadiku				
V		**Open Ended Module**	**12**	
		Solutions for Maxwell's equations in free space Group and phase velocity in free space		

		Advanced and planar transmission lines Waveguides Microwave sources amplifiers devices, circuits and applications		

References:

Text Books

1. Engineering Electromagnetics- Haytt
2. Electromagnetic Field theory and transmission lines- G S N Raju
3. Elements of Electromagnetics- Mathew O, O. Sadiku
4. Electronic Communication systems- Kennedy

Web Recourses

1. https://archive.nptel.ac.in/courses/108/104/108104087/
2. https://freevideolectures.com/course/3288/electromagnetic-theory

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	2	2	2	2	1	3	2	-	2	2	-
CO 3	3	2	2	2	2	1	3	2	-	2	2	-
CO 4	3	1	2	3	1	1	3	2	-	2	2	-
CO 5	3	1	1	2	-	-	2	2	-	2	2	-
CO 6	2	3	2	2	3	3	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 (20%)
- Final Exam (70%)

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		✓		

Programme	B. Sc. Electronics				
Course Code					
Course Title	PYTHON PROGRAMMING				
Type of Course	**Major**				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Mathematics Concepts 2. basic computer skills				
Course Summary	This course covers the fundamental aspects of Python programming, ensuring students gain a solid understanding and practical experiences in various application domains.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To explain the concepts of variables, operators, and control flow statements. To describe the purpose and usage of functions and modules	U	F	Instructor-created exams / Quiz
CO2	To demonstrate comprehension of Python programming concepts by explaining how loops, conditional statements, and data structures work.	U	C	Instructor-created exams / Quiz
CO3	apply their knowledge to solve problems by writing Python scripts that use standard programming constructs like functions, loops, and conditional statements	Ap	C	Practical Assignment / Observation of Practical Skills
CO4	to dissect complex problems into smaller, more manageable parts and use Python to solve these sub-problems	An	p	Practical Assignment / Observation of Practical Skills
CO5	To debug Python code by identifying and correcting errors.	An	P	Practical Assignment / Observation of Practical Skills
CO6	To assess the effectiveness of different programming approaches, and make decisions on which algorithms or data	An	P	Group project Work

	structures to use in various scenarios.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	marks
I		**Fundamentals of Python**	**10**	
	1	Python features, comparison with C & Execution of a python program	2	**15**
	2	comments, identifiers, keywords, variables	2	
	3	Datatypes in python- built-in datatypes and user-defined datatypes	3	
	4	Different operators in python, operator precedence and associativity	2	
	5	input & output Statements	1	
E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python Richard L. Halterman, Learning to Program with Python				
II		**Control statements, arrays and strings**	**10**	**20**
	6	If, if…else, if…else if…. else statements	2	
	7	Loops-while, for, infinite, nested	2	
	8	Break, continue, pass, assert and return statements	3	
	9	Arrays-creating, importing an array module, indexing and slicing on arrays	3	
E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python Richard L. Halterman, Learning to Program with Python				
III		**Sequences, dictionaries and Functions**	**13**	20
	10	string operations-length, indexing, slicing, repeating, concatenation, checking, basic string operations	2	
	11	List- creating list, accessing, updating and deleting elements from a list, basic list operations.	2	
	12	Tuple- creating and accessing tuples in python, basic tuple operations	2	
	13	Operations on dictionary, dictionary methods, using for loop with dictionaries	3	
	14	Function-built-in functions, composition of functions, user defined functions	2	
	15	Parameter and arguments, python recursive and anonymous function	2	
E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python Richard L. Halterman, Learning to Program with Python				
IV		**Introduction to OOPs**	**12**	**15**
	16	Procedure orient approach and object orient approach	1	
	17	Problems in procedure orient approach and speciality of python approach	1	
	18	Features related to OOPS	3	

	19	Classes, creating a python class	2	
	20	objects-creating a class, declaring class objects	2	
	21	self-variable, constructor, types of variables and methods	2	
	22	Types of files in python	1	
E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python Richard L. Halterman, Learning to Program with Python				
V	**Hands-on Python**		**30**	
	1	program to generate random numbers		
	2	program to accept 2 complex numbers and find their sum		
	3	program to simulate a simple calculator for performing basic arithmetic operations		
	4	program to generate Fibonacci series		
	5	Program to sort a group of strings in to alphabetical order		
	6	Program to find maximum and minimum elements in a list of elements		
	7	Program that uses a simple structure for storing students' details		
	8	program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.		
	9	Simple project like number guessing game, word guessing game etc.		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References:

Textbooks:

1. E. Balaguruswamy, Introduction to Computing and Problem-Solving Using Python
2. Richard L. Halterman, Learning to Program with Python
3. Martin C. Brown, Python: The Complete Reference

Web resources:

1. https://www.youtube.com/watch?v=eWRfhZUzrAc
2. https://nptel.ac.in/courses/106106145

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6

CO 1	1	-	1	-	1	-	1	-	-	-	-	-

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

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar /project
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

CO 3	✓	✓		✓
CO 4		✓	✓	

CO 5		✓	✓	
CO 6			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	SIGNALS AND SYSTEMS				
Type of Course	**Major**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge about basic mathematics and knowledge about various signals				
Course Summary	This course explores about various operations on signals that is useful for real time world applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the basic properties and classifications of Signals	U	C	Instructor-created exams / Quiz
CO2	To evaluate various Signal properties by performing various operations and to understand their practical implications	Ap	P	Practical/ Assignment / Observation of Practical Skills
CO3	To apply the knowledge to classify systems based on their properties and behaviour	Ap	P	Practical/ Seminar Presentation / Group Tutorial Work
CO4	To apply Z transform and its properties to practical problems in digital signal processing	Ap	P	Practical/ Instructor-created exams / Home Assignments
CO5	To apply the DFT and FFT to complex signals and understand the significance of phase and magnitude spectra	Ap	P	Practical/ Instructor-created exams / Home Assignments
CO6	To develop various signals and systems using simulation tools	C	M	Practical/Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark (70)
\I	**Signals**		**15**	**20**
	1	Signals-Analog, Discrete and Digital	1	
	2	Uni-dimensional and multi-dimensional signals	1	
	3	Energy and power signals	1	
	4	Periodic and aperiodic signal	1	
	5	Causal and non causal signals	1	
	6	Even and odd signals, asymmetric signals	1	
	7	Representation methods-Functional, Graphical, Tabular and Sequential	2	
	8	Standard test signals-Unit impulse, Unit Step and Unit ramp	2	
	9	Basic operations on signals-Vector addition, multiplication, time shifting, folding, scaling (Both amplitude and time) and Convolution	5	
Signals & Systems – A Nagoor Kani				
II	**Systems**		**7**	**15**
	10	Systems Definition	1	
	11	Classification: Static-Dynamic, Linear-Nonlinear, Time Varying-Time in varying, Stable-Astable, Causal-Noncausal, IIR-FIR, Recursive-non recursive	3	
	12	Excitation, Response and Impulse Response	1	
	13	Transfer Function	1	
	14	Characteristic equation and order of system	1	
Signals & Systems – A Nagoor Kani				
III	**Z transform**		**9**	**15**
	15	Definition and ROC	1	
	16	Properties (Linearity, Time shifting, Time reversal, Conjugation, Convolution, Initial Value theorem, Final value theorem)	4	
	17	Z and Inverse Z transform of signals-Problems	4	
Signals & Systems – A Nagoor Kani				
IV	**DFT**		**14**	**20**
	18	DTFT definition properties	2	
	19	DFT and IDFT-Definition and important properties	4	
	20	Circular convolution	2	
	21	FFT Radix-2 Decimation in time	3	
	22	FFT Radix-2 Decimation in Frequency	3	
Signals & Systems – A Nagoor Kani				
V	**Hands-on Signals and Systems Practical Applications and Course Project**		**30**	
	1	Implement the following: 1. Generation of standard test signals 2. Basic operations on signals 3. Linear Convolution 4. Circular Convolution 5. DFT and IDFT 6. FFT.	20	
	2	Mini Project: Applications such as Filter design and systems designing.	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References:

Text Books

1. Signals & Systems – A Nagoor Kani
2. Digital Signal Processing – A Nagoor Kani
3. Digital Signal Processing – S Salivahan
4. Digital Signal Processing – Ramesh Babu

Web Link

1. https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/video galleries/video-lectures/
2. https://www.youtube.com/playlist?list=PLOunECWxELQRYwsuj4BL4Hu1nvj9dxRQ6

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	-	-	3	-	-	3	2	-	3	-	-
CO 3	3	3	-	-	-	-	3	2	-	2	-	-
CO 4	3	3	-	-	-	-	3	2	-	2	-	-
CO 5	3	3	-	-	-	-	3	2	-	2	-	-
CO 6	3	3	2	3	2	3	2	-	-	3	3	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	OPTO ELECTRONICS				
Type of Course	**Major**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic Electronic Devices				
Course Summary	This course explores the optical properties of semiconductors, junction theory, Opto electronic detectors and display devices				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the principles and operation of key optoelectronic devices, such as light-emitting diodes (LEDs), lasers, photodetectors, and optical modulators	U	C	Instructor-created exams / Quiz
CO2	Understand the semiconductor physics underlying optoelectronic devices, including the behavior of carriers, bandgap engineering, and semiconductor material properties	U	C	Assignment / Seminar Presentation
CO3	Understand the principles behind various display technologies, including liquid crystal displays (LCDs), organic light-emitting diodes (OLEDs), and other emerging technologies.	U	C	Seminar Presentation / Group Tutorial Work
CO4	Compare and evaluate different device designs of LEDs and Laser diodes	An	P	Instructor-created exams / Home Assignments
CO5	Utilize the knowledge about photodiodes to design a simple photodetector circuit	Ap	P	Group Tutorial Work
CO6	Classify operational modes and luminescence mechanisms involved in various display devices	U	C	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Optical properties of semiconductors**		**11**
	1	Radiative and non-radiative recombination, band to band recombination	2
	2	Exciton absorption, donor- acceptor and impurity band absorption	2
	3	Relation between absorption and emission	1
	4	Stokes shift in optical transitions	2
	5	LASER principle and characteristics	3
	6	Spontaneous and stimulated emission, examples of LASERs	1
II	**Junction Theory**		**12**
	7	PN junction and Current density across junctions	3
	8	Graded junctions	1
	9	Heterojunction, Double heterojunction	3
	10	Quantum well and Quantum dots	2
	11	LED structures- SH, DH, SQW, MQ	2
	12	Generation of white light and applications	1
III	**Opto-electronic detectors and Display devices**		**14**
	13	Thermal detectors and Photoconductive detectors	4
	14	P-I-N photodetector	1
	15	Silicon photodiodes and performance characteristics	2
	16	Phototransistors and Metal Semiconductor photodetectors	3
	17	PL, EL, CL displays	2
	18	Displays based on LED, Plasma panel and LCD	2
IV	**Introduction to Fiber Optics**		**11**
	19	Introduction to Fiber optics, structure	2
	20	light propagation in fibers and characteristics	2
	21	Critical angle, Total internal reflection, Acceptance angle, Numerical Aperture	5
	22	Advantages of optical Communication	2
V	**Open Ended Module: Virtual lab experiments**		**12**
	1	Design and set up photo detector circuit experiments other photonics experiments Open-Ended Exploration and Assessment: Student-led research on finding the importance of Opto electronics in the present and future, make a report	12

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References:

Text Books

1.Semiconductor optoelectronic devices- Pallab Bhattacharya, PHI, ISBN-978-

81203-2047-5(2009)
2.Semiconductor optoelectronics- Jasprit Singh, Tata Mc Graw Hill (1995)
3.Semiconductor physics and optoelectronics- V Rajendran, J. Hemaletha, M Stalin Maccolin, Vikas Publishers Delhi (2004), ISBN,81-259-1448-X
4.An introduction to Optoelectronics- Wilson and Hawkes, PHI, (1996)
5.Light Emitting Diodes- E Fred Scheubert, Cambridge University Press, (2003)
6.Solid State Lighting- Zukaszukasu, John Wiley Sons, NY (2002)
7.Optoelectronic devices and systems – S C Gupta, PHI, (2005)
8.Solid State Electronic devices- Ben G Streetmann and Sanjay Banerjee, PHI (2003)5 th Edition, ISBN-81-203-1840-4
9.Introduction to Semiconductor Materials and Devices- M S Thyagi, John Wiley Sons, NY, (2003)
10.Physics of semiconductor devices- S M Sze John Wiley Eastern 2 nd Edition, (2002) ISBN- 9971-51-266-1

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	-	-	3	-	-						
CO 2	-	-	-	2	-	-						
CO 3	-	-	-	3	-	-						
CO 4	3	1	-	-	-	-						
CO 5	3	1	1	-	-	-						
CO 6	-	-	-	2	-	-						

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Project/Practical (20%)

- Final Exam (70%)

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	✓	✓		✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	ANALOG AND DIGITAL COMMUNICATION				
Type of Course	**Major**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	• Basic understanding of electronics concepts such as circuits, signals, and components. • Familiarity with mathematical concepts like calculus and probability.				
Course Summary	This course provides a foundation in the principles and techniques of analog and digital communication systems. Students will learn about the basic concepts of amplitude modulation (AM) and frequency modulation (FM) for analog signal transmission, design and function of transmitters and receivers for AM and FM, fundamentals of pulse modulation including sampling, quantization, and coding techniques like PCM, digital pulse modulation techniques like ASK and FSK, and basic communication system. Through this understanding, students will be able to analyze the characteristics of analog signals and their limitations in transmission.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Describe the working principles of amplitude modulation (AM) and frequency modulation (FM) for analog signal transmission	U	F	Instructor-created exams / Quiz
CO2	Understand the design and function of basic transmitter and receiver blocks for AM and FM transmission	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Explain the fundamentals of pulse modulation, including sampling, quantization, and coding techniques like Pulse Code Modulation (PCM)	U	F	Seminar Presentation / Group Tutorial Work
CO4	Differentiate between analog and digital pulse modulation techniques like Amplitude Shift Keying (ASK) and Frequency Shift Keying	An	C	Instructor-created exams / Home Assignments

	(FSK), understanding their modulation and demodulation processes			
CO5	Implement basic communication system components (modulators, demodulators, filters) using hardware or software tools	C	P	Project reports, presentations demonstrating successful implementation of communication system components.
CO6	Analyze the characteristics of analog signals (bandwidth, power spectrum) and understand their limitations in transmission	An	C	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Amplitude Modulation and Angle Modulation,**	**10**	**15**
	1	Block diagram of communication system, Electro magnetic spectrum and history of communication systems	2	
	2	Need for modulation, Amplitude Modulation power relations in AM waves	2	
	3	Basic concepts of Frequency Modulation and Phase Modulation	1	
	4	Types of FM -Narrow band FM, Wide band FM, and comparison	2	
	5	Transmission bandwidth of FM Wave	1	
	6	Comparison of FM and AM, Concept of Pre-emphasis and de-emphasis.	2	
		Electronic Communication Systems: George Kennedy		
II		**Transmitters and Receiver**	**13**	**20**
	7	Block Diagram of AM Transmitter and FM Transmitter	2	
	8	Radio Receiver - Receiver types, TRF	1	
	9	Superheterodyne receiver	2	
	10	Sensitivity, Selectivity, Image frequency and its rejection	2	
	11	IF amplifiers, AGC, Amplitude limiting	1	
	12	Block diagram of FM Receiver,	2	
	13	Stereo-phonic FM multiplex system	2	
	14	Comparison of AM and FM Receivers	1	
		Electronic Communication Systems: George Kennedy		
III		**Pulse Modulation**	**13**	**20**

	15	Sampling - reconstruction - aliasing	2	
	16	Types of Pulse modulation- PAM, PWM and PPM generation	5	
	17	Pulse Code Modulation: PCM Generation and Reconstruction	3	
	18	Quantization, Companding	1	
	19	Multiplexing Techniques - FDM and TDM	2	
		Electronic Communication Systems: George Kennedy		
IV	**Digital Modulation Techniques**		**9**	**15**
	20	ASK- Modulator, Coherent ASK Detector,	3	
	21	FSK- Modulator, Non-Coherent FSK Detector	3	
	22	BPSK- Modulator, Coherent BPSK Detection.	3	
		Taub s Principles of Communication Systems: Herbert Taub		
V	**Hands-on:** **Practical Applications, Case Study and Course Project**		**30**	
	1	List of Experiments: 1. Amplitude modulation 2. AM demodulation 3. Frequency modulation 4. Frequency Division Multiplexing & De multiplexing 5. Pulse Amplitude Modulation 6. PAM Demodulation 7. Pulse Width Modulation 8. Pulse Position Modulation 9. Frequency Shift Keying: Generation and Detection	30	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Mapping of COs with PSOs and POs:

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	1	2	-	-	3	-	-	-	1	-
CO 2	1	-	1	2	-	-	2	-	-	-	2	1
CO3	1	-	1	2	-	1	2	-	-	2	1	-
CO 4		1	-	1	2	-	1	2	-	1	-	1
CO 5		1	-	1	-	-	1	1	-	1	-	-
CO 6		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 (20%)
- Final Exam (70%)

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			✓	

References:

Text Books

1. Analog and Digital Communications, Simon Haykin, John Wiley, 2005
2. Electronics Communication Systems- Fundamentals through Advanced, Wayne Tomasi,5th Edition, 2009, PHI
3. Principles of Communication Systems, Herbert Taub, Donald L Schilling, Goutam Saha, 3rd Edition, McGraw- Hill, 2008.
4. Electronic Communications, Dennis Roddy and John Coolen, 4th Edition, Pearson Education India
5. Electronics & Communication System, George Kennedy and Bernard DavisTMH 2004

Programme	B. Sc. Electronics				
Course Code					
Course Title	EMBEDDDED SYSTEM DESISGN WITH IOT				
Type of Course	**Major**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	2	75
Pre-requisites	Knowledge in Electronics Computer architecture Basic programming skills				
Course Summary	This course provides a comprehensive introduction to embedded systems and the Internet of Things (IoT), covering fundamental concepts, hardware, programming, and practical applications. Students will gain hands-on experience with popular development boards like Arduino and Node MCU, learn basic embedded C programming, and explore various sensors and actuators interfacing techniques.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	This module provides students with a comprehensive understanding of embedded systems, covering their definition, application areas, categories, and architecture	U	C	Instructor-created exams / Quiz
CO2	The "Basic Embedded Systems Programming" course provides participants with a foundational understanding of programming embedded systems using the C language.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	The course provides participants with a comprehensive overview of Arduino boards and their applications in embedded systems development.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	The course provides participants with a comprehensive understanding of Internet of Things (IoT) concepts and practical skills in developing IoT	U	C	Instructor-created exams / Home Assignments

	solutions using Node MCU development boards.			
CO5	The course equips participants with practical skills and knowledge in developing IoT applications using Arduino boards and Node MCU.	Ap	P	One Minute Reflection Writing assignments
CO6	Demonstrate critical thinking and problem-solving skills in IoT and embedded programming.	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Embedded Concepts**		**6**	**10**
	1	Introduction to embedded systems	1	
	2	Application Areas	1	
	3	Categories of embedded systems	2	
	4	Architecture of embedded systems: Hardware architecture and Software architecture	2	
II	**Basics Embedded C Programming**		**10**	**20**
	5	Data types (int, char and float) , Variables and variable declaration	2	
	6	Operators in Embedded C (Relational, Equality, Arithmetic and Logical)	2	
	7	Control flow statements :(if, if- else, if- elseif -else and for statement)	2	
	8	The while, do-while and switch statement	2	
	9	Arrays and Pointers	2	
III	**Introduction to Arduino Board**		**10**	**15**
	10	An overview of Arduino boards	2	
	11	Pin configuration of Arduino Uno (R3)	2	
	12	Arduino Serial Monitor	2	
	13	Interfacing button, switch, LED and OLED with Arduino Uno board	2	
	14	Basics of PWM and ADC in Arduino programming	2	
IV	**IoT and IoT Development Boards**		**19**	**25**
	15	Overview of IoT.	2	
	16	IoT Layering concepts and MQTT	2	

	17	IoT Development Boards: Introduction to Node MCU development board	3	
	18	Node MCU hardware components	2	
	19	Controlling Digital and Analog Pins: Understanding GPIO pins on Node MCU, Digital input and output operations and Analog input using Node MCU's ADC	2	
	20	Connecting Node MCU to Wi-Fi: Configuring Wi-Fi settings on Node MCU, Sending and receiving data over Wi-Fi.	3	
	21	Interfacing Sensors with Node MCU	2	
	22	Understanding the basics of IoT and its applications	3	
V	**Hands-on Embedded System Design with IoT: Practical Applications, Case Study and Course Project**		**30**	
	1	Implement the following: 1. Write an Arduino program to turn ON an LED using button switch. 2. Write an Arduino program to interface OLED. 3. Write an Arduino program to display room temperature and humidity in LCD display. 4. Write an Arduino program to detect an obstacle using IR sensor. 5. DC Motor Speed Control: Connecting a DC motor to an Arduino for speed control. 6. Relay Applications: Integrating relays with Arduino for switching applications. 7. Smart Home Automation Simulation: Designing a simulation for home automation, Controlling lights, appliances, and security systems. 8. Agricultural IoT Implementation: Designing a simulation for precision farming and monitoring crop conditions, Integrating sensors for soil moisture, temperature, etc.	20	
	2	Case study	3	
	3	Capstone (/Course) Project: Build a practical application in IoT using Node MCU or Raspberry pi board	7	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References:

Text Books

1. The 8051 Microcontroller and Embedded Systems" by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay
2. Computers as Components: Principles of Embedded Computer System Design" by Wayne Wolf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	DIGITAL SYSTEM DESIGN				
Type of Course	**Major**				
Semester	**VII**				
Academic Level	**400 - 499**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamentals of Digital Electronics				
Course Summary	This course introduces students to the fundamentals of digital system design, focusing on combinational and sequential logic circuit design, hardware description languages (HDLs)				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To recall and explain the fundamental concepts of digital system design, including Boolean algebra and Simplification methods	U	C	Instructor-created exams / Quiz
CO2	To demonstrate the principles behind multi level gate circuits and combinational circuit design.	U	C	Instructor-created exams / Quiz
CO3	Apply the concepts of Boolean algebra and combinational circuit design to solve problems in digital system design.	Ap	P	Seminar Presentation
CO4	Analyse state graphs and tables to derive and reduce sequential circuits for specific applications.	An	C	Instructor-created exams / Assignments
CO5	To understand the Fundamentals of VHDL	U	C	Assignments
CO6	To apply the Digital design concepts and successfully simulate the design using VHDL	Ap	P	Assignments

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hours (45)	Marks (70)
I		**Concepts of Digital System Design**	**12**	**15**
	1	Boolean Algebra - Basic Operations, Expressions and Truth Tables	2	
	2	Applications of Boolean Algebra, Minterm and Maxterm expansions	3	
	3	K-Map Simplifications *(upto Five Variable)*	4	
	4	Quine-McCluskey Method / Tabular Method	3	
	Sections from References: 1. Fundamentals of Logic Design Charles Roth Jr. 2. Digital Design M Morris Mano, Michel D Ciletti			
II		**Multilevel Gate Circuits and Combinational Circuit Design**	**12**	**20**
	5	Design of Two level and Multilevel Gate Circuits	3	
	6	Combinational Circuit Design using Gates, Gate Delays and Timing Diagrams, Hazards.	3	
	7	Multiplexers, Three state buffers, Decoders and Encoders	2	
	8	Programmable Logic Devices: PLA, PAL	2	
	9	CPLD, FPGA	2	
	Sections from References: 1. Fundamentals of Logic Design, Charles Roth Jr. 2. Digital Design, M Morris Mano, Michel D Ciletti			
III		**Sequential Circuits Design**	**15**	**25**
	10	Latches and Flip Flops	1	
	11	Registers and counters	2	
	12	Analysis of clocked Sequential Circuits	3	
	13	Derivation of State graphs and Tables	3	
	14	Reduction of State tables and State Assignment	3	
	15	Sequential Circuit Design, Mealy and Moore model of FSM	3	
	Sections from References: 1. Fundamentals of Logic Design, Charles Roth Jr. 2. Digital Design, M Morris Mano, Michel D Ciletti			
IV		**Introduction to VHDL**	**6**	**10**
	18	VHDL description of Combinational Circuits	1	
	19	VHDL Models for multiplexers and VHDL Modules	2	
	20	Signals and constants, Arrays, Operators	1	
	21	Packages and Libraries, IEEE Standard logic	1	
	22	Compilation and simulation of VHDL Code	1	

	Sections from References: 1. Fundamentals of Logic Design, Charles Roth Jr.			
V	**Hands-on: Practical Applications**		**30**	**20**
	1	Design a seven segment display driver.		
	2	Design 8 X 1 Multiplexer using gates.		
	3	To build a Flip- Flop Circuits using elementary gates. *(RS, Clocked RS, D-type).*		
	4	Design a counter using D/T/JK Flip-Flop.		
	5	Write VHDL code to realise basic and derived logic gates.		
	6	Write VHDL code to Half adder, Full Adder using basic and derived gates.		
	7	Write VHDL code to Half subtractor and Full Subtractor using basic and derived gates.		
	8	Write VHDL code to Clocked D FF, T FF and JK FF (with Reset inputs).		
		Case study: Traffic light controller /Stepper motor sequence generator / Rolling display.		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Resources:

Textbooks	1. Fundamentals of Logic Design, Charles Roth Jr., Cengage Learning, India Edition, 5th Edition. 2. Digital Design, M Morris Mano, Michel D Ciletti, Pearson, 5th Edition. 3. Digital System Design using VHDL, Charles H Roth, Jr. and Lizy Kurian John, Cengage Learning
References:	1. Digital System Design with VHDL, Mark Zwoli´nski, Pearson Education Limited. 2. A VHDL Primer, Jayaram Bhasker, Prentice Hall. 3. Digital Systems Design, A Nagoor Kani, CBS Publishers and Distributors Pvt Ltd.
Online Resources	1. Electronics – Digital circuits and systems, Prof. S Srinivasan, Dept. of Electrical engineering IIT Madras: https://youtube.com/playlist?list=PL803563859BF7ED8C&si=h0rYDWcmJKgWdhZ2

	2. Digital System Design, Prof. Neeraj Goel, Assistant Professor, Dept. of Computer Science and Engineering, IIT Ropar: https://youtu.be/BoIOLczVulQ?si=b6KUQ1t6d4KOZhZL

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	2	-	-	3	-	-	-	-	-
CO 2	2	2	-	2	-	-	3	3	-	-	-	-
CO 3	-	-	2	-	-	-	2	3	1	-	-	-
CO 4	-	-	2	-	-	-	2	-	2	3	-	-
CO 5	-	2	2	-	-	2	3	2	-	-	-	-
CO 6	2	-	2	-	-	2	3	2	-	3	-	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment / Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	ANTENNAS AND RF TECHNOLOGY				
Type of Course	**Major**				
Semester	VII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge about Electromagnetic field theory and wave propagation				
Course Summary	This course explores about the basic operational parameters of an antenna, various types of antennas, microwave devices and components and modern RF technologies.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the fundamentals of antenna design gaining the knowledge of radiation mechanisms and antenna parameters	U	C	Instructor-created exams / Quiz
CO2	To understand the basic characteristics of microstrip antennas, feeding methods and dipole antenna design considerations	U	C	Practical Assignment / Observation of Practical Skills
CO3	To understand the working principles of microwave devices and components	U	C	Instructor-created exams/ Seminar Presentation
CO4	To understand the principles of transmission line theory, including characteristic impedance, reflection coefficient and standing wave ratio and to use Smith chart to solve problems involving impedance matching	U	C	Instructor-created exams / Group Tutorial Work /Home Assignments
CO5	To analyse planar transmission lines such as strip line, slot line and coplanar waveguides	An	P	Practical Assignment /One Minute Reflection Writing assignments
CO6	To design and simulate various types of microstrip antennas and understand the radiation	Ap	P	Practical Assignment/Viva Voce

	mechanism			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Basic Antenna Theory**	**15**	
	1	Antenna Definition	1	
	2	Radiation mechanism and polarization	3	
	3	Antenna parameters-Gain Directivity, radiation efficiency, effective aperture, EIRP	3	**20**
	4	Antenna array of two isotropic point sources-Broad side and End-fire	2	
	5	Half wave dipole antenna design	2	
	6	Microstrip antennas-Rectangular and circular patch	4	
		Antenna Theory Design and Analysis, Constantine A. Balanis Microstrip Antennas, Bahl I. J. and Bhartia		
II		**Microwave devices and components**	**10**	
	7	Rectangular waveguide-cut off frequency, TE and TM modes	2	
	8	Basic principle of two cavity klystron	1	
	9	Reflex klystron	1	**20**
	10	Principle of operation of Magnetron	2	
	11	Passive microwave components- Isolator, circulator, phase shifter and directional coupler	4	
		Microwave Engineering, David M. Pozar Microwave devices and circuits, Samuel Y. Liao Microwave K C Gupta		
III		**Planar Transmission lines**	**10**	
	12	Types of RF transmission lines, Substrate, Effective Permittivity	3	
	13	Microstrip Line	2	
	14	Slot Line	1	**15**
	15	Coplanar Waveguide	1	
	16	Smith Chart	3	
		Antenna Theory Design and Analysis, Constantine A. Balanis Microstrip Antennas, Bahl I. J. and Bhartia Microwave Integrated circuits, Gupta K. C., and Amarjit Singh		
IV		**Modern RF Technologies (Basic Concepts only)**	**10**	
	17	Scattering parameters	2	
	18	Vector Network analyser	1	
	19	Concept of EMI/EMC	2	**15**
	20	RFiD Technology	2	
	21	Wireless power transfer	1	
	22	Concept of Specific Absorption Ratio (SAR)	2	
		Antenna Theory Design and Analysis, Constantine A. Balanis Microstrip Antennas, Bahl I. J. and Bhartia		

Microwave Integrated circuits, Gupta K. C., and Amarjit Singh				
V	**Hands-on Antenna and RF Technology Practical Applications and Course Project**		**30**	
	1	Implement the following using simulation tool: 1. VSWR measurement using Smith Chart 2. Microstrip, Slotline and CPW transmission line of Characteristic impedance 50 Ohm 3. Rectangular and Circular patch antenna-Reflection, radiation and surface current 4. Effective permittivity calculation of a substrate.	20	
	2	Mini Project: Designing and modelling of an RF device such as Antenna/Filter/waveguide/transmission line etc using simulation tool.	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text Books:

1. Antenna Theory Design and Analysis, Constantine A. Balanis
2. Microstrip Antennas, Bahl I. J. and Bhartia
3. Microwave Engineering, David M. Pozar
4. Microwave devices and circuits, Samuel Y. Liao
5. Microwave, K C Gupta
6. Foundations for Microwave engineering, Robert E. Collin
7. Microwave Integrated circuits, Gupta K. C., and Amarjit Singh.
8. Stripline-like transmission lines for microwave integrated circuits, Bharathi Bhat and S. K. Koul.
9. Foundation for Microstrip Circuit Design, T. C. Edwards

Web Resources:

1. https://archive.nptel.ac.in/courses/108/101/108101092/
2. https://www.coursera.org/lecture/microwave-antenna/weblecture-3-1-antenna-introduction-iXKQP
3. https://ocw.mit.edu/courses/6-661-receivers-antennas-and-signals-spring-2003/pages/lecture-notes/

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-

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

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics:

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	ADVANCED DIGITAL SIGNAL PROCESSING				
Type of Course	**Major**				
Semester	VII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Knowledge of Signals and Systems 2. Foundational Mathematics				
Course Summary	This course introduces various spectrum estimation methods, concept of multirate digital signal processing. A study of Discrete random signal processing and simulation using Matlab is discussed.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To Understand Signal Processing Systems. Comprehend multirate signal processing and demonstrate its applications.	U	C	Instructor-created exams / Quiz
CO2	Demonstrate an understanding of the power spectral density and apply it to discrete random signals and systems.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Develop proficiency in programming languages commonly used for signal processing, such as MATLAB	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Analyze the characteristics of digital filters and understand their design parameters.	An	P	Instructor-created exams / Home Assignments
CO5	Design and optimize digital filters for specific applications. Analyze adaptive filtering problems and demonstrate its application.	An	P	One Minute Reflection Writing assignments
CO6	Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation. Apply power spectrum estimation techniques to random signals.	Ap	P	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**INTRODUCTION TO DSP**	**10**
	1	Signals and system Operations, Convolution, Correlation	2
	2	Sampling, Aliasing, Fourier series, Fourier transforms	3
	3	DFT –FFT, Z transforms	2
	4	Concept of discrete time systems, Concept of filters, IIR and FIR filters	3
II		**INTRODUCTION TO MATLAB**	**10**
	5	Introduction to MATLAB	3
	6	MATLAB Characteristics – MATLAB Preliminaries	3
	7	Rules on Variable and Function, Names Special Characters	2
	8	Basic Arithmetic Operators Elementary math Intrinsic Functions File Types.	2
III		**SPECTRUM ESTIMATION**	**15**
	9	Non-parametric methods-correlation method	2
	10	Co-variance estimator- performance analysis of estimators	2
	11	Unbiased, consistent estimators	1
	12	Windows- periodogram estimator	2
	13	Barlett spectrum estimation	2
	14	Welch estimation	2
	15	Model based approach - ar, ma, arma signal modelling- p	2
	16	parameter estimation using Yule – walker method	2
IV		**MULTIRATE DIGITAL SIGNAL PROCESSING**	**10**
	17	Mathematical description of change of sampling rate	
	18	Interpolation and decimation, Continuous time model	2
	19	Direct digital domain approach, decimation by an integer factor	2
	20	Interpolation by an integer factor single and multistage realization	2
	21	Poly phase realization, application to sub band coding	2
	22	Wavelet transform and filter bank implementation of wavelet expansion of signals	2
V		**Hands-on Data Structures:** **Practical Applications, Case Study and Course Project**	**30**
	1	**1. Familiarization to MATLAB** **2. Matrix Operations:** Matrix Addition, Matrix Subtraction, Inverse Of The Matrix **3. Convolution:** Linear Convolution, Circular Convolution **4. Time domain :** Discrete Time Signals And Systems, DTFT, DFT **5. Frequency domain :** Impulse Response, FFT Operation, IFFT Operation **6. Sampling Theorem :** Verification Of Sampling Theorem **7. Filter Design :** Design Of FIR Filters and IIR Fileters **8. Transforms :** Z Transforms **9. DSP Trainers :** Familiarization of Texas Instrument DSP Kit TMS320 Series	20
	2	Case study	3
	3	Capstone (/Course) Project: Implement filter applications, low pass , high pass filters	7

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text Books:

1. Monson H. Hayes, Statistical Digital Signal Processing And Modeling, John Wiley And Sons, Inc.,New York,1996.

2. Hunt, Lipsman, Rosenberg, A Guide To Matlab,Cambridge

3. JohnG.Proakis, DimitrisG.Manolakis, Digital Signal Processing Prentice Hall Of India,1995

4. SanjaySharma,Signals And Systems,KatsonBooks,

5.SopoclesJ.Orfanidis, Optimum Signal Processing,Mcgraw Hill, 1990

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	-	-	1	-	-						
CO 2	-	-	-	3	3	-						
CO 3	-	-	1	-	-	-						
CO 4	-	1	2	3	-	-						
CO 5	-	1	-	2	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	CONTROL SYSTEM ENGINEERING				
Type of Course	**Major**				
Semester	VII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamental Mathematics Concepts: Laplace transform				
Course Summary	A course combining these topics equips students with valuable skills in analyzing, modeling, and designing feedback control systems with an emphasis on servo motor applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define and explain the key concepts of open-loop and closed-loop control systems and block diagrams.	U	C	Instructor-created exams / Quiz
CO2	Understand and build signal flow graphs to represent control systems and analyse their signal flow characteristics.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Develop mathematical models of physical systems (mechanical, electrical) using differential equations and convert them to transfer functions	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Understand the operating principles of various types of servo motors (DC, AC, stepper) and their characteristics relevant to control system design.	U	C	Instructor-created exams / Home Assignments
CO5	Analyse the stability and performance of linear time-invariant (LTI) systems using time and frequency domain analysis techniques (Bode plots, Nyquist plots, root locus plots)	Ap	P	One Minute Reflection Writing assignments
CO6	Build and test basic servo motor control systems using hardware platforms, sensors, and actuators.	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Basic Concepts**		**4**
	1	Historical review	1
	2	Deinitions	1
	3	Classifications	1
	4	Comparison between open loop and closed loop control systems	1
II	**Mathematical Models & Components**		**16**
	5	Linear and nonlinear systems	1
	6	Transfer function	1
	7	Mathematical modelling of Electrical and Mechanical systems	4
	8	Analogies: Force- Current and Force-Voltage	1
	9	Block diagram and Signal flow graphs	5
	10	Servo Motors : AC and DC	2
	11	Potentiometers	1
	12	Stepper motor	1
III	**Time & Frequency Domain Analysis**		**12**
	13	Time and frequency response of first and second order systems	4
	14	Relationship between time and frequency domain specifications	2
	15	Steady state errors and error constants	2
	16	Concepts and applications of P,PD,PI and PID controllers	4
IV	**Stability Analysis**		**13**
	17	Definition	1
	19	Routh-Hurwitz Criterion	3
	20	Root Locus technique	3
	21	Nyquist criterion	1
	22	Bode plot	3
	23	Relative stability : Phase margin and gain margin	2
V	**Hands-on Data Structures: Practical Applications, Case Study and Course Project**		**30**
	1	**1. Characteristics of DC servo motor** Aim: To find speed torque characteristics of DC servo motor Apparatus: DC servo motor set up, multi meter, connecting wires **2. DC position control system** Linear Search: Basic sequential search on an unordered list. Binary Search: Search on a sorted list using the divide-and-conquer approach. **3. ON/OFF Temperature control system** Selection Sort and Insertion Sort **(**In-place comparison sort)**.** Quicksort **(**Divide-and-conquer approach) **4. Characteristics of AC servo motor** Binary Trees,Binary Search Trees, AVL trees, Heap Trees,Tries, B-Trees: **5. Time domain analysis of second order system** **6. Temperature control system using PID** Application domains include dictionaries, caches, and symbol tables. **7. Level control system** Dijkstra's Algorithm (non-negative edge weights) and Bellman-Ford Algorithm (negative edge weights) **8. Open loop and closed loop control system** Prim's and Kruskal's Algorithm	20

	2	Case study	3
	3	Capstone (/Course) Project:Build a practical application using hash tables (e.g., custom web cache, password manager)	7

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PS O5	PSO 6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

References

Text Books:

1. Modern Control Engineering, Ogata K.,Prentice-Hall of India Pvt Ltd., New Delhi, 3rd edition, 2000.
2. Feedback Control of Dynamic Systems,Franklin G.F., Powell J.D., Emami-Naeini A. Pearson, 5th edition, 2006
3. Control Systems Engineering by Nagrath and Gopal New Age Publication
4. Automatic Control Systems Benjamin C.Kuo 8th Edition, Farid Golnaraghi, John Wiley &Sons.
5. Feedback and Control Systems, Joseph J Distefano 2nd Edition TMH

Programme	B. Sc. Electronics				
Course Code					
Course Title	DIGITAL IMAGE PROCESSING				
Type of Course	**Major**				
Semester	VII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Knowledge of Signals, Systems, Image concepts 2. Foundational Mathematics				
Course Summary	The course provides a comprehensive overview of the fundamentals and applications of digital image processing. The course also includes practical sessions where students work with software tools such as MATLAB, Python with libraries like OpenCV, or dedicated image processing software packages.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Gain a thorough understanding of the fundamental concepts underlying digital image processing systems	U	C	Instructor-created exams / Quiz
CO2	Develop the ability to analyse images in the frequency domain using various transformation techniques, enabling the enhancement and restoration of images.	Ap	C	Practical Assignment / Observation of Practical Skills
CO3	Attain the ability to analyze, design, and implement digital image processing algorithms using software	An	P	Practical Assignment / Observation of Practical Skills
CO4	Apply various techniques for enhancing the quality of digital images, including contrast stretching, histogram equalization, and spatial & frequency domain methods.	An	P	Instructor-created exams / Home Assignments
CO5	To be able to identify and remove noise from images using different restoration techniques, such as filtering and deconvolution	Ap	P	One Minute Reflection Writing assignments
CO6	To analyse and extract information from images for pattern recognition tasks, including image classification, object detection, and image	Ap	P	Viva Voce

	understanding.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**DIGITAL IMAGE FUNDAMENTALS**		**10**	**15**
	1	Elements of digital image processing systems, Vidicon and Digital Camera working principles	2	
	2	Elements of visual perception, brightness, contrast, hue, saturation	3	
	3	Image sampling, Quantization, dither	3	
	4	Two-dimensional mathematical preliminaries	2	
II	**IMAGE TRANSFORMS**		**10**	**15**
	5	1D DFT, D transforms DFT	3	
	6	DCT, Discrete Sine, Walsh, Hadamard,	3	
	7	Slant, Haar, KLT	2	
	8	SVD, Wavelet transform	2	
III	**IMAGE ENHANCEMENT AND RESTORATION**		**15**	**25**
	9	Histogram modification, Noise distributions, Spatial averaging	2	
	10	Directional Smoothing, Median, Geometric mean, Harmonic mean	2	
	11	Contra harmonic and Yp mean filters	1	
	12	Image restoration – degradation model, Unconstrained and Constrained restoration	2	
	13	Inverse filtering removal of blur caused by uniform linear motion,	2	
	14	Wiener filtering,	2	
	15	Geometric transformations-spatial transformations	1	
	16	Gray-Level interpolation.	1	
	17	Edge detection, Edge linking and boundary detection,	2	
IV	**IMAGE SEGMENTATION AND RECOGNITION**		**10**	
	18	Image segmentation, Region growing	2	
	19	Region splitting and merging, Patterns and pattern classes,	2	
	20	Matching by minimum distance classifier, Matching by correlation.	2	
	21	Neural networks-Back propagation network and training,	2	
	22	Neural network to recognize shapes.	2	
V	**Hands-on:** **Practical Applications, Case Study and Course Project**		**30**	
	1	1 Display of an Image. Negative of an Image(Binary & Gray Scale) 2. Transformations of an Image 3. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization 4. Display of FFT(1-D & 2-D) of an image 5. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image 6. Implementation of Image Smoothening Filters (Mean and Median filtering of an Image) 7. Implementation of image sharpening filters and Edge Detection using Gradient Filters 8. Implementation of image restoring techniques 9. Implementation of Image Intensity slicing technique for image	20	

		enhancement		
	2	Case study: Image Compression by DCT, DPCM, HUFFMAN coding	3	
	3	Capstone Mini Project: Pattern recognition tasks, image classification, object detection, neural network architectures commonly used for shape recognition: convolutional neural networks (CNNs), recurrent neural networks (RNNs), and deep neural networks (DNNs)	7	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, ‘ Digital Image Processing’, Pearson Education, Inc., Second Edition, 2004

2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,‘ Digital Image Processing using MATLAB’, Pearson Education, Inc., 2004.

3. Anil K. Jain, ‘ Fundamentals of Digital Image Processing’, Pearson Education, Inc., 2002.

4. "Digital Image Processing" by R. Castleman, Prentice-Hall, 1996. A foundational text covering the basics of digital image processing.

5. D.E. Dudgeon and R.M. Mersereau, ‘Multidimensional Digital Signal Processing’, Prentice Hall Professional Technical Reference, 1990.

6. William K. Pratt, ‘ Digital Image Processing’, John Wiley, NewYork, 2002.

7. Milan Sonka et al, ‘IMAGE PROCESSING, ANALYSIS AND MACHINE VISION’, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999,

6."Handbook of image and video processing" edited by Al Bovik, Academic Press, 2000.

7."Computer Vision" by Linda Shapiro and George Stockman, Prentice Hall, 2001.

Web resources:

1. **OpenCV.org** - The official site for OpenCV, a library of programming functions for real-time computer vision. OpenCV Official Website
2. **Scikit-image.org** - Offers documentation and tutorials for scikit-image, a collection of algorithms for image processing in Python. Scikit-image Official Website

3. **ImageProcessingPlace.com** - Companion site to the "Digital Image Processing" books by Gonzalez & Woods, offering resources and MATLAB examples. Image Processing Place

4. **LearnOpenCV.com** - Provides tutorials, courses, and articles on OpenCV, deep learning, and computer vision. Learn OpenCV

5. **Algorithmia.com** - A marketplace for algorithms, including many for image processing and computer vision. Algorithmia Official Website

6. **PyImageSearch.com** - A blog dedicated to teaching computer vision and deep learning, with a focus on image processing. PyImageSearch

7. **Stack Overflow** - A community website where you can find answers or ask questions about image processing among other topics. Stack Overflow

8. **GitHub** - Hosts numerous projects and libraries related to image processing. Searching for "image processing" on GitHub can lead to many relevant projects. GitHub

9. **Coursera** & **edX** - Both platforms offer online courses in image processing from universities and colleges around the world. Coursera edX

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	-	-						
CO 2	1	3	-	-	3	-						
CO 3	-	-	1	-	-	-						
CO 4	-	1	2	3	-	-						
CO 5	-	1	-	2	-	-						
CO 6	-	-	-	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 (20%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	OPTICAL FIBER COMMUNICATION				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic Electronic devices 2. Basic principles of light transmission through a fiber				
Course Summary	This course explores the Light propagation characteristics in Optical Fibers, Signal degradation in optical fibers, Optic fiber couplers, optical sources and detectors				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the concept of fiber optic communication and how it pertains to information transmission.	U	C	Instructor-created exams / Quiz
CO2	To Understand the structure, performance, and signal analysis of optical sources and detectors, including LEDs and semiconductor lasers.	U	C	Assignment / Group Tutorial Work
CO3	To Identify the elements of an optical fiber transmission link, including fibers, cables, connectors, and splices	Ap	C	Seminar Presentation / Group Tutorial Work
CO4	To understand the fundamental principles of light propagation in optical fibers, including total internal reflection, modal dispersion, and waveguiding.	U	C	Instructor-created exams / Home Assignments
CO5	To understand the causes of signal loss in optical fibers, including absorption, scattering, and bending losses, and learn how to minimize these losses.	U	C	One Minute Reflection Writing assignments
CO6	Understand the different types of dispersion—modal, chromatic, and polarization mode dispersion—that can affect signal integrity and how to manage them in fiber optic	Ap	C	Instructor-created exams/Viva Voce

	communication systems.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create ©
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Light propagation characteristics in Optical Fibers**	**11**
	1	Recollection of basic principles of optics transmitting light on a fiber	2
	2	Light propagation in fibers and characteristics-Critical angle - Total internal reflection.	2
	3	Classification of Fibers: Single mode and multimode Fibers, Step index and Graded index Fibers, comparison	3
	4	Refractive Index profile - Effect of index profile on propagation	1
	5	Acceptance angle, Acceptance cone	1
	6	Numerical aperture	1
	7	Mode field diameter, Cut off wavelength	1
II		**Signal degradation in optical fibers**	**12**
	8	Attenuation in single mode and multimode fibers	2
	9	Absorption loss, scattering loss and bending loss	3
	10	Dispersion – Material dispersion, Waveguide dispersion	3
	11	Modal dispersion, Polarization mode dispersion	3
	12	Band Width limitation	1
III		**Optic fiber couplers**	**13**
	13	Types of couplers	3
	14	Fiber to fiber joints	2
	15	Splicing techniques- Fusion splice, V groove splice, Elastic tube splice	4
	16	Optical fiber connectors -Structure of a connector	2
	17	Optical Communication System, point to point transmission systems and modulation	2
IV		**Optical sources and detectors**	**12**
	18	Light production, LEDs and characteristics,	2
	19	DFB lasers, tunable DBR lasers	3
	20	Photoconductors, photodiodes, and phototransistors,	3
	21	Optical receiver	2
	22	Optical amplifiers- SOAs and EDFAs	2
V		**Open Ended Module:**	**12**
		Study Fiber optic communication kit/ Virtual lab experiments Characterization of Fiber/Study and submit an assignment on different Fiber optic sensors	12

References

1. Optical Fibre communication - J. M. Senior. Prentice Hall India (1994)

2. Optical Fibre communication systems - J. Gowar, Prentice Hall India (1995)

3. Fibre optic communication - J. Palais, Prentice Hall India (1988)

4. Fundamentals of Fibre Optic Telecommunication -B. P. Pal., Wiley Eastern (1994)

5. Integrated Optics - R. G. Huspcrger. Springer Verlag, (1998)

6. Fundamentals of Fibre Optics-B. P. Pal, Wiley Eastern, (1994)

7. Understanding Fiber optics- J. Hecht, Pearson Edu. Inc (2006)

8. An introduction to Fiber Optics, Ghatak and Thyagarajan, Cambridge University Press 1998

9. Fibre optic sensors - principles and applications - B.D.Gupta, New India Publishing, (2006)

10. Fibre Optic Communication Systems, 3rd Edition - G.P. Agrawal, John Wiley andSons, (2002)

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	2	-	-						
CO 2	2	1	-	3	-	-						
CO 3	-	-	-	2	-	-						
CO 4	-	-	-	3	-	-						
CO 5	2	1	1	2	-	-						
CO 6	1	1	1	3	-	-						

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Project/Practical (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	SATELLITE AND RADAR SYSTEMS				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic concepts of microwave electronics and Antenna Theory				
Course Summary	This course explores about Satellite communications and RADAR systems				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand different types of satellite orbits and its applications	U	C	Instructor-created exams / Quiz Home Assignments
CO2	To analyse the power requirements for satellite links and communication payloads	An	P	Instructor-created exams / Quiz Home Assignments
CO3	To understand the fundamental principles of RF propagation and the impact of atmospheric conditions on RF signal propagation	U	C	Instructor-created exams / Quiz Home Assignments
CO4	To understand satellite access techniques and operation principle of GPS	U	C	Instructor-created exams / Quiz Home Assignments
CO5	To understand principle of RADAR operations and factors that affects RADAR signals	U	C	Instructor-created exams / Quiz Home Assignments
CO6	To analyse and compare the performance of various RADAR and LIDAR	Ap	P	Instructor-created exams / Quiz Home Assignments

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Satellite Communication**	**13**	
	1	Types of Communication Satellites	1	
	2	Uplink, Downlink and Satellite link design	2	
	3	Keplers law, Orbital parameters and perturbations	2	
	4	Subsystems of satellite-propulsion system, telemetry, tracking and control Transponder	1	**20**
	5	Earth stations-Antenna, feed and tracking system	2	
	6	Solar and sidereal days	1	
	7	Satellite access-FDMA, TDMA and CDMA	2	
	8	GPS-Principle of operation	2	
		Satellite Communications systems engineering, Louis J. Ippolito Jr. Satellite Communications, Dennis Roddy Satellite Communication Systems: Design Principles, M. Richharia GPS Theory and Practice, B. Hofmann Wollenhof, H. Lichtenegger and J. Collins		
II		**Propagation Effects**	**13**	
	9	Atmospheric effect on propagation and Loss in free space	4	
	10	Path analysis-Unfaded signal level and thermal noise	3	
	11	Threshold and frequency deviation	2	**15**
	12	Antenna gain and Friis Transmission formula	3	
	13	Sources of noise and Noise power ratio	1	
		Satellite Communications systems engineering, Louis J. Ippolito Jr. Satellite Communications, Dennis Roddy Satellite Communication Systems: Design Principles, M. Richharia		
III		**RADAR Fundamentals**	**14**	
	14	Block diagram	2	
	15	RADAR Frequencies, Range equation and ambiguities	6	**20**
	16	RADAR Displays and duplexers	4	
	17	RADAR cross sections	2	
		Radar Principles for the Non-Specialist, J. C. Toomay, Paul Hannen Radar systems, MerrilI Skolnik		
IV		**Special Purpose RADARs**	**10**	
	18	Pulsed RADAR, FM CW RADAR and Doppler RADAR	3	
	19	MTI and Pulse Compression RADAR	2	
	20	Air surveillance RADAR	3	**15**
	21	RADAR Jamming	1	
	22	LIDAR	1	
		Radar Principles for the Non-Specialist, J. C. Toomay, Paul Hannen Radar systems, MerrilI Skolnik		
V		**Open Ended Module**	**10**	
		Satellite link performance and mobile satellite channel Atmospheric effects of RADAR Antennas used in RADAR and Satellite Communication Tracking techniques of RADAR RCS Reduction		

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

Text Books:

1. Satellite Communications systems engineering, Louis J. Ippolito Jr.
2. Satellite Communications, Dennis Roddy
3. Satellite Communication Systems: Design Principles, M. Richharia
4. Radar Principles for the Non-Specialist, J. C. Toomay, Paul Hannen
5. Radar systems, MerrilI Skolnik
6. GPS Theory and Practice, B. Hofmann Wollenhof, H. Lichtenegger and J. Collins

Web resources:

1. https://www.youtube.com/watch?v=MEtgoFjNCEw&ab_channel=Dr.SapnaKatiyar
2. https://archive.nptel.ac.in/courses/108/105/108105154/
3. https://www.ll.mit.edu/outreach/radar-introduction-radar-systems-online-course
4. https://www.jpl.nasa.gov/edu/teach/activity/build-a-satellite/

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	3	2	2	2	1	3	1	-	2	2	-
CO 3	3	2	2	2	2	1	3	2	-	2	2	-
CO 4	3	1	3	2	1	2	3	2	-	2	2	-
CO 5	3	1	1	2	-	-	2	2	-	2	2	-
CO 6	2	3	2	2	3	3	2	-	-	3	2	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Assignments (20%)
- Final Exam (70%)

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	✓	✓		✓

Programme	B. Sc. ELECTRONICS				
Course Code					
Course Title	OPTIMISATION ALGORITHMS				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Foundational Mathematics and Set Theory 2. Genetic Fundamentals and Evolution				
Course Summary	This course is on various evolutionary optimization techniques. It provides basic exposition to the goals and methods of soft computing. It applies to intelligent techniques for problem solving.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand and solve problems using optimization techniques	U	C	Instructor-created exams / Quiz
CO2	Formulate real-world problems into mathematical optimization models.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Explore and apply various optimization algorithms	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Demonstrate a solid understanding of fundamental optimization concepts and principles.	U	C	Instructor-created exams / Home Assignments
CO5	Apply optimization techniques to linear and nonlinear programming problems.	Ap	P	Instructor-created exams / Home Assignments
CO6	Develop critical thinking skills in identifying optimization problems, selecting appropriate algorithms, and interpreting results	E	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)				

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Neural Networks**	**10**
	1	Machine Learning using Neural Network	2
	2	Learning algorithms, Supervised Learning Neural Networks	3
	3	Feed Forward Network	3
	4	Unsupervised Learning Neural Networks	2
II		**Conventional Optimization Techniques**	**10**
	5	Introduction to optimization techniques	3
	6	Statement of an optimization problem	3
	7	Classification	2
	8	Unconstrained optimization	2
III		**Optimisation Algorithms**	**20**
	9	Gradient search method	2
	10	Gradient of a function,	3
	11	Steepest gradient conjugate gradient	1
	12	Newton's Method	3
	13	Marquardt Method	3
	14	Constrained optimization	3
	15	Sequential linear programming	1
	16	Interior penalty function method	1
	17	External penalty function method	3
IV		**Evolutionary Optimization Techniques**	**8**
	18	Genetic algorithm	2
	19	Working principle, Basic operators and Terminologies	2
	20	Building block hypothesis	2
	21	Travelling Salesman Problem	1
	22	Particle swam optimization, Ant colony optimization	1
V		**Open Ended Module: Understanding Group Behaviour Model**	**12**
	1	**Case studies:** 1. Managing a large crowd in a social gathering 2. Direct marketing and other business models **Real-World Applications and Trade-offs:** Applications of Evolutionary Algorithms to solve Real World Problems **Open-Ended Exploration and Assessment:** Student-led research on Evolutionary Algorithms **Group Assignment:** Handling Pattern Recognition Task using PSO	12

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

Text Books:

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications,Prentice Hall,
1995.
3. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, Neuro-Fuzzy and Soft Computing, Prentice-
Hall of India, 2003.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
6. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc,
1999.
7. Singiresu S. Rao, Engineering optimization Theory and practice, John Wiley & sons, inc,Fourth
Edition, 2009
8. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
9. VenkataRao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, springer 2012

Web resources:

1. https://archive.nptel.ac.in/courses/108/105/108105132
2. https://www.youtube.com/playlist?list=PLBlnK6fEyqRjMH3mWf6kwqiTbT798eAOm
3. https://pages.uoregon.edu/rayfrey/DigitalNotes.pdf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	-	-	-						
CO 2	2	1	-	-	-	-						
CO 3	-	-	2	-	-	-						
CO 4	-	-	1	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	SEMICONDUCTOR FABRICATION TECHNOLOGY				
Type of Course	**Elective**				
Semester	V				
Academic Level	300- 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Basic Knowledge in Physics and basics of semiconductor theory.				
Course Summary	This course provides an overview of the foundational concepts of semiconductor fabrication technology delving into topics such as Hybrid and Monolithic IC fabrication techniques.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To Understand the basic concepts of semiconductor physics and material science relevant to IC fabrication.	U	C	Instructor-created exams / Quiz
CO2	To Analyze the different stages of the IC fabrication process in detail, including photolithography, etching, doping, deposition, metallization, and packaging.	U	C	Assignment /Seminar
CO3	To address the challenges and opportunities in miniaturization and scaling of transistors.	U	C	Quiz / Assignment
CO4	To develop critical thinking and problem-solving skills through case studies and discussions.	U	C	Instructor-created exams
CO5	To describe the CMOS and BJT process sequence.	U	C	Seminar Presentation
CO6	To understand the challenges and limitations of present technology and emerging trends in IC fabrication.	U	C	Discussion

*** Cognitive Level:**
R - Remember**, U** - Understand**, Ap** - Apply**, An** - Analyze**, E** - Evaluate**, C** - Create

 # Knowledge Level: F - Factual**, C** - Conceptual**, P** - Procedural**, M** - Metacognitive

Detailed Syllabus:

Module	Unit	Topics	Hours 60	Marks 70
I		**Introduction to Integrated Circuits**	**11**	**15**
	1	History of semiconductor devices.	1	
	2	Moore's law, feature size and minimum feature size trend.	1	
	3	Advantages of ICs over Discrete Components.	2	
	4	Features of Hybrid IC Technology.	3	
	5	Features of Monolithic IC Technology.	3	
	6	Classification of Integrated Circuits based on Chip size	1	
		Integrated Circuits by K R Botkar, Khanna Publishers.		
II		**Crystal Growth And Wafer Preparation**	**9**	
	7	Understanding the Silicon crystal structure	2	**15**
	8	Clean room technology	2	
	9	Crystal Growth and Silicon Wafer Preparation.	3	
	10	Crystalline defects and their effects.	2	
		G. S. May and S. M. Sze, *Fundamentals of Semiconductor Fabrication*, Wiley India		
III		**Unit Fabrication Steps in IC**	**19**	
	11	Epitaxial growth processes	2	
	12	Oxidation: Thermal Oxidation and PECVD	3	
	13	Photolithography: Electron beam and X- ray lithography	3	
	14	Etching: Wet Chemical Etching and Dry Etching.	3	
	15	Doping : Diffusion and ion implantation	3	
	16	Deposition: Physical vapor deposition and chemical vapor deposition	3	
	17	Planarization: chemical–mechanical polishing (CMP)	2	
		G. S. May and S. M. Sze, *Fundamentals of Semiconductor Fabrication*, Wiley India, 2004.		

IV	**Process Integration**		**9**	
	18	Schematic representation of IC fabrication	1	**15**
	19	Bipolar Technology: n–p–n bipolar transistor fabrication sequence.	3	
	20	MOS Technology: Basics of NMOS, PMOS and CMOS fabrication sequence.	3	
	21	Automated Test Equipment (ATE)	1	
	22	Die Separation and Package Types	1	
	G. S. May and S. M. Sze, *Fundamentals of Semiconductor Fabrication*, Wiley India, 2004.			
V	**Open Ended Module**		**12**	
	1. Challenges for Integration. (Seminar,Discussion) 2. System on Chip. (Case study) 3. Future Trends in IC Technology (Seminar,Discussion)			

Textbook:	1. G. S. May and S. M. Sze, *Fundamentals of Semiconductor Fabrication*, Wiley India, 2004. 2. Integrated Circuits by K R Botkar, Khanna Publishers.
Reference:	1. Richard C. Jaeger, "Introduction to Microelectronic Fabrication" 2. S. M. Sze, *Semiconductor Devices: Physics and Technology*, 2nd Edn., Wiley India, 2011. 3. Introduction to Semiconductor Manufacturing Technology – Second Edition, Hong Xiao, SPIE Press, 2012.
Online Resources:	1. Prof. Naresh Kumar Emani, IIT Hyderabad: https://youtu.be/mRkONceq2Bk?sib09VKEhVTF5SjzI- 2. https://www.learnabout-electronics.org

Note: The course is divided into five modules, with four modules together having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO 4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	2	-	-	2	-	-	2	-	-
CO 2	3	3	3	-	-	-	3	3	3	-	-	2
CO 3	2	-	-	2	-	-	2	-	-	2	-	-
CO 4	2	-	3	-	-	-	2	3	-	2	1	-
CO 5	2	-	-	-	2	-	2	-	-	2	-	-
CO 6	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 (20%)
- Final Exam (70%)

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	✓		✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	COMPUTER HARDWARE & NETWORK MAINTENANCE				
Type of Course	**Elective**				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Basic knowledge of computer 2. Familiarity with operating systems				
Course Summary	This course provides a structured approach to learning computer hardware and network maintenance, ensuring that students are well-prepared for entry-level IT support roles or for further specialized studies.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will be able to identify and describe the key components of a computer system	U	C	Instructor-created exams / Quiz
CO2	Students will be able to assemble a PC and install operating systems (Windows/Linux)	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Students will be able to analyse and diagnose common hardware issues using diagnostic tools and software	An	P	Seminar Presentation / Group Tutorial Work
CO4	Students will be able to design and implement a secure home or small office network, including the selection and configuration of network devices	C	P	Practical Assignment / Observation of Practical Skills
CO5	Students will be able to evaluate and select appropriate PC components for upgrades, considering factors such as performance enhancement, compatibility, and cost	E	P	Practical Assignment / Observation of Practical Skills
CO6	Students will be able to create a comprehensive maintenance and troubleshooting strategy for personal computers that includes preventive maintenance, troubleshooting workflows, and upgrade plans	C	P	Viva Voce

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

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Computer System Architecture**	**11**	**15**
	1	Introduction to computer system components	2	
	2	Understanding system buses, connectors, and expansion slots	2	
	3	Overview of peripheral devices (Input/Output)	2	
	4	BIOS/UEFI settings	3	
	5	Boot processes	2	
	"Computer Organization and Design MIPS Edition: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy "Computer Systems: A Programmer's Perspective" by Brent Bershad and Heath LeBlanc			
II		**Assembly and Configuration**	**13**	**20**
	6	Assembling a PC: Step-by-step guide and hands-on practice	3	
	7	Laptop and its internal structure	2	
	8	Installing and configuring operating systems (Windows/Linux)	3	
	9	Customize Operating System	2	
	10	Drivers and software installation	1	
	11	Device Driver, OS Update and Firewall Security	2	
	"Build Your Own PC Do-It-Yourself For Dummies" by Mark L. Chambers "Upgrading and Repairing PCs" by Scott Mueller			
III		**Hardware Troubleshooting and Maintenance**	**11**	**15**
	12	Diagnostic tools and software for troubleshooting	2	
	13	Common hardware issues and repair techniques	3	
	14	Preventive Maintenance and Troubleshooting of PC	2	
	15	Upgrading components for enhanced capabilities	2	
	16	PC tuning, overclocking, and cooling solutions	2	
	"Upgrading and Repairing PCs" by Scott Mueller "Troubleshooting and Maintaining Your PC All-in-One For Dummies" by Dan Gookin			
IV		**Network Setup, Management, and Security**	**13**	**20**
	17	Networking fundamentals (LAN/WAN, routers, switches, protocols)	3	
	18	Network Protocols	2	
	19	Wired and wireless network setup and configuration	2	
	20	Network troubleshooting and tools	3	
	21	Network security	2	
	22	Data backup and Data recovery	1	
	"Networking All-in-One For Dummies: Incorporating the Boundary Element Method" by Doug Lowe "Network Security Essentials: Applications and Standards" by William Stallings			
V		**Open Ended Module:**	**12**	
		• Demonstrate testing and troubleshooting for power supplies in I/O devices and trace circuit of PC SMPS • Assemble and repair Desktop Computer with all its hardware components. • Install different Operating System and all other application software. • Install Printer, Scanner and troubleshoot their faults. • Set up and configure Networking System using various network devices.	12	

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

1. "Upgrading and Repairing PCs" by Scott Mueller
2. "Computer Organization and Design MIPS Edition: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy
3. “Computer Systems: A Programmer's Perspective” by Brent Bershad and Heath LeBlanc
4. "Build Your Own PC Do-It-Yourself for Dummies" by Mark L. Chambers
5. "Troubleshooting and Maintaining Your PC All-in-One For Dummies" by Dan Gookin
6. “Networking All-in-One for Dummies: Incorporating the Boundary Element Method” by Doug Lowe
7. "Network Security Essentials: Applications and Standards" by William Stallings

Mapping of COs with PSOs and POs:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B.Sc. Electronics				
Course Code					
Course Title	MOBILE COMMUNICATION				
Type of Course	**Elective**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	-	60
Pre-requisites	Basic Knowledge in Principles of Communication				
Course Summary	This course introduces students to the Wireless Communication Principles, development and evolution of wireless communication, its underlying architecture and various technologies adopted in the present era of communication				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Knowledge of fundamental Wireless communication principles and practices.	**R**	**C**	Internal Exam
CO2	Understand the basic concepts of basic Cellular System and the design requirements	**U**	**C**	Internal Exam
CO3	Gain knowledge and awareness of the technologies like GSM, GPRS, EDGE etc.	**R**	**C**	Discussion /Assignment
CO4	Operation of the communication devices in terms of data transmission and losses.	**U**	**C**	Internal Exam

CO5	Understanding of the emerging trends in Wireless communication like WiFi, WiMAX	**U**	**C**	Discussion / Quiz
CO6	Critically assess the limitations and future developments of mobile communication technologies	**Ap**	**C**	Discussion /Assignment

*** Cognitive Level:**
R - Remember**, U** - Understand**, Ap** - Apply**, An** - Analyze**, E** - Evaluate**, C** - Create

 # Knowledge Level: F - Factual**, C** - Conceptual**, P** - Procedural**, M** - Metacognitive

Detailed Syllabus

Module	Unit	Content	Hours (60)	Marks (70)
I	**Overview of Wireless Communication System**		**9**	**15**
	1	Introduction, Advantages and Challenges	3	
	2	Wireless Communication Network Architecture	2	
	3	Functional Block, Spectrum Allocation Methods	2	
	4	Wireless communication system - Cordless, Cellular, Paging, Bluetooth, Wireless data service system, Zigbee, WLL	2	
	Sections from References: 1. Mainak Chowdhury, Arumita Biswas, 'Wireless Communication Theory and Practice' Cambridge University Press			
II	**Introduction to Cellular Systems**		**12**	**15**
	5	Introduction to Cellular Systems, Development trend in cellular system,	2	
	6	Cellular System Principles- System Components, Cell: Structure and type,	2	

	7	Channel assignment, Channel Reuse.	2	
	8	Source Interference, Interference Mitigation Technique	2	
	9	Handsoff: *Initiation, Protocol, prioritisation, classification*	2	
	10	Diffraction losses, Fading	2	
	Sections from References: 1. Mainak Chowdhury, Arumita Biswas, 'Wireless Communication Theory and Practice' Cambridge University Press			
III	**Global system for Mobile**		**15**	**15**
	11	GSM Architecture	3	
	12	GSM Interfaces: *Air Interface, Abis Interface, A interface*	2	
	13	Spectrum Allocation, Areas of GSM, Logical Channels	2	
	14	GSM Processes*: Security and data confidentiality, Location update, Call management, Handover management*	2	
	15	GPRS services, System architecture	4	
	16	Enhanced Data Rates for GSM Evolution (EDGE)	2	
	Sections from References: 1. Mainak Chowdhury, Arumita Biswas, 'Wireless Communication Theory and Practice' Cambridge University Press			
IV	**3G, HSDPA, HSUPA and LTE**		**12**	**15**
	17	WCDMA Based 3G Network,	3	
	18	HSDPA, HSUPA	2	
	19	LTE system architecture, Key technologies of LTE	2	
	20	Multi carrier technology, MIMO Technology	1	
	21	IEEE 802.11, Topologies of 802.11, IEEE 802.11 Variants	2	

	22	MAC techniques, Introduction to WiMAX	2	
	Sections from References: 1. Mainak Chowdhury, Arumita Biswas, 'Wireless Communication Theory and Practice' Cambridge University Press			
V	**Open Ended Module**		**12**	
	Case study: On any Advanced Mobile communication System Open-Ended Exploration and Assessment: ● Conduct a discussion on present communication devices. ● Invite industry experts or researchers to share their knowledge and experience with the class.		12	

Resources:

Text Book	1. Mainak Chowdhury, Arumita Biswas, 'Wireless Communication Theory and Practice' Cambridge University Press

Reference Books	1. 'Wireless Communication Principles and Practices',Rappaport T. S, Pearson Education, Asia, New Delhi, 3rd Ed.2003. 2. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications 3. 'Mobile communication', JochenSchiller, Pearson Education,Asia. 4. 'Principles and Applications of GSM', Vijay K Garg, Joseph E Wilkes, Pearson Education. 5. Wireless digital communication, Kamilo Feher, PHI 6. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI). 7. Wireless Communications-T.L.Singh-TMH 8. Adhoc Mobile Wireless network, C.K.Toh Pearson
Online Resource	1. Prof. David Koilpillai, Dept. of Electrical Engineering, IIT Madras: https://youtu.be/f2wlHL1Sok8?si=6L3imkxhpAstelQn

Mapping of COs with PSOs and POs:

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO 1	2	-	-	2	-	-	2	-	-	-	-	-
CO 2	2	2	-	-	-	-	2	-	-	-	-	-
CO 3	-	-	1	-	-	-	1	-	-	-	-	-
CO 4	-	-	2	-	-	-	2	2	-	-	-	-
CO 5	-	-	-	-	1	-	1	-	-	1	1	-
CO 6	-	-	-	-	-	2	-	-	2	-	2	2

Correlation Levels:

Level	**Correlation**
-	Nil
1	Slightly / Low
2	
3	

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam (20%)
- Final Exam (70%)

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		✓		

Programme	B. Sc. Electronics				
Course Code					
Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE				
Type of Course	**Elective**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamental Mathematics Concepts 2. Basic programming knowledge				
Course Summary	This course aims to provide students with a comprehensive understanding of the intersection between artificial intelligence and writing. It covers fundamental concepts, techniques, and applications of AI in the field of writing, including natural language processing, machine learning, and language generation				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To recall the history and foundational concepts of Artificial Intelligence.	R	F	Instructor-created exams / Quiz
CO2	To identify different types of AI agents and their applications.	U	C	Instructor-created exams / Quiz
CO3	To analyse the ethical implications of AI development and deployment	U	F	Seminar Presentation / Group Tutorial Work
CO4	To represent AI domain knowledge with logic systems and interface techniques for reasoning in AI systems	Ap	P	Seminar Presentation / Group Tutorial Work
CO5	To iIllustrate different types of learning techniques used in intelligent systems	U	C	Instructor-created exams / Quiz
CO6	To assess the societal and economic impact of AI advancements critically	E	F	Seminar Presentation / Group Tutorial Work

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)

Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks(70)
I	**Introduction**		**10**	
	1	What is Artificial Intelligence(AI)?	1	16
	2	The Foundations of AI, History of AI, Applications of AI.	2	
	3	Intelligent Agents – Agents and Environments	2	
	4	Good behaviour: The concept of rationality, nature of Environments, Structure of Agents	2	
	5	Solving Problems by searching-Problem solving Agents	2	
	6	Example problems	1	
1. Gerhard Welss, - Multi Agents Systems, Second Edition, 2013 **2. David L. Poole and Alan K. Mackworth, - Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010**				
II	**Solution Searching**		**14**	**20**
	7	Searching for solutions	2	
	8	Uninformed search strategies, Informed search strategies	2	
	9	Heuristic functions	2	
	10	Adversarial search - Games, Optimal decisions in games	2	
	11	The Minimax algorithm, Alpha-Beta pruning.	2	
	12	Constraint Satisfaction Problems – Defining CSP	1	
	13	Constraint Propagation- inference in CSPs, Backtracking search for CSPs, Structure of CSP problems	3	
1. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill,2017 **2. M. Tim Jones, - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers Inc.; First Edition, 2008.**				
III	**Knowledge Representation**		**13**	**20**
	14	Logical Agents – Knowledge based agents, Logic,	3	
	15	Knowledge Representation First Order Predicate Logic – Prolog Programming	2	
	16	Unification – Forward Chaining-Backward Chaining – Resolution –	3	
	17	Knowledge Representation – Ontological Engineering-Categories and Objects –	2	
	18	Events – Mental Events and Mental Objects – Reasoning Systems for Categories -Reasoning with Default Information	3	
1. I. Bratko, —Prolog: Programming for Artificial Intelligence, Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011. **2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill,2017**				
IV	**AI applications**		**11**	**14**
	19	Language Models	2	
	20	Information Retrieval, Information Extraction	3	
	21	Natural Language Processing , Machine Translation , Speech Recognition	3	
	22	Robot – Hardware –Perception – Planning – Moving	3	

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009. **2. Artificial Intelligence: A Modern Approach, 4th Edition, Stuart Russell, peter Norvig University of California at Berkeley, Pearson education, 2020.**				
V	**Open Ended Module: current contours & sub-disciplines**		**12**	
	1	Contemporary Developments Related to the Course during the Semester Concerned Exploring sub-discipline of AI	12	

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

Text books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.

2. Artificial Intelligence: A Modern Approach, 4th Edition, Stuart Russell, peter Norvig University of California at Berkeley, Pearson education, 2020.

3. I. Bratko, ―Prolog: Programming for Artificial Intelligence, Fourth Edition, Addison-Wesley Educational Publishers Inc., 2011.
4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2017
5. M. Tim Jones, - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers Inc.; First Edition, 2008.
6. Nils J. Nilsson, - The Quest for Artificial Intelligence, Cambridge University Press, 2009.
7. Gerhard Welss, - Multi Agents Systems, Second Edition, 2013
8. David L. Poole and Alan K. Mackworth, - Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
9. Dan W. Patterson, "Introduction to AI and ES", PearsonEducation,2007

Web resourse:

1. https://nptel.ac.in/courses/106105077
2. http://www.digimat.in/nptel/courses/video/106102220/L01.html

Mapping of COs with PSOs and POs :

	PSO	PSO	PSO	PSO4	PSO	PSO6	PO1	PO2	PO3	PO4	PO5	PO6

	1	2	3		5							
CO 1	-	-	-	-	-	-	2	1	-	-	-	-
CO 2	1	-	-	-	-	-	2	1	-	-	-	-
CO 3	-	-	1	-	-	-	-	-	1	-	-	2
CO 4	2	3	1	-	2	1	-	2	-	2	-	-
CO 5	2	2	-	-	-	1	2	2	-	1	-	-
CO 6	-	-	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 (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Presentation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓
CO 3	✓	✓		✓

CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6			✓	

Programme	B.Sc. Electronics				
Course Code					
Course Title	SMART MATERIALS				
Type of Course	**Major**				
Semester	V				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4			60
Pre-requisites	1. Fundamentals of Materials 2. Classification of Materials				
Course Summary	This course offers a comprehensive introduction to smart materials, their definitions, needs, classifications, and applications. It is designed to provide students with an understanding of how smart materials respond to changes in their environment and how they can be used in various technological applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Define and describe smart materials and understand their importance in technological advancements.	U	C	Instructor-created exams / Quiz
CO2	Classify smart materials based on their properties and identify suitable applications for each class	U	C	Practical Assignment / Observation of Practical Skills
CO3	Explain the principles behind nanomaterials and shape memory alloys, and discuss their roles in modern electronics and devices.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Understand the operation and applications of rheological fluids, including magneto-rheological and electro-rheological fluids.	U	C	Instructor-created exams / Home Assignments
CO5	Analyze and evaluate the advantages and limitations of various smart	An	P	One Minute Reflection

	materials and their impact on design and functionality.			Writing assignments
CO6	Conduct research on recent developments in smart materials, synthesize information from academic journals, and present findings effectively.	C	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I	**Introduction to Smart Materials**		**8**	**16**
	1	Definition of Smart Materials	1	
	2	Need for Smart Materials	1	
	3	Classification and Applications of Smart Materials	2	
	4	Piezo electric and Magneto strictive Materials	2	
	5	Ultra-Light Materials	2	
II	**Nano Materials**		**10**	
	6	Definitions and Classification of Nano Materials	3	**16**
	7	Graphene, Carbynes and Nano composites	2	
	8	Fabrication Techniques of Nano-Materials	2	
	9	Characterisation Techniques of Nano-Materials: Microscopic and Diffraction Techniques	3	
III	**Shape Memory Alloys**		**10**	
	10	Definition of Shape Memory Alloys	2	**18**
	11	Working of Shape Memory Alloys	2	
	12	Characteristics of Shape Memory Alloys	3	
	13	Applications of Shape Memory Alloys	3	
IV	**Rheological Fluid**		**20**	
	14	Definition of Magneto-Rheological Fluid	1	**20**
	15	Parts of Magneto-Rheological Fluid	2	
	15	Mode of Magneto-Rheological Fluid (MRF)	2	
	16	Advantages and Disadvantages of MRF	2	
	17	Applications of MRF:	2	
	18	Linear MR devices and Rotary MR devices	2	
	19	Electro-Rheological Fluid: Definition and Parts	3	
	20	Mode of Electro -Rheological Fluid (ERF)	2	
	21	Advantages and Disadvantages of ERF	2	
	22	Applications of ERF	2	
V	**Open Ended Module: Recent Developments in Smart Materials**		**12**	
		Recent Research Developments Real Time Applications Review Writing Based on Research Journal Presentation	10	

		Open-Ended Exploration and Assessment: Student-led research on Smart Materials. Presentation and discussion of findings **Group Assignment:** Write a Review Report based on Recent Journal Publications		

Mapping of COs with PSOs and POs :

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO 1	1	-	2	-	-	-
CO 2	2	-	1	2	-	-
CO 3	1	1	-	-	-	-
CO 4	2	-	-	-	-	-
CO 5	-	-	2	1	-	-
CO 6	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 (20%)
- Final Exam (70%)

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			✓	

Suggested Learning Resources:

Text Books:

1. "Smart Structures –Analysis and Design", A.V.Srin ivasan, Cambridge University Press, New York, 2001, (ISBN:0521650267).

2. "Smart Materials and Structures", M.V.Gandhi and B.S.Thompson Chapmen & Hall, London, 1992 (ISBN:0412370107)

Website Links

1. https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.tce.edu/sites/default/files/ PDF/RV4-Smart-Materials.pdf
2. https://civil.poriyaan.in/topic/shape-memory-alloys--sma--40134/chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://srict.in/UploadedFiles/133039117797739107.pdf
3. https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.tce.edu/sites/default/files/ PDF/RV8-ER-Fluid.pdf

Programme	B. Sc. Electronics				
Course Code					
Course Title	INTRODUCTION TO MACHINE LEARNING				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamental AI Concepts 2. Basic programming knowledge				
Course Summary	This course enables the learners to understand the advanced concepts and algorithms in machine learning. The course covers the standard and most popular supervised learning algorithms and helps the students to provide machine learning based solutions to real world problems.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To define and recall key concepts in machine learning, such as supervised learning, semi-supervised, unsupervised learning, and reinforcement learning	R	C	Instructor-created exams / Quiz
CO2	To explain the working principles of various ML algorithms and their strengths and weaknesses	U	C	Instructor-created exams / Quiz
CO3	To implement and apply machine learning algorithms to real-world datasets	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	To solve practical problems using supervised and unsupervised learning techniques.	Ap	P	Seminar Presentation / Group Tutorial Work
CO5	To evaluate the performance of machine learning models through metrics like accuracy, precision, recall, and F1 score	An	C	Instructor-created exams / Quiz
CO6	To assess the ethical considerations and potential biases in machine learning application	U	F	Seminar Presentation / Group Tutorial Work

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	marks(70)
I		**Introduction**	**10**	**15**
	1	Introduction, easy for human hard for machines, a simple predicting machine	2	
	2	Machine learning paradigms-supervised, semi-supervised, unsupervised, reinforcement learning	2	
	3	Basics of parameter estimation - maximum likelihood estimation (MLE) and maximum a posteriori estimation (MAP).	2	
	4	Introduction to Bayesian formulation.	2	
	5	Gaussian Mixture Models, Hidden Markov models	2	
1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010. 2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016				
II		**Supervised Learning**	**17**	**20**
	6	Regression - Linear regression with one variable, Linear regression with multiple variables	2	
	7	solution using gradient descent algorithm and matrix method, basic idea of overfitting in regression.	2	
	8	Linear Methods for Classification- Logistic regression, Naive Bayes,	2	
	9	Decision tree algorithm ID3.	2	
	10	SVM - Introduction, Maximum Margin Classification, Mathematics behind Maximum Margin Classification, Maximum Margin linear separators, soft margin SVM classifier	3	
	11	Random Forest	2	
	12	Artificial Neural Network: Introduction	2	
	13	Perceptrons, multi-layer networks and back propagation	2	
1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010. 2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016				
III		**Unsupervised Learning**	**11**	**20**
	14	Clustering - Similarity measures, Supervised vs Unsupervised Clustering Analysis	2	
	15	Hierarchical Agglomerative Clustering,	2	
	16	K-means partitional clustering	2	
	17	Expectation maximization (EM) for soft clustering	2	
	18	Dimensionality reduction – Principal Component Analysis.	3	
1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997 2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.				
IV		**Modelling and evaluation**	**10**	**15**
	19	Building the model, Training a model	2	
	20	Evaluating a model, improving a model	2	
	21	Classification Performance measures - Precision, Recall,	3	

		Accuracy, F-Measure, Receiver Operating Characteristic Curve (ROC)		
	22	- Area Under Curve (AUC. Bootstrapping, Cross Validation, Ensemble methods, Bias-Variance decomposition	3	
1. Tom Mitchell, Machine Learning, McGraw-Hill, 1997 2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.				
V	**Open Ended Module: real world problems using ML methods**		**12**	
	1	Exercises to solve the real-world problems using the following machine learning methods: Linear Regression Logistic Regression Neural Networks Support Vector Machines K-Means Clustering & PCA	12	

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd edition, MIT Press 2010.
2. Mohammed J. Zaki and Wagner Meira, Data Mining and Analysis: Fundamental Concepts and Algorithms, Cambridge University Press, First South Asia edition, 2016.
3. Jake VanderPlas, Python Data Science Handbook, O'Reilly Media, 2016
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.
5. Christopher Bishop. Neural Networks for Pattern Recognition,Oxford University Press, 1995.
6. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective, MIT Press 2012.
7. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements Of Statistical Learning, Second edition Springer 2007.
8. P. Langley, Elements of Machine Learning, Morgan Kaufmann, 1995.
9. Richert and Coelho, Building Machine Learning Systems with Python.
10. Davy Cielen, Arno DB Meysman and Mohamed Ali.Introducing Data Science.

Web resourses:

1. https://nptel.ac.in/courses/106106139
2. www.digimat.in/nptel/courses/video/106106198/L01.html

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	1	-	-	-	-	2	1	1	-	1	-
CO 2	-	1	1	-	2	2	2	2	-	1	-	-
CO 3	-	2	1	-	3	1	-	1	-	1	-	-
CO 4	-	1	2	-	2	2	-	2	-	2	-	-
CO 5	1	1	-	-	-	-	2	1	-	1	-	-
CO 6	-	-	-	-	-	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 (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

	Internal Exam	Assignment	Presentation	End Semester Examinations
CO 1	✓			✓
CO 2	✓			✓

CO 3	✓	✓		✓
CO 4		✓	✓	✓
CO 5		✓	✓	✓
CO 6	✓	✓	✓	✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	VLSI TECHNOLOGY				
Type of Course	**Elective**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	• Strong foundation in digital logic design (Boolean algebra, logic gates) • Basic understanding of electronics and semiconductor devices • Programming experience (familiarity with C++ or similar languages)				
Course Summary	This course introduces students to the fundamental concepts, design principles, and implementation techniques of Very Large-Scale Integration (VLSI) circuits. Through a combination of theory and practical classes, students will learn to analyze, design, and simulate digital circuits using hardware description languages (HDLs) and programmable logic devices (FPGAs). The course covers topics such as combinational and sequential circuits, FSMs, FPGAs, and HDL design.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1				
CO2				
CO3	Understand the architecture and key features of Field-Programmable Gate Arrays (FPGAs) and their advantages in digital system design	R & U	F & C	Seminar Presentation / Group Tutorial Work
CO4				
CO5	To Utilize hardware description languages (HDLs) for digital circuit design	Ap & C	P	Seminar presentations
CO6	Utilize hardware description languages (HDLs) such as Verilog or VHDL for digital circuit design and simulation in VLSI projects.	Ap	C	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Combinational and Sequential circuit elements**	**8**	**12**
	1	Classification of ICs, features of ICs: monolithic and hybrid ICs	1	
	2	Historical evolution and future trends of VLSI technology	1	
	3	Digital logic design flow. Review of combinational circuits.	2	
	4	Combinational building blocks: multiplexers, demultiplexers	2	
	5	Decoders, encoders and adder circuits.	2	
	VLSI Fabrication Principles: S.K. Gandhi: John Wiley Inc.			
II		**Introduction to VLSI Physical Design Automation**	**16**	**23**
	7	Design Representation, VLSI Design Styles	2	
	8	VLSI Physical Design automation.	2	
	9	Partitioning, Floor planning	2	
	10	Pin Assignment, Standard cell	2	
	11	Performance issues in circuit layout, delay models, Layout styles.	2	
	12	Placement: Problem formulation, classification,	2	
	13	Simulation based placement algorithms, Partitioning based placement algorithms	2	
	14	Time driven and performance driven placement.	2	
	Algorithms for VLSI Physical Design Automation – Naveed Sherwani, 3rd Ed., 2005			
III		**Logic design and FPGA**	**12**	**15**
	14	Evolution of Programmable logic devices. PAL, PLA , CPLD and FPGA	2	
	15	FPGA Technology: FPGA resources - Logic Blocks and Interconnection Resources; Economics and applications of FPGAs	2	
	16	Implementation Process for FPGAs Programming Technologies - Static RAM Programming,. Anti Fuse Programming	2	
	17	EPROM and EEPROM Programming Technology	2	
	18	Commercially available FPGAs - Xilinx FPGAs, Altera FPGAs	2	
	19	FPGA Design Flow Example - Initial Design Entry, Translation to XNF Format, Partitioning, Place and Route,	2	
	1. FPGA-Based System Design Wayne Wolf, Verlag: Prentice Hall 2. Modern VLSI Design: System-on-Chip Design (3rd Edition) Wayne Wolf, Verlag			
IV		**Verilog HDL:**	**12**	**20**
	20	Introduction to HDL. Verilog primitive operators and structural Verilog Behavioral Verilog.	6	
	21	Design verification. Modelling of combinational and sequential circuits	3	
	22	(including FSM and FSMD) with Verilog Design examples in Verilog.	3	
	Verilog HDL Synthesis A practical primer : J.Bhasker VHDL primer : J Bhasker			

	Open Ended Module		**12**	
V	1	**Case studies:** • Design and implementation of a real-world application using an FPGA (e.g., simple audio filtering, data acquisition system) • Comparison of different VLSI design methodologies for a specific application • Analysis of the impact of VLSI technology on various industries **Real-World Applications and Trade-offs:** **1.** Discuss ethical considerations and environmental impact of FPGA technology **2.** Explore emerging trends and applications of FPGAs in areas like artificial intelligence, machine learning, and edge computing. **Open-Ended Assessment:** Develop teamwork and communication skills through collaborative projects involving FPGA design and implementation **Group Assignment:** Evolution of IC technologies	12	

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs :

	PSO 1	PSO 2	PSO 3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	-	-	1	-	-
CO 2	2	3	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	1	-	-	-	-	-	2	-	-	-
CO 4	-	-	2	3	-	-	-	-	-	-	-	1

CO 5	-	1	-	-	-	-	-	-	-	-	1	-
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

REFERENCES

R1.	"VLSI Fabrication Principles"	S.K. Gandhi	John Wiley Inc.
R2.	. "VLSI Technology"	S.M. Sze	McGraw Hill
R3.	"Silicon VLSI Technology: Fundamentals, Practice and Modeling"	James D. Plummer	Pearson Education
R4.	Principles of Digital Systems Design and VHDL.	LizyKurien and Charles Roth.	Cengage Publishing. ISBN-13: 978-8131505748
R5.	Verilog HDL	Palnitkar, Samir	Pearson Education; Second edition (2003)

Programme	B.Sc. Electronics				
Course Code					
Course Title	POWER ELECTRONICS				
Type of Course	**Elective**				
Semester	V				
Academic Level	300-399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	Knowledge in Electronic Devices and Circuits				
Course Summary	This course introduces the principles of power electronics, power semiconductor devices, switching techniques, types of converters, control methods and its applications.				

Course Outcomes (CO): .

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To identify power electronic semiconductor devices, its operation and application.	U	C	Instructor-created exams/ Quiz
CO2	To understand the turn on and power electronic devices.	U	C	Assignment
CO3	To understand different firing, commutation and protection circuits for thyristors.	U	C	Seminar Presentation / Group Tutorial Work
CO4	To understand the principles and operation of various power electronics converters such as rectifiers, choppers, inverters, and AC voltage controllers	U	C	Internal exams
CO5	To understand the classifications and operation of switch mode regulators.	U	C	Group Discussion/ Quiz
CO6	To identify and discuss the applications of power electronics in various domains	Ap	C	Internal exams/ Quiz

*** Cognitive Level:**
R - Remember**,** U - Understand**,** Ap - Apply**,** An - Analyze**,** E - Evaluate**,** C – Create

 # Knowledge Level: F **-** Factual**,** C - Conceptual**,** P - Procedural**,** M - Metacognitive

Detailed Syllabus:

Module	Unit	Content	Hours (60)	Marks (70)
I	**Power Semiconductor Devices**		**9**	**15**
	1	Power Diode, DIAC , TRIAC	2	
	2	Characteristics of Power Transistors	1	
	3	Characteristics of Thyristor / SCR	2	
	4	Gate Turn Off Thyristor (GTO)	1	
	5	Two transistor model of Thyristor	1	
	6	SCR Specification and Ratings	2	
	Sections from References: 1. Power Electronic Drives and Advanced Applications, Vinod Kumar, Ranjan kumar Behra, Dheeraj Joshi, Umesh Bansal, CRC Press			
II	**Thyristor control and Protection circuits**		**13**	**20**
	7	SCR: Methods of Turn ON	2	
	8	SCR: Firing (triggering) Circuits	3	
	9	Series and Parallel operation of SCR	2	
	10	Thyristor commutation techniques *(Circuit operation only)*	4	
	11	Protection of SCR	2	
	Sections from References: 1. Power Electronic Drives and Advanced Applications, Vinod Kumar, Ranjan kumar Behra, Dheeraj Joshi, Umesh Bansal, CRC Press 2. Industrial and Power Electronics G K Mithal, Dr. Maneesha Gupta, Khanna Publishers.			
III	**Power Electronic Converters**		**12**	**20**
	12	AC-DC Converters (Rectifiers): Thyristor Circuits and their Control, Single-Phase Converters	2	
	13	DC-DC Converters (Choppers): Step down (Buck) converter, Step Up (Boost) converter	3	
	14	Step up/Step down (Buck-Boost) converter and Cuk converters.	2	

	15	DC-AC Converter (Inverters): Single-Phase Inverters	3	
	16	AC –AC Converter: Single Phase Half wave AC voltage Controller	2	
	Sections from References: 1. Industrial and Power Electronics G K Mithal, Dr. Maneesha Gupta, Khanna Publishers.			
IV	**Applications of Power Electronics**		**11**	**15**
	17	Switched Mode Power Supplies (SMPS)	3	
	18	Power conditioners, Uninterruptible power supplies (UPS)	2	
	19	Induction Heating..	2	
	20	Battery Charging Regulator.	1	
	21	Emergency Lighting System.	1	
	22	Electric vehicles battery chargers.	2	
	Sections from References: 1. Power Electronics M D Singh, K B Khanchandani, Tata Mc Graw Hill			
V	**Open Ended Module:**		**12**	
		Case studies: Wireless Power Transfer in electric vehicle Real-World Applications and Trade-offs ● Identify the operation of Fan Speed controller ● Construct an LED Emergency Lamp Open-Ended Exploration and Assessment: ● Study and analyse the operation of a SMPS adaptor		
	Sections from References: 1. Power Electronic Drives and Advanced Applications, Vinod Kumar, Ranjan kumar Behra, Dheeraj Joshi, Umesh Bansal, CRC Press			

Text Books:	1. Power Electronic Drives and Advanced Applications, Vinod Kumar, Ranjan kumar Behra, Dheeraj Joshi, Umesh Bansal, CRC Press 2. Industrial and Power Electronics G K Mithal, Dr. Maneesha Gupta,

	Khanna Publishers. 3. Power Electronics M D Singh, K B Khanchandani, Tata Mc Graw Hill 4. Power Electronics and its Applications, Alok Jain, Penram International
References:	1. Power electronics: Circuits, Devices and Applications , M.H. Rashid third Edition (2004),Pearson Education 2. Power Electronics, Dr. P S Bimbhra, Khanna Publishers. 3. Power Electronics, Ned Mohan, Tore. M. Undeland, William P. Robbins, John Wiley & Sons Third Edition-2006
Online Resource	1. Prof. G. Bhuvaneshwari, Dept. of Electrical Engineering, IIT Delhi: https://youtube.com/playlist?list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO&si=gC6uVfEgHN8WCMR1 2. Prof. Vivek Agarwal, Dept. of Electrical Engineering, IIT Bombay: https://youtube.com/playlist?list=PLOzRYVm0a65dVYOA7_3-N67Xu1NIrLnR0&si=u08y6yKY-HvtQgkr

Note: The course is divided into five modules, with four modules together having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	1	1	3	-	-	3	1	-	-	2	2
CO 2	2	-	1	3	-	-	3	-	-	-	2	-
CO 3	2	-	2	3	-	-	3	1	-	-	2	-
CO 4	3	2	2	3	-	-	3	1	-	1	2	-
CO 5	2	2	2	3	-	-	3	1	-	-	2	-
CO 6	2	2	2	2	-	-	3	1	2	-	2	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

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			✓	

Programme	B.Sc. Electronics				
Course Code					
Course Title	MEDICAL ELECTRONICS				
Type of Course	**Elective**				
Semester	VI				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4			60
Pre-requisites	Knowledge of Instrumentation and Measurement				
Course Summary	The course is designed to give the basic concepts of Instrumentation involved in medical field and human physiology. Biomedical Instrumentation is application of technology for medical field. During the course, students will explore Electro- physiological measurements, medical imaging etc. The course will make the students understand the devices used in diagnosing the diseases.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identify and select appropriate transducers for biomedical applications, including piezoelectric and ultrasonic transducers, and understand the use of fiber optic sensors for temperature measurements.	U	C	Instructor-created exams / Quiz
CO2	Understand the operation and application of various medical amplifiers, including preamplifiers, differential amplifiers, chopper amplifiers, and isolation amplifiers.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Recognize shock hazards and leakage currents.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Understand and differentiate between radiographic and fluoroscopic techniques, computer tomography, MRI, ultrasonography, endoscopy, and thermography.	U	P	Instructor-created exams / Home Assignments
CO5	Acquire knowledge about different types of biotelemetry systems and how they are used in patient monitoring.	Ap	P	Practical Assignment
CO6	Understand the use of spirometers, photo plethysmography, body plethysmography, and blood gas analyzers for measuring blood pH, pCO2, pO2, as well as the use of fingertip oximeters, ESR, and GSR measurements.	U	P	Presentation and Tech Talk

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I		**Introduction**	**8**
	1	Introduction to Transducers and its Selection Criteria, Factors in the design of biomedical instrument system	2
	2	Piezo-Electric, Ultrasonic Transducers, Temperature, measurements - Fiber optic temperature sensors	2
	3	Electrodes: Limb electrodes, floating electrodes, pre-gelled disposable electrodes, Micro, needle and surface electrodes.	4
II		**Electro – Physiological measurements**	**16**
	4	Amplifiers: physiological signal amplifier, Preamplifiers,Instrumentation amplifiers, chopper amplifiers, Isolation amplifier	3
	5	ECG, EEG, EMG, ERG	3
	6	Sodium Pump	3
	7	Typical waveforms	2
	8	Electrical safety in medical environment: shock hazards, leakage current	3
	9	Instruments for checking safety parameters of biomedical equipment	2
III		**Medical Imaging**	**14**
	10	Radiographic and fluoroscopic techniques	2
	11	X-rays	2
	12	Computer tomography	2
	13	Mammography, MRI, fMRI	2
	14	Ultrasonography, Endoscopy, Thermography	2
	15	Different types of biotelemetry systems and patient monitoring	4
IV		**Assisting and Therapeutic equipment**	**10**
	16	Pacemakers	1
	17	Defibrillators and Ventilators	2
	18	Nerve and muscle stimulators, Diathermy	2
	19	Heart Lung machine	2
	20	Audio meters	1
	21	Dialyzers	1
	22	Lithotripsy	1
V		**Open Ended Module**	**12**
		Non-electrical parameter measurements Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, spirometer, Photo Plethysmography, Body Plethysmography, Blood Gas analyzers: pH of blood, measurement of blood pCO2, pO2, finger-tip oximeter, ESR, GSR, measurements, Standard HL7	12

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 50 instructional hours for the fixed modules and 10 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO 1	1	-	2	-	-	-
CO 2	2	-	1	2	-	-
CO 3	1	1	-	-	-	-
CO 4	2	-	-	-	-	-
CO 5	-	-	2	1	-	-
CO 6	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 (20%)
- Final Exam (70%)

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			✓	

Suggested Learning Resources:

Text Books:

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing CoLtd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation andMeasurements', II edition, Pearson Education, 2002 / PHI.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley &Sons, 1975.

Programme	B.Sc. Electronics				
Course Code					
Course Title	FUNDAMENTALS OF ROBOTICS AND APPLICATIONS				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4			60
Pre-requisites	Basic Knowledge in Robotics				
Course Summary	Robotics is an interdisciplinary branch of electronic engineering and mechanical engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design machines that can help and assist humans. Robotics integrates fields of mechanical engineering, electrical engineering, information engineering, Mechatronics, electronics, bioengineering, computer engineering, control engineering, software engineering, mathematics, etc.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the significance, social impact and future prospects of robotics and automation in various engineering applications	U	C	Instructor-created exams
CO2	Identify and describe the components and anatomy of robotic system.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Know about various path planning techniques and analyse different motions of robotics system	An	P	Group Tutorial Work
CO4	Use the suitable drives and end-effectors for a given robotics application	Ap	P	Home Assignments/seminar
CO5	Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types	Ap	P	One Minute Reflection Writing assignments

	of robots based on the design and applications in real world scenarios			
CO6	Communicate effectively about complex robotic concepts through presentations and technical discussions.	P	P	Presentation and Tech Talk
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Introduction to Robotics**		**12**
	1	Introduction to Robotics	1
	2	Laws of Robot	1
	3	Brief History of Robotics & Basic Components of Robot	3
	4	Robot Locomotion	3
	5	AI in Robotics	2
	6	Robotic Research Areas	2
II	**Robot Anatomy and Motion Analysis**		**12**
	7	Anatomy of a Robot	1
	8	Types of Robot Sensors	1
	9	Hardware Designing Using Software	2
	10	Power Supply in Robotics	1
	11	Microcontroller in Robotics	1
	12	Basics of Robot Configurations and its applications	2
	13	Degrees of freedom(path)	2
III	**Robot Drives and End Effectors**		**14**
	14	Robot Drive Systems: Hydraulic, Pneumatic and Electric Drive Systems	2
	15	Classification Of End Effectors	2
	16	Grippers: Mechanical Grippers, Vacuum Grippers, Magnetic Grippers, Adhesive Gripper, Gripper Force Analysis and Gripper Design	4
	17	Tools As End Effectors	3
	18	Robot Control Types: Limited Sequence Control, Point-To-Point Control, Playback with Continuous Path Control, and Intelligent Control.	3
IV	**Path Planning and Robot Application**		**10**
	19	Material Handling: Pick and Place, Palletizing and Depalletizing, Machining Loading and Unloading, Welding & Assembly	2
	20	Medical, Agricultural and Space Applications	2
	21	Unmanned Vehicles: Ground, Ariel and Underwater Applications	2
	22	Types Of Robots: Manipulator, Legged Robot, Wheeled Robot, Aerial Robots, Industrial Robots, Humanoids, Robots, Autonomous Robots, and Swarm Robots	2
V	**Open Ended Module**		**12**

		Discussion of Recent developments in Robotic Field Presentation and Assignment submission by Students Tech Talk by Students	10

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 50 instructional hours for the fixed modules and 10 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs :

Mapping of COs with PSOs and POs :												
	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO 1	1	-	2	-	-	-						
CO 2	2	-	1	2	-	-						
CO 3	1	1	-	-	-	-						
CO 4	2	-	-	-	-	-						
CO 5	-	-	2	1	-	-						
CO 6	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 (20%)
- Final Exam (70%)

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			✓	

Suggested Learning Resources:

Text Books:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.

2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).

3. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.

Reference Books:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.

2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence",McGraw Hill, 1987. https://www.robots.com/applications

Website Links

1. https://www.javatpoint.com/robotics-tutorial
   https://efaidnbmnnnibpcajpcglclefindmkaj/https://www.theseus.fi/bitstream/handle/10024/37806/Shakhatreh_Fareed.pdf
   https://efaidnbmnnnibpcajpcglclefindmkaj/https://srict.in/UploadedFiles/1330391 17797739107.pdf

Programme	B. Sc. Electronics				
Course Code					
Course Title	INDUSTRIAL AUTOMATION				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400- 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Digital and Analog Electronics, Microprocessor Based Computer System 2. Basic Electrical Wiring and Control Logic.				
Course Summary	This course provides a comprehensive introduction to industrial automation, covering essential concepts, components, and programming techniques. Participants will gain a deep understanding of automation system using PLCs and, general concepts on SCADA (Supervisory Control and Data Acquisition) and Distributed Control Systems (DCS). Practical applications and hands-on experiences will enhance students' ability to design, implement, and troubleshoot industrial automation solutions.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the basics and need for automation in industries.	U	C	Instructor-created exams / Quiz
CO2	To understand various automation components in the categories of sensors and actuators used in industry.	U	C	Seminar Presentation / Group Tutorial Work
CO3	To analyse the basic functions in PLC using input/output modules.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	To design and analyze ladder logic PLC Programme, that includes Timer/Counter, relay logics and math functions, for an automation sequence.	An	P	Practical Assignment / Observation of Practical Skills s
CO5	To evaluate the automation process created in PLC logic program for a specific application in industry.	E	P	Practical Assignment / Observation of Practical Skills s
CO6	To acquire a detail knowledge on data	U	C	Viva Voce

	acquisition system interface and SCADA system			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45+12)	Marks (70)
I		**Introduction to Industrial Automation**	**10**	**15**
	1	Automation overview, Requirement of automation systems	2	
	2	Architecture of Industrial Automation system	1	
	3	Introduction to PLC and SCADA	2	
	4	Fundamentals of Automatic Control	2	
	5	Advantages of using PLC for Industrial automation.	1	
	6	Introduction to P-I-D Control	2	
II		**Automation Components**	**12**	**15**
	7	Manually and mechanically operated switches.	1	
	8	Sensors for temperature, Pressure, Force, Displacement, Speed, Flow, Level, Humidity and Proximity	4	
	9	Actuators: Relay, Process Control Valves, Solid State Relay	3	
	10	Basics of speed control in DC and AC motors using drives.	4	
III		**PLC Programming**	**15**	**25**
	10	Programmable Logic Controllers	1	
	11	Analog And Digital Input And Output Modules	1	
	12	PLC Programming, Ladder Logic, Ladder Diagram,	2	
	13	Sequential Flow Chart	1	
	14	Basic Relay Instructions, Latching Relays	2	
	15	Input-Output Instructions	1	
	16	Arithmetic and Comparison Functions	1	
	17	Timer Instructions, On Delay Timer and Off Delay Timer	2	
	18	Counter Instructions - Up/Down Counters	1	
	19	Application of PLC to Process Control Industries.	3	
IV		**Distributed Control System**	**8**	**15**
	20	Overview of DCS, DCS software and communication	2	
	21	0-10V and 4-20mA wire communication. I to V and V to I converter.	2	
	22	Industrial bus systems: Modbus and Profibus,	2	
	23	DCS integration with PLC and Computers	2	
V		**Open Ended Module: PLC for Industrial Automation**	**12**	
		Case studies: 1. Converting relay schematics into PLC ladder programs 2. Ladder program execution with ON & OFF Timer and Relay. **Real-World Applications and Trade-offs:** 1. Implementing an Alarm based control scheme and run in a simulated environment. 2. Designing an entire PLC logic for filling and draining water tank automatically. **Open-Ended Exploration and Assessment:**	**12**	

		Speed control of Motors using PLC program. **Group Assignment:** Automatic Control of Warehouse Door or Automatic Packing Mechanism.		

REFERENCES

1. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006.
2. S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003.
3. E.A.Parr, Newnes ,NewDelhi,"Industrial Control Handbook",3rd Edition, 2000.
3. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2019.
4. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication
5. Stuart Boyer A, "SCADA: Supervisory control and data Acquisition", Fourth Edition, ISA- The Instrumentation, Systems, and Automation Society,2010

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 45 instructional hours for the fixed modules and 30 hours for the open-ended one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V.Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks).The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6												

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 (20%)
- Final Exam (70%)

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		✓		✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	DRONE TECHNOLOGY				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic knowledge of electronics, including understanding circuits, microcontrollers, and interfacing with sensors and actuators. 2. Proficiency in at least one programming language (e.g., Python, C++, Java) is essential. 3. Knowledge of matrices, vectors, and linear transformations is essential for understanding robot kinematics, dynamics, and computer vision.				
Course Summary	Learn about the fundamental principles of robotics and drones. Understand the components and systems that make up drones. Explore the applications and impact of drone technology across various industries. Discuss the ethical, legal, and social implications of drone technology.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Gain a solid foundation in the principles of robotics and drone technology, including mechanics and electronics	U	C	Instructor-created exams / Quiz
CO2	Learn to select appropriate sensors, actuators, and controllers for different types of robotic and drone projects.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Gain experience with software tools for simulation, design, and testing of robotic systems and drones.	An	P	Practical Assignment / Observation of Practical Skills
CO4	Understand how machine learning and artificial intelligence can be applied to enhance the capabilities of robotic systems and drones.	Ap	P	Instructor-created exams / Home Assignments
CO5	Explore the ethical, legal, and societal implications of robotics and drone technology, including privacy, safety, and regulatory considerations.	U	P	One Minute Reflection Writing assignments
CO6	Gain insights into current research	U	P	Viva Voce

	trends and challenges in robotics and drone technology, setting a foundation for further education and innovation.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48 +12)	Marks (70)
I	**Introduction to Robotics and Drones**		**10**	**15**
	1	Overview of robotics and drone technology	2	
	2	History and evolution of drones	3	
	3	Types of drones	3	
	4	Applications of drones	2	
II	**Fundamentals of Flight**		**10**	**15**
	5	Principles of flight and aerodynamics	3	
	6	Drone components and systems	3	
	7	Introduction to Unmanned Aerial Vehicle	2	
	8	UAV design and engineering	2	
III	**Sensors and Navigation**		**15**	**25**
	9	Sensors used in drones (GPS, IMU, LiDAR, cameras)	2	
	10	Basics of navigation and control systems	3	
	11	Introduction to remote sensing and data collection	1	
	12	Understanding flight controllers	3	
	13	Basics of drone piloting and manual control	3	
	14	Introduction to autopilot systems and software	3	
	15	Principles of autonomous flight	1	
	16	Path planning and obstacle avoidance	1	
	17	Machine learning and AI in drones	3	
IV	**Drone Applications and Safety**		**10**	**15**
	18	Surveying and mapping	2	
	19	Agriculture and environmental monitoring	2	
	20	Search and rescue, surveillance, and delivery services	2	
	21	Privacy concerns and surveillance, Regulatory and safety considerations	1	
	22	Future of drone technology and societal impact	1	
V	**Open Ended Module: Understand the different types of actuators in arm**		**30**	
	1	**Case studies:** 1. Medical Robotics: Explore the use of robotic arms in surgery and rehabilitation, focusing on the requirements for precision and safety. **Real-World Applications and Trade-offs:** Learn about agriculture and environmental monitoring with practical examples. **Open-Ended Exploration and Assessment:**	12	

		Study how robotic arms are used in manufacturing for tasks like assembly, welding, and painting. **Group Assignment:** Study any one industrial Automation.		

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

Text Books:

1. Internet of Things: Robotic and Drone Technology, Edited ByNitin Goyal, Sharad Sharma, Arun Kumar Rana, Suman Lata Tripathi, CRC Press

2. Drone Technology: Future Trends and Practical Applications Editor(s):Sachi Nandan Mohanty, J.V.R. Ravindra, G. Surya Narayana, Chinmaya Ranjan Pattnaik, Y. Mohamed Sirajudeen, Wiley Publ.

3. "Drone Technologies and Applications" authored by Koç Mehmet Tuğrul, edited by Dragan Cvetković https://www.intechopen.com/books/1002775

4 "Drones - Applications" edited by George Dekoulis https://www.intechopen.com/books/6465

5. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson Publ.

6. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.

7. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).

8. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.

Web resources:

1. https://robotsguide.com
2. https://roboticscasual.com/best-online-resources-to-learn-robotics/
3. https://www.coursera.org/specializations/robotics
4. https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/
5. https://ardupilot.org/
6. https://px4.io/
7. https://dronecode.org/

8. https://diydrones.com/
9. https://www.edx.org/
10. https://www.youtube.com/user/sparkfun

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	3	-	-						
CO 2	1	3	-	-	3	-						
CO 3	-	-	-	-	2	-						
CO 4	-	1	2	3	-	-						
CO 5	-	1	-	2	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	INTEGRATING AI WITH FLUTTER				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400- 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamentals of AI, Basic knowledge of programming				
Course Summary	This course provides a comprehensive introduction to Flutter development and the integration of AI, covering fundamental concepts and practical implementation within mobile applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand AI fundamentals and Flutter framework features, facilitating their ability to integrate AI functionalities effectively into Flutter apps.	U	P	Instructor-created exams / Quiz
CO2	To explore Flutter app development concepts such as widgets, UI components, state management, user input handling, navigation, and routing.	U	P	Seminar Presentation / Group Tutorial Work
CO3	To gain knowledge in machine learning concepts, explore ML's role in mobile app development, and provide an overview of popular AI frameworks and libraries compatible with Flutter.	U	P	Practical Assignment / Observation of Practical Skills
CO4	To integrate AI functionalities proficiently into Flutter apps, leveraging their understanding of AI concepts and Flutter framework features to develop innovative and intelligent mobile applications.	Ap	P	Practical Assignment / Observation of Practical Skills s
CO5	To acquire a comprehensive	U	P	Viva Voce

	understanding of implementing text classification and language translation features within Flutter applications using ML Kit's natural language processing capabilities.			
CO6	To develop proficiency in designing and implementing advanced text classification and language translation features within Flutter applications, fostering their ability to create intelligent and dynamic user experiences.	Ap	P	Practical Assignment / Observation of Practical Skills s
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+12)	Marks (70)
I		**Basic of AI and Flutter**	**5**	**10**
	1	Introduction to AI and its subsets	1	
	2	Introduction to Flutter	1	
	3	Overview of artificial intelligence and its applications.	1	
	4	Introduction to Flutter framework and its features.	1	
	5	Setting up the development environment for Flutter.	1	
II		**Intermediate Flutter Development**	**12**	**15**
	6	Basics of Flutter App Development	1	
	7	Flutter widgets	2	
	8	UI components	2	
	9	State management in Flutter apps	3	
	10	Handling user input and gestures	2	
	11	Handling navigation and routing	2	
III		**Machine Learning in Flutter**	**12**	**15**
	12	Introduction to AI in Mobile Apps	2	
	13	Concepts of machine learning.	3	
	14	Role of ML in mobile app development.	3	
	15	Overview of popular AI frameworks	2	
	16	AI libraries compatible with Flutter.	2	
IV		**AI Services in Flutter**	**16**	**30**
	17	Text Classification with Flutter	2	
	18	Text Classification with ML Kit	2	
	19	Introduction to ML Kit for Flutter.	3	
	20	Text classification using ML Kit's natural language processing capabilities.	3	
	21	Developing a text classification feature within a Flutter app.	3	

	22	Implementing language translation in Flutter	3	
V	**Open Ended Module: App Development with Flutter**		**12**	
		Case studies: 1. Setting up Flutter development environment. 2. Building UI components using Flutter widgets. **Real-World Applications and Trade-offs:** 1. Implementing state management in a Flutter app. 2. Handling user input and gestures within a Flutter app. Navigating between screens and handling routing in a Flutter app. 3. Exploring popular AI frameworks and libraries compatible with Flutter. **Open-Ended Exploration and Assessment:** Implementing text classification features in a Flutter app. Or ML Kit's natural language processing capabilities for text classification. **Group Assignment:** Integrating language translation functionalities into a Flutter app.	**12**	

REFERENCES

1. Beginning App Development with Flutter, Rap Payne
2. Beginning Flutter: A Hands On Guide to App Development, Marco L. Napoli
3. Flutter for Beginners, Thomas Bailey, and Alessandro Biessek
4. https://www.tutorialspoint.com/flutter/flutter_tutorial.pdf
5. https://www.classcentral.com/report/best-flutter-and-dart-courses/
6. https://www.youtube.com/watch?v=VPvVD8t02U8

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 45 instructional hours for the fixed modules and 30 hours for the open-ended one. Module Vis designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V.Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks).The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1		1	2	-	1	1						
CO 2	-	2	1	-	1	1						
CO 3	-	2	1	-	1	1						
CO 4	-	2	1	-	1	1						

CO 5	-	1	1	-	1	-						
CO 6	-	3	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 (20%)
- Final Exam (70%)

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			✓	✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	LIGHT AND AUDIO SYSTEMS ENGINEERING				
Type of Course	**Elective**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamental Mathematics Concepts: Set, Functions, Logic 2. CSC2CJ101 – Fundamentals of Programming				
Course Summary	This course explores implementations of linked list and array-based data structures, delving into the inner workings of basic data structures including lists, stacks, queues, trees, and graphs.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will be able to identify and describe the basic properties of light and sound	U	C	Instructor-created exams / Quiz
CO2	Students will comprehend the functions and applications of various lighting fixtures and sound equipment	An	P	Practical Assignment / Observation of Practical Skills
CO3	Students will be able to determine optimal illumination levels for various settings. They will also apply knowledge of loudspeaker specifications and power requirements to set up a sound system for live events.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Students will analyze and design advanced lighting and sound systems	An	P	Instructor-created exams / Home Assignments
CO5	Students will synthesize knowledge from various areas to create innovative projection mappings and other projection technologies.	C	P	Practical Assignment / Observation of Practical Skills

CO6	Students will critically evaluate the advantages and disadvantages of different types of projectors and sound systems	E	P	Viva Voce

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

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (48 +12)	Marks (70)
I		**Fundamentals of Lighting**	**10**	**15**
	1	Basics of light-color,temperature, brightness, and intensity, Types of Lighting -Ambient, task and accent lighting	2	
	2	Different light sources (LED, fluorescent, halogen, etc.), Overview of lighting fixtures and their functions	3	
	3	Lighting Calculations and Measurements-Calculating illumination levels, understanding lumens, lux and foot-candles, using light meters.	3	
	4	Lighting Controls and Systems - Dimmers, motion sensors and smart lighting systems	2	
	"Lighting Design Basics" by Mark Karlen and James R. Benya. "IES Lighting Handbook" by Illuminating Engineering Society. "Lighting Control: Technology and Applications" by Robert S. Simpson.			
II		**Introduction to Projection Techniques**	**10**	**15**
	5	Understanding different types of projectors, Projection surfaces and aspect ratios.	3	
	6	Projection Mapping- techniques for mapping video content to irregular surfaces	3	
	7	Creating interactive displays using projectors and motion sensors.	2	
	8	3D holographic and cutting-edge projection technologies	2	
	"Projection Displays" by Edward H. Stupp and Matthew S. Brennesholtz. “Projection mapping A Complete Guide” by Gerardus Blokdyk			
III		**Introduction to Sound**	**20**	**25**
	9	Sound waves- amplitude, frequency and phase.	2	
	10	Room acoustics and soundproofing	3	
	11	Microphones- Types (based on Transduction and functional design)	1	
	12	Preamplifiers and mixers	3	
	13	Stage monitors and mixing consoles	3	
	14	Loudspeakers specifications and power requirements.	3	
	15	Placement strategies for optimal sound.	1	
	16	Use of SPL meters for speaker calibration.	1	
	17	Setting up a sound system for a live event.	3	
	"The Sound Reinforcement Handbook" by Gary Davis and Ralph Jones			

	"Modern Recording Techniques" by David Miles Huber and Robert E. Runstein			
IV	**Introduction to Advanced Sound Systems**		**8**	**15**
	18	Principles of surround sound, 5.1 and 7.1 setups.	2	
	19	Concepts of Object-based audio	2	
	20	Basics of Dolby Atmos	2	
	21	Overview of DTS:X and other DTS sound systems	1	
	22	Comparison between DTS and Dolby Atmos.	1	
	"Surround Sound: Up and Running" by Tomlinson Holman. Dolby Atmos / DTS official documentation and guides.			
V	**Open Ended Module: Setting up of Projector and Sound**		**12**	
	1	• **Case studies:** • 1. Explore the functionality and benefits of dimmers, motion sensors, and smart lighting systems. • 2. explore the technique of projection mapping by projecting video content onto irregular surfaces. [mapping software (e.g., Mad Mapper, VPT7), objects with irregular surfaces (e.g., mannequin, small architectural model)] **Real-World Applications and Trade-offs:** Set up a live sound system and experiment with microphone and speaker placement to control feedback. **Open-Ended Exploration and Assessment:** • Create a simple sound system setup with microphones, mixers, amplifiers, and speakers • **Group Assignment:** Compare and contrast the functionality and applications of various types of projectors, including DLP (Digital Light Processing), LCD (Liquid Crystal Display), and LED (Light Emitting Diode) projectors.	12	

Books and References:

1. "Lighting Design Basics" by Mark Karlen and James R. Benya.
2. "IES Lighting Handbook" by Illuminating Engineering Society.
3. "Lighting Control: Technology and Applications" by Robert S. Simpson.
4. "Projection Displays" by Edward H. Stupp and Matthew S. Brennesholtz.
5. “Projection mapping A Complete Guide” by Gerardus Blokdyk
6. "The Sound Reinforcement Handbook" by Gary Davis and Ralph Jones
7. "Modern Recording Techniques" by David Miles Huber and Robert E. Runstein
8. "Surround Sound: Up and Running" by Tomlinson Holman.
9. Dolby Atmos / DTS official documentation and guides.

Note: The course is divided into five modules, with four modules together having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronic Science				
Course Code					
Course Title	CLEAN ENERGY SOLUTIONS				
Type of Course	**MDC**				
Semester	I				
Academic Level	100 - 199				
Course Details	**Credit**	**Lecture per week**	**Tutorial per week**	**Practical per week**	**Total Hours**
	3	3	-	-	45
Pre-requisites	1. Basic Knowledge of Physical Science and Electricity.				
Course Summary	This course serves as an introduction to the fundamental concepts of clean energy, emphasizing its role in sustainable development. Participants will explore a wide range of energy sources, with a particular focus on renewable technologies, and gain insights into the solar power generation, components of solar PV system and their functions.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand clean energy sources and articulates its significance in addressing climate change and environmental challenges.	U	C	Assignment / Seminar Presentation
CO2	To become familiar with conventional and non-conventional energy sources.	U	C	Assignment / Seminar Presentation
CO3	To demonstrate proficiency in assessing the economic feasibility of clean energy projects.	Ap	P	Assignment / Seminar Presentation
CO4	To examine the basics of solar energy, its applications, and methods for storage.	U	P	Seminar Presentation / Group Tutorial Work
CO5	To understand different solar PV systems, considering off-grid, on-grid, and hybrid configurations.	U	P	Instructor-created exams / Quiz
CO6	To understand the functions and importance of charge controllers and inverters in solar power systems.	U	P	Assignment / Seminar Presentation

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)

Metacognitive Knowledge (M)

Module	Unit	Content	Hrs (36+12)	Marks (50)
I	**Introduction to Clean Energy**		**5**	**6**
	1	Definition of Power and energy, Distinguishing Power from Energy	2	
	2	The Crucial Role of Energy in Development	1	
	3	Defining Clean Energy. Importance of Clean Energy in Climate Change Mitigation	1	
	4	Global Clean Energy Initiatives and Sustainability Goals.	1	
II	**Energy Sources**		**11**	**14**
	5	Classification of Energy Sources – Conventional and Non-conventional	1	
	6	Conventional energy (Non- Renewable) sources - Hydro Electric, Thermal and Nuclear,	2	
	7	Advantages and disadvantages of Conventional energy sources	2	
	8	Non-Conventional Energy (Renewable) sources - Bio-mass, geo-thermal, solar, wind energy, ocean energy and wave energy,	2	
	9	Advantages and disadvantages of Non-Conventional Energy sources	2	
	10	Comparison of Conventional and Non-Conventional Energy sources	2	
	11	Commercial energy sources - fossil-fuels, coal, oil, natural gas, hydro electric power, and nuclear	2	
	12	Advantages and disadvantages of Commercial energy sources	1	
III	**Solar Power System**		**15**	**20**
	13	Solar Energy Overview and Importance, storage of solar energy, solar applications- solar pump, solar water heater, solar distillation, solar cooker, solar green houses.	4	
	14	Storage of Solar Energy, Solar Energy Conversion, Solar PV Systems, Basic Components: Solar Panel, Battery System, Power Converter.	4	
	15	Types of Solar PV systems - off-grid, On-grid and Hybrid.	4	
	16	Comparison of Solar PV systems, Initial cost and payback period	3	
IV	**Solar PV system components and selection parameters**		**5**	**10**
	17	Solar Cell Function, Solar Technologies, Solar Cell Parameters – Voltage, Power Ratings, Efficiency.	2	
	18	Energy Storage: Battery Function, Types, Parameters, Selection, Maintenance.	2	
	19	Charge Controller and Inverter (Basic Functions)	1	
	Open Ended Module : Solar PV system		**12**	

V	1	**Case studies:** 1. Discuss clean energy initiatives 2. Classification of Energy sources **Real-World Applications and Trade-offs:** 1. Identification of Solar components 2. Economic Analysis of installing solar PV system **Assessment:** **Group Assignment:** Types of Solar PV system		

Note: The course is divided into five modules, with four having total 19 fixed units and one open-ended module with a variable number of units. There are total 36 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules.

References

a) Renewable energy; power for a sustainable future; oxford; Stephen peake; oxford university press- 2017
b) Renewable energy systems; Devid M, Buchla, Thomas E kissell, Thomas, L Floyd; Pearson India Education Services Pvt. Ltd. 2017
c) Fundamentals of Renewable Energy Systems Paperback – D.Mukherjee, New Age International Publisher; First edition (2011)
d) Solar Power Hand Book, Dr. H. Naganagouda(2014)
e) Solar Photovoltaic; Chetansingh solanki; PHI, Learning private ltd., New dehli- 2018
f) Non-conventional Sources of Energy , G.D Rai, Khanna Publishers, Delhi, 2012
g) Solar Power Hand Book, Dr. H. Naganagouda (2014)
h) Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)
i) "Renewable energy power for a sustainable future" by Godfrey Boyle ,2004 Oxford University Press in association with the Open university.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	1	-	-	-	-						
CO 2	1		-	-	-	-						
CO 3	-	1	2	-	-	-						
CO 4	-	-	-	2	-	-						
CO 5	-	-	1	-	-	-						

CO 6	-	-	-	2	-	-						

Correlation Levels:

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

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	✓			✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	COMPUTER HARDWARE				
Type of Course	**MDC**				
Semester	II				
Academic Level	100- 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	1. Basic understanding of electronics and digital circuits 2. Fundamental computer and number system Concept				
Course Summary	This course covers the fundamental concepts of computer hardware, including number systems, logic gates, internal components, operating systems, and software. Through a combination of theory and practical classes, students will gain a comprehensive understanding of how computers work and how to interact with them effectively.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the role of operating systems in managing hardware resources and providing a user interface for interaction with the computer system.	Ap & U	C	Instructor-created exams / Quiz
CO2	To become familiar with different number systems such as binary, octal, decimal, hexadecimal, and understand their significance	An & U	C	Assignment / Seminar Presentation
CO3	To analyse methods for converting numbers from one system to another, such as from binary to hexadecimal or decimal to binary	Ap & U	P	Seminar Presentation / Group Tutorial Work
CO4	To apply the truth tables to represent the behaviour of logic gates	R & U	F	Instructor-created exams / Home Assignments
CO5	To gain a comprehensive understanding of what system software is including operating systems, device drivers, and utility software structures and algorithms to address complex computational	An & U	C	One Minute Reflection Writing assignments

	challenges.			
CO6	To become knowledgeable about internal computer components such as motherboards, central processing units (CPUs), memory (RAM), storage devices	Ap& An	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Mark (50)
I		**Introduction to Computer Hardware**	**8**	**10**
	1	Characteristics, Functionalities and applications of Computer	2	
	2	Generations of Computer	1	
	3	Block diagram of computer	1	
	4	IO Subsystem of a Computer -Bus Structures	3	
	5	Data processing cycle of computers and classification of computer	1	
	Computer Fundamentals – B. Ram			
II		**Number systems**	**8**	**10**
	6	Number System: Decimal, Binary, Hexadecimal, Octal -Conversions	4	
	7	1's & 2's complement, Representation of Positive and Negative Numbers	2	
	8	Arithmetic operation on Binary numbers, Addition and Subtraction	1	
	9	ASCII code, conversion -ASCII to Decimal, Decimal to ASCII	1	
	Computer Fundamentals – B. Ram			
III		**Logic Gates**	**5**	**10**
	10	Logic Gates, AND, OR, NOT GATES and their Truth tables.	2	
	11	Universal Gates, Boolean Theorems, DeMorgan's Theorems	3	
	Electronics And Microprocessors: B.V. Santhosh Krishna			
IV		**CPU, Storage devices and Software**	**15**	**20**
	12	CPU- Control unit, Memory and ALU, types of storage unit	2	
	13	Types of memory (RAM, ROM, Cache), Memory hierarchy	2	
	14	Storage Devices: HDD, SSD, Flash drives and memory cards	3	
	15	Types of software-System software &Application Software	2	
	16	Operating systems and classifications, characteristic features of OS	2	
	17	Malwares- protecting software for computer systems against threats	2	
	18	Types of Computer languages, Editor, Compiler, Assembler, Interpreter.	1	
	19	Parts of Motherboard	1	
	Introduction To Computers: Peter Norton Computer Organization And Design : P. Pal Chauduri			
V		**Open Ended Module: Mastering Hashing for Efficient Data Handling**	**9**	
	1	**Case studies:** 1. Discuss evaluation of core processors 2. Multicore processors **Real-World Applications and Trade-offs:** i. Assembling of computer ii. Installation of OS (windows/Linux)	9	

		iii. Installation of MS Office iv. Hard disk partition **Assessment:** **Group Assignment:** Different types of Pentium Core processors		

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	3	1	-	2	2	3	-	-	-	1
CO 2	3	-	-	3	-	-	3	-	-	-	1	-
CO 3	-	3	-	-	2	-	1	-	-	1	-	-
CO 4	-	2	-	3	-	-	3	-	-	2	-	-
CO 5	-	1	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	-	3	3	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 (20%)
- Final Exam (70%)

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			✓	

Reference

Text Books:

1.	Computer Fundamentals	B. Ram – New Age International Publishers	
2.	"Computer Organization & Architecture"	Rashid Sheikh	
3.	Computer Organization	Hamacher, Vranesic and Zaky, McGraw Hill.	
4.	Digital Logic and Computer Design	Morris Mano, PHI	
5.	Computer Organization and Architecture	William Stallings, Pearson Education Asia.	
	Introduction To Computers:	Peter Norton	
Others: *(Web / Journals / Course Packets / Class Notes / etc.:* *https://www.youtube.com/watch?v=fJbRqwFDWoE* *https://www.youtube.com/watch?v=pJQ-bm3SY7s* *https://www.youtube.com/watch?v=G3_GXImETg8* *https://www.youtube.com/watch?v=I0lDau83Cbc*			

Programme	B. Sc. Electronics				
Course Code					
Course Title	COMPUTER AIDED DESIGN AND 3D PRINTING				
Type of Course	**SEC**				
Semester	V				
Academic Level	100- 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	Digital and analog electronics, Microprocessor and Microcontrollers				
Course Summary	The course will provide a balanced understanding of both CAD for PCB design and 3D printing technology, enabling students to integrate these technologies for innovative solutions in diverse industries.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand various PCB manufacturing technologies and processes involved in creating layouts that meet industry standards and functional requirements.	U	C	Instructor-created exams / Quiz
CO2	To familiarize with the CAD layout for devices/components that may be mounted on PCB.	U	P	Assignment / Seminar Presentation
CO3	To understand the PCB layout techniques for optimized component density and power saving.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	To perform design and printing of PCB with the help of various image transfer and soldering techniques	Ap	P	Practical Assignment / Observation of Practical Skills
CO5	To understand the technology involved with 3D printing process from conceptualizing designs to the selection of appropriate additive manufacturing techniques.	U	C	Seminar Presentation / Group Tutorial Work
CO6	To design a 3D printing model with selected materials and selected processes.	Ap	P	Practical Assignment / Observation of Practical

				Skills

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (36+12)	Marks (50)
I	**CAD for PCB Design**		**10**	**12**
	1	Introduction to CAD	1	
	2	General Rules of Layout, Layout of Resistance, Capacitance and Inductance	3	
	3	Conductor Spacing, Supply and Ground Conductors, Component Placing and Mounting.	3	
	4	PCB Types: Single sided board, double sided, Multilayer boards, Plated through holes technology	2	
	5	Benefits of Surface Mount Technology (SMT).	1	
II	**PCB Manufacturing Process**		**10**	**15**
	6	Laminates, Manufacture of Copper Clad Laminates	2	
	7	Basic Printing Process for Double Sided PCB's – Photo Resists, Wet Film Resists, Coating Process for Wet Film Resists, Dry Film Resists.	4	
	8	Introduction to Etching, Etchant System .	1	
	9	Principles of Solder Connection , Solder Joints, Solder Alloys, Soldering Fluxes , Soldering - De-soldering Tools and Techniques.	3	
III	**Introduction to 3D printing technology**		**10**	**15**
	10	Prototyping fundamentals, Introduction to 3D printing, 3D Printing - Process, Classifications, Advantages.	3	
	11	3D modeling, CAD for Additive Manufacturing	2	
	12	RP data formats, STL format, Data translation, Data loss	1	
	13	Data transmission, Checking and preparing, Building, Post processing	1	
	14	Additive Manufacturing Techniques: Stereo- Lithography, LOM, FDM, SLS, SLM.	2	
	15	Binder Jet technology	1	
IV	**3D Printing Materials and Applications**		**6**	**8**
	16	Printing Materials: Polymers, Metals, Non-Metals	1	
	17	Ceramics Process, Process parameter, Process Selection for various applications.	1	
	18	Various forms of raw material- Liquid, Solid, Wire, Powder.	1	
	19	Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools.	3	
V	**Open Ended Module: CAD for PCB modelling**		**12**	
	1	**Case studies:** 1. Discuss various steps in circuit modelling in CAD s/w 2. Design single sided PCB for a IC based circuit	12	

		Real-World Applications and Trade-offs: 1. Design a basic circuit in CAD software and fabricate PCB 2. Familiarize net-list, autorouting and other features in CAD software **Group Assignment:**3D modelling design and printing exercises		

Note: The course is divided into five modules, with four having total 19 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules.

Reference
Text books:

1. Printed circuit Board – Design & Technology by Walter C. Bosshart, Tata McGraw Hill.
2. Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, TATA McGraw Hill Publisher.
3. Printed Circuits Handbook. Clyde F. Coombs, Jr, Happy T. Holden, 6th Edn., TMH Education, 2016.
4. Complete PCB Design Using OrCAD Capture and PCB. Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition., 2019.
5. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
6. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
7. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.
8. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1		1	1	1								
CO 2	1		1	1								
CO 3			2	1								
CO 4	1	3	1									
CO 5				1	1							
CO 6	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 (20%)
- Final Exam (70%)

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			✓	✓

Programme	B. Sc. Electronic Science				
Course Code					
Course Title	EV TECHNOLOGY				
Type of Course	**SEC**				
Semester	VI				
Academic Level	100- 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	1. Basic electrical wiring and control logic, Digital and instrumentation electronics, Microprocessor based computer system and basic mechanical and automobile concepts.				
Course Summary	To equip students with the knowledge and skills necessary for understanding, selecting, and effectively utilizing Electric Vehicle Technology and to provide them insight to the EV drive components such as battery, motors and other control systems used in this technology.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identify the basic components in EV/HEV drive and differntiate between various configuratrion and architecture structures.	U	C	Instructor-created exams / Quiz
CO2	Develop a solid understanding of energy storing methods, EV battery charging parameters, EV battery technologies and also acquire fundamental understanding of modern energy storage devices such as fuel cells and super capacitors.	Ap	P	Assignment / Seminar Presentation
CO3	Explore different types of motors used in EV drive applications and to analyse the motor performance parameters including torque/power-speed characteristics and efficiency maps of various motors.	An	P	Seminar Presentation / Group Tutorial Work
CO4	Gain awareness of Electric Vehicle grid interface frameworks, including Grid-to-Vehicle (G2V), Vehicle-to-Grid (V2G), Vehicle-to-Vehicle (V2V), and Vehicle-to-Home (V2H).	U	P	Instructor-created exams / Home Assignments
CO5	Develop a comprehensive understanding of Electric Vehicle Control Systems, including Energy Management Systems (EMS), Battery Management Systems (BMS), regenerative braking, and anti-roll back control.	U	C	One Minute Reflection Writing assignments

CO6	Understand the basics of automotive software (AUTOSAR) and gain familiarity with vehicle communication protocols (CAN).	U	P	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (36+12)	Marks (50)
I		**Electric Vehicle System**	**8**	**15**
	1	Introduction to EV system, EV system Components	1	
	2	Power transmission in ICEV and EV, EV/ICEV comparison	1	
	3	HEV system components, Classification of HEV based on electric energy utilization - Micro Hybrid, Mild Hybrid, Full Hybrid and PHEV.	2	
	4	Architecture of HEV- Series hybrid, Parallel hybrid, Series-parallel hybrid.	3	
	5	Power flow in HEV, In-wheel drives.	1	
II		**EV Battery**	**9**	**10**
	6	Energy storing, Battery parameters, Battery capacity, Battery voltage, State of Charge, Depth of Discharge, Discharge rate.	3	
	7	Battery life and deep cycle, Equalizing.	1	
	8	Battery Types - Lead-acid battery, Nickel-based batteries, Lithium-ion battery.	2	
	9	Battery charging and discharging characteristics.	1	
	10	Basic principle and operation of Fuel Cell, Hydrogen Fuel cell, Super capacitors	2	
III		**EV Motors**	**9**	**15**
	11	Motor rating, EV motor Parameters - speed, torque, power, Efficiency, motor weight, Torque per unit volume.	2	
	12	Basic study on EV Motors - Brushless DC Motor, Switched Reluctance Motor, Induction Motor.	4	
	13	EV Motor performance parameters - Torque/power -speed characteristics, Efficiency map.	2	
	14	Basic function of EV motor controller	1	
IV		**EV Control System and EV charging**	**10**	**10**
	15	EV control systems - EMS, BMS, Regenerative braking, Anti-roll back control, Basic function of Speed and Torque control of EV drive.	3	
	16	EV auxiliaries - Auxiliary power supplies, Air conditioners, Navigation systems.	2	
	17	Introduction to automotive software – AUTOSAR and Vehicle communication protocol – CAN.	2	
	18	EV Charging - Domestic charging infrastructure, Public charging	2	

		infrastructure, Fast charging, Inductive Charger, Battery swapping stations		
	19	EV grid interface frameworks - G2V, V2G, V2V and V2H.	1	
V	**Open Ended Module: Mastering Hashing for Efficient Data Handling**		**12**	
	1	**Case studies:** 1. Discuss the cost analysis b/w ICEV and EV use 2. Simulation of EV drive control using battery, motor and controller using Matlab/Simulink software **Real-World Applications and Trade-offs:** 1. Demonstration of EV components in 2/3/4 wheelers. 2. Integration of EV components and testing. **Group Assignment:** Assembling or retrofitting trail of EV components in 2/3/4 wheelers.	12	

Note: The course is divided into five modules, with four having total 19 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules.

REFERENCES

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2021.
4. Wie Liu, “Hybrid Electric Vehicle System Modeling and Control”, Second Edition, John Wiley & Sons, 2017
5. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, 1st edition, CRC Press, 2004.
6. Build Your Own Electric Vehicle,Seth Leitman , Bob Brant, McGraw Hill, Third Edition 2013.
7. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	2	1	-	-	-						
CO 2	1	1	2	-	-	-						
CO 3	-	1	-	-	-	1						
CO 4	2	-	-	1	-	-						

CO 5	-	-	-	1	-	1						
CO 6	-	-	-	-	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 (20%)
- Final Exam (70%)

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		✓		✓

Programme	B. Sc. Electronic Science				
Course Code					
Course Title	GREEN ENERGY FOR SUSTAINABLE DEVELOPMENT				
Type of Course	**VAC**				
Semester	III				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	1. Fundamental Science Concepts.				
Course Summary	The course provides a comprehensive overview of energy and its intersection with environmental concerns, focusing on India's energy scenario in comparison to the global context.				

Course Outcomes (CO):				
CO	**CO Statement**	**Cognitive Level***	**Knowledge Category#**	**Evaluation Tools used**
CO1	To understand the energy production and consumption trends between India and the world, evaluating their impact on climate change, global warming, and ozone depletion.	U	C	Assignment / Seminar Presentation
CO2	To understand the roles and functions of international agreements such as the United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties (COP) in addressing global energy and environmental challenges.	U	C	Assignment / Seminar Presentation
CO3	To become familiar with conventional energy sources and land pollution, while understanding environmental	U	P	Assignment / Seminar Presentation

	standards, measurement techniques, and control measures to mitigate emissions effectively.			
CO4	To examine the basics of renewable energy sources, its potential, and their relative merits and demerits.	Ap	P	Seminar Presentation / Group Tutorial Work
CO5	To demonstrate proficiency in examining the energy strategies for integrating renewable energy sources into existing energy systems, develop roadmaps for ethanol blending in fuel, optimize energy efficiency measures, and formulate balanced energy mixes to promote sustainability and resilience.	U	P	Instructor-created exams / Quiz
CO6	To analyse national and state energy policies, including initiatives such as the National Solar Mission and National Hydrogen Mission, and evaluate their effectiveness in promoting renewable energy integration, energy efficiency, and sustainable development goals.	Ap	P	Assignment / Seminar Presentation
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Module	Unit	Content	Hrs (36+12)	Marks (50)
I	**ENERGY SCENARIO**		**5**	**6**
	1	Comparison of energy scenario – India Vs World with respect to energy production and consumption	2	
	2	Climate Change, Global Warming	1	
	3	Ozone Depletion, Carbon credits	1	
	4	UNFCCC, COP.	1	
II	**ENERGY AND ENVIRONMENT**		**8**	**10**
	5	Conventional Energy Sources - Coal, Oil, Gas.	2	
	6	Emissions from fuels – Air, Water and Land pollution	2	
	7	Advantages and disadvantages of Conventional energy sources	2	
	8	Environmental standards - measurement and controls	2	
III	**RENEWABLE ENERGY TECHNOLOGY**		**10**	**14**
	9	Renewable Energy – Sources and Potential	2	
	10	Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans	6	
	11	Principle of operation	1	
	12	Relative merits and demerits	1	
IV	**ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT**		**13**	**20**
	13	National & State Energy Policy	2	
	14	National solar mission	2	
	15	Framework of Central Electricity Authority	1	
	16	National Hydrogen Mission	1	
	17	Energy and climate policy - State Energy Action Plan	2	
	18	RE integration, Road map for ethanol blending	2	
	19	Energy Efficiency and Energy Mix	2	
	Open Ended Module : Solar PV system		**12**	
V	1	**Case studies:** 1. Evaluate the roles and functions of international agreements such as the United Nations Framework Convention on Climate Change (UNFCCC) and Conference of the Parties (COP) in addressing global energy and environmental challenges.		

		2. Analyse national and state energy policies, including initiatives such as the National Solar Mission and National Hydrogen Mission, and evaluate their effectiveness in promoting renewable energy integration **Real-World Applications and Trade-offs:** 1. Examine the renewable energy sources used in India for energy production, its potential, and their relative merits and demerits. 2. Economic Analysis of installing solar PV system in various sectors.		

Note: The course is divided into five modules, with four having total 19 fixed units and one open-ended module with a variable number of units. There are total 36 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 19 units from the fixed modules.

References

a) Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
b) Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
c) Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
d) Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New India Publishing Agency- Nipa, 2020.
e) Matthew John Franchetti , Defne Apul "Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies" CRC Press, 2012
f) Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4th Edition,Wiley, 2022
g) M.H. Fulekar,Bhawana Pathak, R K Kale,"Environment and Sustainable Development" Springer, 2016
h) Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011
i) Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006
j) https://www.niti.gov.in/verticals/energ

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	1	-	-	-	-						
CO 2	-	1	-	-	-	-						
CO 3	1	1	-	-	-	-						
CO 4	-	1	-	2	-	-						
CO 5	1	1	1	-	-	-						
CO 6	-	1	-	-	-	-						

Correlation Levels:

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

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	✓			✓

Programme	B.Sc. Electronics				
Course Code					
Course Title	E-WASTE MANAGEMENT				
Type of Course	**VAC**				
Semester	IV				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	3	3	-	-	45
Pre-requisites	NA				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the environmental impacts of e-waste.	U	C	Instructor-created inventories
CO2	Apply concepts of e-waste management hierarchy.	Ap	C	Practical Assignment / Observation
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.	An	P	Group Tutorial Work
CO4	Analyze the e – waste management measures proposed under national and global legislations.	An	P	Assignments/seminar
CO5	Categorize different e-wastes based on the origin and their impacts.	Ap	P	Field Work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I	**Introduction :**		**9**	**8**
	1	E- waste; composition and generation	1	
	2	E-waste pollutants	1	
	3	Global context in e- waste	1	
	4	E waste hazardous properties	2	
	5	Effects of pollutant (E- waste) on human health and surrounding environment	2	
	6	Effects of pollutant (E- waste) on human health and surrounding environment	2	
II	**E-waste - Effects on Global trade :**		**10**	**12**
	7	Essential factors in global waste trade economy	2	
	8	Waste trading as an essential part of electronic recycling	1	
	9	Import of hazardous e-waste in India	1	
	10	India's stand on liberalizing import rules	2	
	11	E-waste economy in the organized and unorganized sector	2	
	12	Estimation and recycling of e-waste in metro cities of India.	2	
III	**E-waste control measures:**		**8**	**15**
	14	Need for stringent health safeguards and environmental protection laws in India	2	
	15	Extended Producers Responsibility (EPR)	2	
	16	Import of e-waste permissions	2	
	17	Administrative Controls & Engineering controls	1	
	18	monitoring of compliance of Rules	1	
IV	**The International legislation**:		**8**	**10**
	19	The Basel Convention	1	
	20	The Bamako Convention	1	
	21	The Rotterdam Convention	2	
	22	Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union	2	
	23	Restrictions ofHazardous Substances (RoHS) Directive	2	
V	**Open Ended Module**		**10**	
		• Prepare Inventory and estimate the magnitude of electrical and electronic waste from home ,college or the selected site • Categorise e-waste into different types as per international and national guidelines • Preparation of list of certified electronics recyclers in your city and have an interactive session to learn from the processes being followed. • Prepare a poster showing the salient features of the e-waste management act of India.		

Learning Resources
Text Books
1. Rakesh Johri , E-waste: implications, regulations, and management in India and current global bestpractices, TERI Press, New Delhi 2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009
Reference Books
1. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017Elsevier
E-Resources
1. https://news.mit.edu/2013/ewaste-mit 2. https://youtube.com/playlist?list=PLzX8jgv9ZCbSrFhXR2TMALJTNiRPwr35k&si=NEr2PHV5Xa-XK3cJ

Programme	B. Sc. Electronics				
Course Code					
Course Title	ELECTRONIC FUNDAMENTALS				
Type of Course	**Minor**				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge in science				
Course Summary	This course introduces some of the basic electronics devices like diode and different type of transistors and also basic applications using these devices.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identify and differentiate basic electronic components.	U	C	Instructor-Demonstration
CO2	Understand fundamentals laws of electric circuits.	U	C	Instructor-created exams /
CO3	Differentiate voltage source and current source	Ap	C	Instructor-created exams / Quiz
CO4	Explain principle and behaviour of semiconductor devices.	U	P	Instructor-created exams / Quiz
CO5	To understand and use basics of testing and measuring instruments	Ap	P	Practical Work
CO6	Build simple electronic circuits	Ap	P	Practical work

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I	**Electronic Components**		**10**	**15**
	1	Introduction to Electronics	1	
	2	Introduction Passive Components: Resistor, Capacitor, Inductor, Transformer, resistor colour coding.	3	
	3	Voltage, Current, Voltage source, Current source, Ohm's Law, Kirchhoff's laws	3	
	4	R, C, L series and parallel connections.	3	
II	**Semiconductor diode**		**10**	**15**
	5	Classification of solids- Conductor, Insulator and semiconductor	2	
	6	Intrinsic and extrinsic semiconductors. N type and P type semiconductors, Minority and majority carriers.	2	
	7	Basic principle of operation of PN junction diode, depletion layer, biased PN junction V-I characteristics of diode	3	
	8	PIV of diode, Knee voltage, static and dynamic resistance of Diode.		
	9	Basic principles of LED and Zener diode and its Applications	3	
III	**BJT and FET**		**13**	**20**
	10	BJT Pins, Structure of NPN and PNP transistor.	1	
	11	Biased transistor, active ,saturation and cut off modes	1	
	12	CE transistor configuration.	1	
	13	Current gain of transistor in CE configuration	1	
	14	CE transistor Characteristics,	2	
	15	Introduction to FET, Types of FET, Comparison between FET and BJT.	4	
IV	**Electronic circuits**		**12**	**20**
	16	Introduction to rectifier, Rectifier types.	3	
	17	Circuit diagram and working of Half wave rectifier.		
	18	DC output voltage, ripple factor and rectifier efficiency of half wave rectifier.(detailed analysis not required)		
	19	Full wave rectifier, Circuit diagram of centre tap and bridge rectifiers.	3	
	20	DC output voltage, ripple factor and rectifier efficiency of full wave rectifier. (detailed analysis not required), Capacitor filter		
	21	Block diagram of DC Power supply,	3	
	22	Circuit diagram of CE transistor amplifier and voltage gain of CE amplifier.(Detailed analysis not required)	2	
V	**Electronics Practical Hardware implementation or Simulation Lab**		**30**	
	1	1) Familiarisation of Passive and active components 2) Validating Ohm's law. 3)Application of KVL and KCL 4) Series and parallel connection of resistors. 5) VI characteristics of diode.	30	

		6) Reverse characteristics of zener diode. 7) Half wave rectifier.		

Note: The syllabus has five modules.There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text books:

1.Electronic Devices and Circuit Theory by Robert L Boyleshad.
2.Principles of electronics- V.K Metha.

3. Basic electronics and linear circuits – N.N Bhargava, Kurukshetra and Gupta.

4. Electronics Engineering - B.L.Theraja
5. Textbook of Applied electronics – R.S Sedha.

Online resources

1. https://onlinecourses.swayam2.ac.in/nou23_ec06/preview (Swayam portal online course)

2. https://onlinecourses.nptel.ac.in/noc21_mm03/preview (Swayam portal online course)

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	1			1	
CO 2	2	3	-	-	-	-	1	1			1	
CO 3	-	-	1	-	-	-	1	1			1	
CO 4	-	-	2	3	-	-	1	1			1	
CO 5	-	1	-	-	-	-	1	1			1	

CO 6	-	-	-	3	-	-	1	1			1	

Correlation Levels:

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

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	FUNDAMENTALS OF DIGITAL ELECTRONICS				
Type of Course	**Minor**				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Nil				
Course Summary	This course covers different number systems, Boolean algebra theorems, combinational logic circuits, sequential logic circuits and overview of computer memories.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand different number systems and logic gates	U	C	Instructor-Demonstration
CO2	Understand and Analyse simple combinational logic circuits	An	C	Instructor-created exams /
CO3	Understand and Analyse simple sequential logic circuits	An	C	Instructor-created exams / Quiz
CO4	Understand different type of computer memories	U	C	Instructor-created exams / Quiz
CO5	Design and implement simple combinational logic circuits.	An	P	Practical Work
CO6	Design and implement simple sequential logic circuits	An	P	Practical work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I	**Number system and codes**		**10**	**15**
	1	Decimal, Binary, Hexadecimal number systems conversion of one code to another. Binary Coded Decimal,	1	
	2	Logic Gates : Truth Tables, OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates.	3	
	3	Boolean Algebra Theorems.	3	
	4	DeMorgan's Theorems.	3	
II	**Combinational Logic Analysis and Design**		**10**	**17**
	5	Standard representation of logic functions (SOP and POS).	2	
	6	Minimization of SOP expression using Karnaugh map.	2	
	7	Adder (half and full) and half subtractor and basic binary Decoder.	3	
	8	Multiplexers and Demultiplexers	3	
III	**Sequential logic circuit**		**15**	**22**
	9	Operation of S –R Latch and Gated D Latch	1	
	10	Flip flop (FF), S-R FF,	1	
	11	J-K FF and D type FFs.	1	
	12	Introduction to Counters (synchronous and asynchronous)	1	
	13	Logic circuit of 2 bit asynchronous and 2 bit synchronous counter	3	
	14	Introduction to shift registers different types of shift registers.	2	
	15	Logic circuit of serial in serial out shift register	2	
	16	Logic circuit of Johnson counter	2	
	17	Logic circuit of Ring counter	2	
IV	**Memories**		**10**	**16**
	18	Introduction to memory.	2	
	19	General memory operations. Read and write operation in a single bit memory device.	2	
	20	Basic concepts of RAM.	1	
	20	Types of RAM.	2	
	21	Basic concepts of ROM	1	
	22	Types of ROM	2	
V	**Digital Electronics Practical Hardware Implementation or Simulation Lab**		**30**	
	1	1. Familiarization of logic gates using ICs (NOT, OR, AND, XOR, NAND, NOR). 2. Implement a Half Adder using logic gates 3. Implement a Half subtractor logic gates.	30	

		4. Implement D flip flop using logic gates or IC 5. 4 bit adder using ICs 6. Multiplexer using ICs or logic gates. 7. Johnson counter 8. Ring counter		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

1. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia .

2. Donald P. Leach, Albert Paul Malvino, Digital Principles and Applications, Tata McGraw Hill.
3. M. Morris Mano, Michael D. Ciletti, Digital Design, Pearson Education Asia, (2007) 30
4. R.L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw-Hill
5. https://onlinecourses.nptel.ac.in/noc24_ee52/preview

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	1	-	-	-	-	1					
CO 2	1	1	-	-	-	-	1					
CO 3	1	1	1	-	-	1	1	1			1	
CO 4	2	1	2	-	-	1	2	1			1	
CO 5	2	1	2	-	-	1	2	1			1	

CO 6	2	1	2	-	-	1	2	1			1	

Correlation Levels:

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

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	ARDUINO CODING WITH EMBEDDED C				
Type of Course	**Minor**				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge in Science.				
Course Summary	This course covers introduction to microcontrollers, fundamentals arduino platform, fundamentals of Embedded C, arduino programming and interfacing of sensors and actuators to the arduino board.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand arduino platform	U	C	Instructor-Demonstration
CO2	Understand fundamentals of embedded C	U	C	Instructor-created exams /
CO3	Write codes for simple input and out functions using arduino	U	C	Instructor-created exams / Quiz
CO4	Understand and write codes to interface sensors to arduino.	Ap	P	Practical work
CO5	Understand and write codes to interface motors to arduino	Ap	P	Practical Work
CO6	Build simple projects using Arduino	Ap	P	Practical work

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Module	Unit	Content	Hrs	Marks 70
I	**Introduction to arduino platform**		**8**	**15**
	1	Introduction to microcontroller, Features of AVR microcontroller.	2	
	2	Arduino overview, Key features of Arduino and Arduino board types	2	
	3	Various components on Arduino Board, Pin configuration arduino uno	2	
	4	Installation of arduino IDE	2	
II	**Embedded C**		**18**	**20**
	5	Introduction to embedded C, Program structure.	1	
	6	Data types: Character, byte, integer and word.	2	
	7	Variables and constant	2	
	8	Operators: Arithmetic operators, Comparison operators, Boolean operators and Bitwise operators.	3	
	9	Control statements: If else statement and Switch case statement.	2	
	10	Loops: While loop, Do while loop, For loop and Nested loop	3	
	11	Function and function declaration.	3	
	12	Strings.	2	
III	**Writing Arduino programming**		**10**	**15**
	13	Learning about the standard library of Arduino	3	
	14	Acquiring the skills for writing arduino sketch. Working with examples	2	
	15	Interfacing switches with arduino and Reading analog voltage using arduino	2	
	14	Interfacing LED and buzzer with arduino	1	
	15	Pulse width modulation	2	
IV	**The basic sensors and actuators using Arduino**		**18**	**20**
	16	Definition of sensor, Types of sensors. Difference between Analog and Digital sensors	2	
	17	Concept of ADC and roll of pull up and pull down resistor when interfacing sensors with an Arduino Uno.	2	
	18	Interfacing light sensor, temperature sensor, ultrasonic distance meter and humidity sensors to arduino uno board.	3	
	19	Reading data from the sensors on to the serial monitor.	3	
	20	Introduction to actuators	2	
	21	Actuator types and Principle of actuators.	2	
	22	Interfacing DC motor and stepper motor to arduino board.	4	

V	**Electronics Practical**		**30**	
	1	To blink an LED using arduino uno	30	
	2	Using push button to control LED using arduino uno.		
	3	Interfacing light sensor to arduino board		
	4	Interfacing temperature sensor to arduino board.		
	5	Interfacing DC motor to arduino Board		
	6	Interfacing stepper motor to arduino board.		

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

1. Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury.

2. https ://www.arduino.cc/en/Tutorial/HomePage

3. Arduino Made Simple by Ashwin Pajankar

4. Getting started with Arduino by Massino Banzi.

4. Embedded C, Pont, Michael J

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	-	-	1	-	-	-	1	-	-	-	2	-
CO 2	-	3	2	-	-	-	2	-	-	-	2	-
CO 3	-	-	2	-	2	2	2	-	-	-	2	-
CO 4	-	2	3	-	2	2	2	2	-	-	2	-

CO 5	-	2	3	-	2	2	2	2	-	-	2	-
CO 6	-	2	3	-	2	2	2	2	-	-	2	-

Correlation Levels:

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

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			✓	

Programme	BSc. Electronics				
Course Code					
Course Title	MOBILE PHONE TECHNOLOGY				
Type of Course	**Minor**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Principles of Communication				
Course Summary	This course introduces the Basic conceptual and practical skills in Mobile Phone servicing and enables the aspiring students to exploit the area of mobile phone servicing.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identification of Parts and functions in the handset.	R	C	Internal Exam
CO2	Understand the Peripherals and attachments of handsets.	U	C	Internal Exam
CO3	Diagnosing the symptoms and repair the common faults in the Mobile handset	R	C	Discussion/ Assignment
CO4	Troubleshooting hardware and software problems.	Ap	P	Internal Exam
CO5	Assembly and Disassembly of mobile devices.	Ap	P	Discussion/ Quiz

CO6	Familiarize to repair and service a handset professional	Ap	P	Internal /Assignment
* Cognitive Level: R - Remember, U - Understand, Ap - Apply, An - Analyze, E - Evaluate, C - Create				
# Knowledge Level: F - Factual, C - Conceptual, P - Procedural, M - Metacognitive				

Detailed Syllabus:

Module	Unit	Content	Hours (45)	Marks (70)
I	**Mobile Phone Fundamentals**		**10**	**15**
	1	Evolution of mobile phone generations, types and it Working	2	
	2	Cell Phone Opening Mechanisms: Screw Type, Lock Type, Screw with Lock Type, Slider Type, Flip Top Mobile, Palmtop Mobile	3	
	3	Mobile Phone Accessories: Headphone, Handsfree with Microphone, Double-Sided Handsfree, Bluetooth Handsfree	3	
	4	Memory Cards and Readers, Types of Memory Cards, Memory Card Readers, Screen Guards	2	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
II	**Inside Components**		**12**	**20**
	5	Displays: LCD Display, TFT Display, STN Display	2	
	6	Display Components: Display Flex Cable, Display Cleaners, Display Connectors	1	
	7	Input Devices: Cell Phone Inner Keypads, Cell Phone Keypads, Joysticks	2	
	8	Integrated Circuits (ICs): Function-Specific ICs (Power IC, Charging IC , Audio IC , FM IC, Bluetooth IC, Camera IC, Keypad Light Controller IC ,SIM Card Control IC , Display Control IC)	3	
	9	Network and Processing ICs: PF IC, RF IC, Network IC, CPU, RAM, ROM, UEM IC	2	
	10	Mobile Camera Resolutions: QCIF, QVGA, CIF, VGA, SVGA, XGA, SXGA, UXGA	2	

	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
III	**Mobile Phone Repair Techniques**		**15**	**25**
	11	Component Testing: Soldering and Desoldering, Speaker Testing: External Speaker Testing Method, Buzzer Testing Method, Microphone Testing Method, Vibrator Motor Testing	3	
	12	Battery Connector Testing, LED Testing: Keypad LED, SMD LED types, Damaged LED Finding Method	2	
	13	Testing Other Components: MMC Port, Cracked Screw	1	
	14	Jumper Tools, Jumpering Techniques: Audio Jumpering, Ringer Jumpering, Vibrator Jumpering, Keypad Jumpering, Display Jumpering, Keypad LED Jumpering, On-Off Switch Jumpering	3	
	15	Common Mobile Phone Issues: Ripped Keypads, Water Damage, Power Problems, Network Problems, Insert SIM Problems, Locking Problems	3	
	16	Charging Problems, LED Problems, Display Problems, Ringer Problems, Incoming Voice Not Heard Problems, Outgoing Voice Not Sending Problems, Auto Shut Off Problems, Camera Not Working Problems	3	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
IV	**Mobile Phone Software Maintenance**		**8**	**10**
	17	Mobile Device Drivers and Flashing: Installation of UFS Driver,UFS Suite and its functionalities (brief overview) Flashing Files (concept and basic understanding)	2	
	18	Mobile Network and Identity Management: IMEI Number Detection Methods, Introduction to Mobile GSM Utility Codes	1	
	19	Wireless Technologies: Introduction to different Wireless Options (Bluetooth, Wi-Fi, etc.)	1	
	20	Mobile Operating Systems: Mobile OS Introduction (brief overview of common mobile operating systems like Android, iOS), OS Formatting (concept and basic understanding)	2	
	21	Computer Connections: SIM Card Reader, Memory Card Reader	1	

	22	Mobile Security: Virus Prevention Techniques, Removing Viruses from Mobile Phones (basic methods)	1	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
V	**Hands-on: Practical Applications**		**30**	**20**
	1	Operating the Hot air gun and the soldering station		
	2	Operating the Rework station to Desolder a component		
	3	Demonstration to replace SMD, Exchange SMD components.		
	4	Skill of Soldering a resistor onto a circuit board and then desoldering it safely.		
	5	Troubleshooting a faulty LED (e.g., keypad LED) on a phone, learning proper soldering and component handling techniques		
	6	Troubleshooting a faulty Microphone and the speaker		
	7	Troubleshooting the battery terminal and Charging Pin		
	8	Replacement of Filter cap and display		
		The students shall undergo the inplant training. The training center should be the authorized service center		

Resources:

Text Book	1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications. 3. Smartphones and Tablets Repairs: Money Making Venture Skill,Chukky Oparandu, Mondraim Books
Reference Books	1. 'Wireless Communication Principles and Practices', Rappaport T. S, Pearson Education, Asia, New Delhi, 3rd Ed.2003. 2. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications 3. 'Mobile communication', JochenSchiller, Pearson Education,Asia.
Online Resource	1. http://www.mobilecellphonerepairing.com/mobile-phone-repairing-tutorial.html 2. https://www.lesics.com/how-does-your-mobile-phone-work.html

Mapping of COs with PSOs and POs :											
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

CO 1	3	3	1	2	-	-	3	-	-	-	-	-
CO 2	2	2	1	2	-	-	3	-	-	-	-	-
CO 3	3	1	3	2	-	-	2	2	-	-	1	-
CO 4	3	1	3	2	-	-	2	2	-	-	1	-
CO 5	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/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

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		✓		

Programme	B. Sc. Electronics				
Course Code					
Course Title	**CONSUMER ELECTRONICS**				
Type of Course	Minor				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge in science				
Course Summary	This course introduces some of the basic consumer electronics equipment like microwave oven, washing machine, air condition and refrigerator.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the working and maintenance of microwave Oven,	U	C	Instructor-Demonstration
CO2	Understand the working and maintenance of washing machines and vacuum cleaners.	U	C	Instructor-created exams /
CO3	Understand the working and maintenance of AC and Refrigerator.	U	C	Instructor-created exams / Quiz
CO4	Understand the working and maintenance of Facsimile machine, barcode scanner, calculator and digital clocks.	U	C	Instructor-created exams / Quiz
CO5	To identify components or parts of various consumer electronics equipment.	Ap	P	Practical Work
CO6	To troubleshoot problems in	Ap	P	Practical work

	various consumer electronic equipment.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I		**Microwave oven**	**10**	**16**
	1	Microwave Oven block diagram and principle of operation	2	
	2	Concept of LCD timer with alarm used in Microwave Oven.	2	
	3	Use of Single-chip Controllers in Microwave Oven.	2	
	4	Types of Microwave Oven	2	
	5	Wiring and Safety Instructions for a microwave Oven.	1	
	6	Care and Cleaning for Microwave Oven.	1	
II		**washing machine**	**15**	**20**
	5	Electronic controller for washing machines	2	
	6	Washing machine hardware and software	2	
	7	Types of washing machines	2	
	8	Fuzzy logic washing machines	2	
	9	Features of washing machines	2	
	10	Block diagram, basic working mechanism, maintenance of Dishwasher	2	
	11	Block diagram, basic working mechanism and maintenance of Vacuum cleaner.	3	
III		**Air Condition and Refrigerators**	**10**	**17**
	12	Air conditioning, Components of air conditioning systems	2	
	13	Basic principle and components of All air-air conditioning system,	3	
	14	Basic principle and components of Unitary and central air conditioning systems, Basic principle of Split air conditioners.	2	
	15	Refrigerator Block diagram , working mechanism and maintenance	3	
IV		**Electronic Gadgets and Domestic Appliances**	**10**	**17**
	16	Basic Structure of a calculator.	1	
	17	Internal organization of a calculator	1	
	18	servicing electronic calculators	1	
	19	Basics of barcode scanner and decoder.	1	
	20	Block diagram and working mechanism of Digital clocks	2	

	21	Block diagram and basic details of Xerographic copier	2	
	22	Home security system, CCTV.	2	
V	**Electronics Practical Hardware implementation or Simulation Lab**		**30**	
	1	1) Understand the steps to diagnose the common issues with the microwave oven 2) Understand the steps to diagnose the common issues with the washing machine. 3) Understand the steps to diagnose the common issues with the AC 4) Understand the steps to diagnose the common issues with the Refrigerator. 5) Study the parts/components of calculator and barcode scanner 6) Understand the steps to diagnose the common issues with the Photocopier. 7) Market survey of microwave oven, 8) Market survey of washing machines. 9) Market survey of AC. 10) Market survey of refrigerators.	30	

Note: The syllabus has five modules.There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

1. Bali S.P. Consumer Electronics, Pearson Education India, latest edition.

2. The Washing Machine Manual: DIY Plumbing, Fault-finding, Repair and Maintenance, Graham Dixon, J H Haynes & Co Ltd; 4th edition, 2006.

3. A Textbook of Refrigeration & Air Conditioning by R. K. Rajput , S.K. Kataria & Sons

4. Textbook of Refrigeration and Air Conditioning by R. S. Khurmi, Joyeeta Gupta , S Chand & Co Ltd ,R.S.Khurmi and Joyeeta.Gupta

5. HP41 Repair: A beginner's guide to repairing your HP41 calculator by The Calculator Store

6. B. R. Gupta, V. Singhal, "Consumer Electronics", S. K. Kataria & Sons, 2013

7. Microwave oven user manual.
https://www.lg.com/cac/support/products/documents/3%20KROWM000001993.pdf

8. User manual dishwasher
file:///C:/Users/user/Downloads/DT8B.pdf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	1			1	
CO 2	2	3	-	-	-	-	1	1			1	
CO 3	-	-	1	-	-	-	1	1			1	
CO 4	-	-	2	3	-	-	1	1			1	
CO 5	-	1	-	-	-	-	1	1			1	
CO 6	-	-	-	3	-	-	1	1			1	

Correlation Levels:

Level	Correlation

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

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	ARDUINO PROGRAMMING				
Type of Course	Minor				
Semester	I				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Electronics Devices Basics of Electronics Circuits Basic C Programming				
Course Summary	The "Arduino Programming" course offers a comprehensive journey into the world of Arduino microcontrollers boards, covering essential programming concepts, control structures, interfacing with hardware components, and hands-on project implementation.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	The students completing this module will have a solid foundation in Arduino programming, enabling them to create and understand simple Arduino sketches.	U	C	Instructor-created exams / Quiz
CO2	Upon completion of this module, students will possess the knowledge and skills necessary to effectively utilize control structures in Arduino programming. They will be able to implement conditional logic, iterative processes, and multi-way branching in their Arduino sketches.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Upon completion of this module, students will have a comprehensive understanding of Arduino Uno boards, including their hardware components, pin configurations, and programming environments.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Upon completion of this module, students will have gained experience in interfacing various hardware components with Arduino Uno boards. They will be able to connect, and	U	C	Instructor-created exams / Home Assignments

	program button switches, LEDs, OLED displays, and LCD displays effectively, enabling them to create interactive and informative Arduino-based projects and prototypes.			
CO5	Upon completion of this module, students will have acquired practical skills and experience in writing Arduino programs for various real-world applications. They will be able to integrate different sensors, displays, and input devices to create interactive and functional Arduino-based projects and prototypes.	Ap	P	One Minute Reflection Writing assignments
CO6	Demonstrate critical thinking and problem-solving skills in Arduino Programming.	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I		**Basic Arduino Programming**	**10**	**15**
	1	Introduction to Arduino programming language and structure of Arduino sketch.	2	
	2	Data types in Arduino: int, char and float.	2	
	3	Variables and variable declaration in Arduino	1	
	4	Increment (++) and decrement (--) Operators in Arduino	1	
	5	Relational and Equality Operators in Arduino	1	
	6	Arithmetic and Logical Operators in Arduino	2	
	7	The print() and delay() Functions in Arduino	1	
	Sections from References:			
II		**Control Structure in Arduino**	**10**	**15**
	8	The if , if- else and if- elseif -else statements	3	
	9	The for statement	2	
	10	The while and do-while statement	3	
	11	The switch statement	2	
	Sections from References:			
III		**Introduction to Arduino Uno boards**	**14**	**20**
	12	An overview of Arduino boards	2	
	13	Installing and setting up the Arduino IDE	2	
	14	Understanding the Arduino UNO board and its components	4	
	15	Pin configuration of Arduino Uno (R3)	2	
	16	Arduino Serial Monitor	1	

	17	Basics of PWM in Arduino programming	3	
	Sections from References:			
IV	**Arduino Uno Interfacing with button switch, LED and LCD**		**11**	**20**
	18	An overview of button switch, LED , OLED and LCD	3	
	19	Interfacing button switch with Arduino Uno board	2	
	20	Interfacing LED with Arduino Uno board	2	
	21	Interfacing OLED switch with Arduino Uno board	2	
	22	Interfacing LCD switch with Arduino Uno board	2	
	Sections from References:			
V	**Hands-on Arduino Programming: Practical Applications, Case Study and Course Project**		**30**	
	1	Implement the following: 1. Write an Arduino program to turn ON an LED. 2. Write an Arduino program to interface OLED. 3. Write an Arduino program to turn ON an LED using button switch. 4. Write an Arduino program to read voltage across a potentiometer and display it on LCD display. 5. Write an Arduino program to display room temperature in LCD display. 6. Write an Arduino program to display humidity in the serial monitor. 7. Write an Arduino program to detect an obstacle using IR sensor. 8. Write an Arduino program to read light intensity and display it on LCD display.	20	
	2	Case study	3	
	3	Capstone (/Course) Project: Build a practical application using Arduino Board	7	

Books and References:

1. Object Oriented Programming with C++ , E.Balagurusamy . Mc Grow Hill.
2. https://docs.arduino.cc/
3. https://www.instructables.com/Beginner-Arduino/

Note: The syllabus has five modules. There should be total 22 units in the first four modules together, composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks). The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	IOT HARDWARE AND INTERFACING				
Type of Course	Minor				
Semester	II				
Academic Level	100-199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
		3	-	2	75
Pre-requisites	Basic understanding of electronics Familiarity with Arduino Knowledge of programming				
Course Summary	The "IoT Hardware and Interfacing" course provides a comprehensive exploration of sensor and actuator technologies, focusing on their integration with Arduino microcontrollers for IoT applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will develop a comprehensive understanding of sensors and transducers, distinguishing between analog and digital variants.	U	C	Instructor-created exams / Quiz
CO2	Students in this course will gain a comprehensive understanding of actuators and their role in Arduino projects.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	Students will emerge from this course equipped with a comprehensive understanding of Node MCU development boards and their application in IoT projects. They will master the basics of IoT and its potential across diverse domains.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	Students completing this course will emerge with a comprehensive understanding of IoT applications and their far-reaching impact across various sectors. They will delve into the specifics of implementing IoT solutions in smart cities, industrial settings, agriculture, precision farming, and home automation.	U	C	Instructor-created exams / Home Assignments

CO5	Students will gain a comprehensive understanding of IoT concepts, along with practical skills in sensor interfacing, motor control, relay applications, and simulation design, preparing them for real-world IoT projects and applications.	Ap	P	One Minute Reflection Writing assignments
CO6	Demonstrate critical thinking and problem-solving skills in IoT.	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Arduino Sensors**		**6**	**15**
	1	Introduction to Sensors and Transducers in Arduino	1	
	2	Analog and Digital Sensors: Understanding the Distinctions	2	
	3	Interfacing Analog and Digital Sensors with Arduino	2	
	4	Arduino-Compatible Sensor Modules and Shields	1	
II	**Arduino Actuators**		**13**	**21**
	5	Introduction to Actuators in Arduino	2	
	6	Interfacing DC Motors with Arduino	3	
	7	Interfacing Servo Motors with Arduino	2	
	8	Interfacing Stepper motor with Arduino	2	
	9	Interfacing Relays with Arduino	2	
	10	Understanding PWM (Pulse Width Modulation) for Actuator Control	2	
III	**Introduction to Node MCU and IoT**		**16**	**22**
	11	Overview of Node MCU and IoT	2	
	12	Introduction to Node MCU development board	2	
	13	Understanding the basics of IoT and its applications	2	
	14	Node MCU hardware components	2	
	15	Controlling Digital and Analog Pins: Understanding GPIO pins on Node MCU, Digital input and output operations and Analog input using Node MCU's ADC	3	
	16	Connecting Node MCU to Wi-Fi: Configuring Wi-Fi settings on Node MCU, Sending and receiving data over Wi-Fi.	3	
	17	Interfacing Sensors with Node MCU	2	
IV	**IoT Applications:**		**10**	**12**
	18	Introduction to IoT Applications: Scope and Impact	2	
	19	Smart Cities: IoT Solutions for Urban Management	2	
	20	Industrial IoT (IIoT): Transforming, Manufacturing and Operations	2	

	21	Agriculture and Precision Farming with IoT	2	
	22	Home Automation: Smart Homes and IoT	2	
V	**Hands-on IoT Hardware And Interfacing**: **Practical Applications, Case Study and Course Project**		**30**	
	1	Implement the following: 1. Setting Up IoT Simulation Environment: Installing and configuring IoT simulation software, Simulating basic IoT scenarios. 2. Analog Sensor Interface: Reading and displaying analog sensor values on the Arduino Serial Monitor, Calibration techniques for analog sensors. 3. Digital Sensor Integration: Connecting and interfacing digital sensors (e.g., motion sensors, switches). 4. Servo Motor Control: Interfacing and controlling a servo motor with Arduino, Writing code to control the servo motor's position. 5. DC Motor Speed Control: Connecting a DC motor to an Arduino for speed control. 6. Relay Applications: Integrating relays with Arduino for switching applications. 7. Smart Home Automation Simulation: Designing a simulation for home automation, Controlling lights, appliances, and security systems. 8. Agricultural IoT Implementation:, Designing a simulation for precision farming and monitoring crop conditions, Integrating sensors for soil moisture, temperature, etc.	20	
	2	Case study	3	
	3	Capstone (/Course) Project: Build a practical application using Node MCU development Board	7	
	Sections from References:			

Books and References:

1. "Sensors and Transducers", Patranabis.D, Wheeler publisher
2. Sensors And Actuators by Alegria Francisco Andre Correa, World Scientific India
3. https://www.instructables.com/Quick-Start-to-Nodemcu-ESP8266-on-Arduino-IDE/
4. https://randomnerdtutorials.com/getting-started-with-esp8266-wifi-transceiver-review/

Note: The syllabus has five modules. There should be total 22 units in the first four modules together, composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks). The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	PYTHON PROGRAMMING FOR IOT APPLICATIONS				
Type of Course	Minor				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Knowledge in Electronics Experience in IDE Basic programming skills				
Course Summary	The "Python Programming for IoT Applications" course provides a comprehensive overview of Python's role in Internet of Things (IoT) development. It covers essential Python programming concepts, data handling techniques, file management, and integration with IoT hardware and cloud platforms.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	This course provides students with a comprehensive understanding of Python's role in IoT development and equips them with the necessary skills to navigate through the various aspects of Python programming relevant to IoT applications.	U	C	Instructor-created exams / Quiz
CO2	This course provides students with a comprehensive understanding of cloud computing concepts and their integration with Internet of Things (IoT) applications.	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	This course provides students with a comprehensive understanding of sensors and their pivotal role in IoT (Internet of Things) applications.	Ap	P	Seminar Presentation / Group Tutorial Work
CO4	This course offers students a comprehensive introduction to control and automation within IoT (Internet of Things) applications.	U	C	Instructor-created exams / Home Assignments
CO5	These hands-on sections will provide participants with practical experience and reinforce theoretical concepts,	Ap	P	One Minute Reflection

	enabling them to apply their learning effectively in real-world scenarios.			Writing assignments
CO6	Demonstrate critical thinking and problem-solving skills in IoT and python programming.	Ap	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Introduction to Python for IoT**		**12**	**20**
	1	Role of Python in IoT development, Overview of Integrated Development Environments (IDEs) for IoT in Python.	2	
	2	Basic Python Programming Concepts: Variables, data types, and operators.	2	
	3	Basic Python Programming Concepts: Control flow: loops and conditional statements	2	
	4	Basic Python Programming Concepts: Functions and modules in Python	2	
	5	Data Handling in Python: Working with data structures (lists, tuples, dictionaries)	2	
	6	File handling in Python for IoT applications	2	
II	**Introduction to Cloud Platforms for IoT:**		**15**	**20**
	7	Role of Python in IoT development, Overview of Integrated Development Environments (IDEs) for IoT in Python.	2	
	8	Basic Python Programming Concepts: Variables, data types, and operators.	2	
	9	Basic Python Programming Concepts: Control flow: loops and conditional statements	3	
	10	Basic Python Programming Concepts: Functions and modules in Python	2	
	11	Data Handling in Python: Working with data structures (lists, tuples, dictionaries)	2	
	12	File handling in Python for IoT applications	2	
	13	Role of Python in IoT development, Overview of Integrated Development Environments (IDEs) for IoT in Python.	2	
III	**Introduction to Node MCU and IoT**		**10**	**18**
	14	Overview of sensors and their role in IoT.	2	
	15	Reading sensor data using Python from Arduino or Raspberry pi board	2	
	16	Introduction to sensor interfaces (I2C, SPI, GPIO)	2	
	17	Configuring and processing sensors in Python scripts	2	
	18	Overview of data storage options for sensor data	2	

IV	**Python-based Control and Automation for IoT**		**8**	**12**
	19	Introduction to Control and Automation in IoT	2	
	20	Automation with Python Scripting	2	
	21	Automation and Device Control with Python	2	
	22	Interfacing with motors and relays	2	
V	**Hands-on Python programming for IoT Applications** : **Practical Applications, Case Study and Course Project**		**30**	
	1	Implement the following: 1. Setting up the Development Environment: Installing Python and necessary libraries. 2. Use a 'for' loop to print numbers from 1 to 5. - Include a counter variable. 3. Implement a 'while' loop to print a countdown from 5 to 1. - Include proper loop control. 4. Use an 'if-else' statement to check if a number is even or odd. - Display the result. 5. Define a function that takes two parameters and returns their sum. - Call the function with different arguments. 6. Create a module with a function that multiplies two numbers. - Import the module into another script and use the function. 7. Create a list with at least five elements. - Perform operations like appending, slicing, and modifying elements. 8. Create a tuple with different data types. - Demonstrate the immutability of tuples and perform operations. 9. Create a dictionary with key-value pairs representing information. - Access and modify dictionary values. 10. Develop a script that automates a series of tasks in an IoT environment. 11. Write Python scripts that respond to specific events.	20	
	2	Case study	3	
	3	Capstone (/Course) Project: Build a practical application in IoT using Node MCU or Raspberry pi board	7	

Books and References:

1. Introduction to Computing and Problem Solving Using Python , Balagurusamy, Mc Graw Hill
2. Programming in Python, Pooja Sharma, BPB Publications

Note: The syllabus has five modules. There should be total 22 units in the first four modules together, composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical

will be based on Module V. Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks). The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
Final Exam (70%)

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			✓	

Programme	B.Sc. Electronics				
Course Code					
Course Title	MOBILE PHONE TECHNOLOGY				
Type of Course	**Minor**				
Semester	VIII				
Academic Level	400 - 499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Principles of Communication				
Course Summary	This course introduces the Basic conceptual and practical skills in Mobile Phone servicing and enables the aspiring students to exploit the area of mobile phone servicing.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identification of Parts and functions in the handset.	R	C	Internal Exam
CO2	Understand the Peripherals and attachments of handsets.	U	C	Internal Exam
CO3	Diagnosing the symptoms and repair the common faults in the Mobile handset	R	C	Discussion/ Assignment
CO4	Troubleshooting hardware and software problems.	Ap	P	Internal Exam
CO5	Assembly and Disassembly of mobile devices.	Ap	P	Discussion/ Quiz

CO6	Familiarize to repair and service a handset professional	Ap	P	Internal /Assignment
* Cognitive Level: R - Remember, U - Understand, Ap - Apply, An - Analyze, E - Evaluate, C - Create				
# Knowledge Level: F - Factual, C - Conceptual, P - Procedural, M - Metacognitive				

Detailed Syllabus:

Module	Unit	Content	Hours (45)	Marks (70)
I	**Mobile Phone Fundamentals**		**10**	**15**
	1	Evolution of mobile phone generations, types and it Working	2	
	2	Cell Phone Opening Mechanisms: *Screw Type,Lock Type,Screw with Lock Type,Slider Type,Flip Top Mobile,Palmtop Mobile*	3	
	3	Mobile Phone Accessories: *Headphone, Handsfree with Microphone, Double-Sided Handsfree,Bluetooth Handsfree*	3	
	4	Memory Cards and Readers, Types of Memory Cards, Memory Card Readers, Screen Guards	2	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
II	**Inside Components**		**12**	**20**
	5	Displays:*LCD Display, TFT Display, STN Display*	2	
	6	Display Components: *Display Flex Cable, Display Cleaners, Display Connectors*	1	
	7	Input Devices: *Cell Phone Inner Keypads, Cell Phone Keypads, Joysticks*	2	
	8	Integrated Circuits (ICs): Function-Specific ICs (*Power IC,Charging IC ,Audio IC , FM IC, Bluetooth IC, Camera IC, Keypad Light Controller IC ,SIM Card Control IC , Display Control IC)*	3	
	9	Network and Processing ICs:*PF IC, RF IC, Network IC, CPU, RAM, ROM, UEM IC*	2	
	10	Mobile Camera Resolutions: *QCIF, QVGA, CIF, VGA, SVGA, XGA, SXGA, UXGA*	2	

	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
III	**Mobile Phone Repair Techniques**		**15**	**25**
	11	Component Testing:Soldering and Desoldering, Speaker Testing:*External Speaker Testing Method, Buzzer Testing Method*, Microphone Testing Method, Vibrator Motor Testing	3	
	12	Battery Connector Testing, LED Testing: Keypad LED, SMD LED types, Damaged LED Finding Method	2	
	13	Testing Other Components:*MMC Port, Cracked Screw*	1	
	14	Jumper Tools ,Jumpering Techniques: *Audio Jumpering, Ringer Jumpering, Vibrator Jumpering, Keypad Jumpering, Display Jumpering, Keypad LED Jumpering, On-Off Switch Jumpering*	3	
	15	Common Mobile Phone Issues: Ripped Keypads, Water Damage, Power Problems, Network Problems,Insert SIM Problems, Locking Problems	3	
	16	Charging Problems, LED Problems, Display Problems,Ringer Problems, Incoming Voice Not Heard Problems, Outgoing Voice Not Sending Problems, Auto Shut Off Problems, Camera Not Working Problems	3	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
IV	**Mobile Phone Software Maintenance**		**8**	**10**
	17	Mobile Device Drivers and Flashing: Installation of UFS Driver,UFS Suite and its functionalities (brief overview) Flashing Files (concept and basic understanding)	2	
	18	Mobile Network and Identity Management: IMEI Number Detection Methods, Introduction to Mobile GSM Utility Codes	1	
	19	Wireless Technologies: Introduction to different Wireless Options (Bluetooth, Wi-Fi, etc.)	1	
	20	Mobile Operating Systems: Mobile OS Introduction (brief overview of common mobile operating systems like Android, iOS), OS Formatting (concept and basic understanding)	2	
	21	Computer Connections: SIM Card Reader, Memory Card Reader	1	

	22	Mobile Security: Virus Prevention Techniques, Removing Viruses from Mobile Phones (basic methods)	1	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
V	**Hands-on: Practical Applications**		**30**	**20**
	1	Operating the Hot air gun and the soldering station		
	2	Operating the Rework station to Desolder a component		
	3	Demonstration to replace SMD, Exchange SMD components.		
	4	Skill of Soldering a resistor onto a circuit board and then desoldering it safely.		
	5	Troubleshooting a faulty LED (e.g., keypad LED) on a phone, learning proper soldering and component handling techniques		
	6	Troubleshooting a faulty Microphone and the speaker		
	7	Troubleshooting the battery terminal and Charging Pin		
	8	Replacement of Filter cap and display		
		The students shall undergo the inplant training. The training center should be the authorized service center		

Resources:

Text Book	1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications. 3. Smartphones and Tablets Repairs: Money Making Venture Skill,Chukky Oparandu, Mondraim Books
Reference Books	1. 'Wireless Communication Principles and Practices', Rappaport T. S, Pearson Education, Asia, New Delhi, 3rd Ed.2003. 2. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications 3. 'Mobile communication', JochenSchiller, Pearson Education,Asia.
Online Resource	1. http://www.mobilecellphonerepairing.com/mobile-phone-repairing-tutorial.html 2. https://www.lesics.com/how-does-your-mobile-phone-work.html

Mapping of COs with PSOs and POs :											
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

CO 1	3	3	1	2	-	-	3	-	-	-	-	-
CO 2	2	2	1	2	-	-	3	-	-	-	-	-
CO 3	3	1	3	2	-	-	2	2	-	-	1	-
CO 4	3	1	3	2	-	-	2	2	-	-	1	-
CO 5	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/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

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		✓		

Programme	B. Sc. Electronics				
Course Code					
Course Title	**CONSUMER ELECTRONICS**				
Type of Course	Minor				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge in science				
Course Summary	This course introduces some of the basic consumer electronics equipment like microwave oven, washing machine, air condition and refrigerator.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the working and maintenance of microwave Oven,	U	C	Instructor-Demonstration
CO2	Understand the working and maintenance of washing machines and vacuum cleaners.	U	C	Instructor-created exams /
CO3	Understand the working and maintenance of AC and Refrigerator.	U	C	Instructor-created exams / Quiz
CO4	Understand the working and maintenance of Facsimile machine, barcode scanner, calculator and digital clocks.	U	C	Instructor-created exams / Quiz
CO5	To identify components or parts of various consumer electronics equipment.	Ap	P	Practical Work
CO6	To troubleshoot problems in various consumer electronic equipment.	Ap	P	Practical work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)				

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I		**Microwave oven**	**10**	**16**
	1	Microwave Oven block diagram and principle of operation	2	
	2	Concept of LCD timer with alarm used in Microwave Oven.	2	
	3	Use of Single-chip Controllers in Microwave Oven.	2	
	4	Types of Microwave Oven	2	
	5	Wiring and Safety Instructions for a microwave Oven.	1	
	6	Care and Cleaning for Microwave Oven.	1	
II		**washing machine**	**15**	**20**
	5	Electronic controller for washing machines	2	
	6	Washing machine hardware and software	2	
	7	Types of washing machines	2	
	8	Fuzzy logic washing machines	2	
	9	Features of washing machines	2	
	10	Block diagram, basic working mechanism, maintenance of Dishwasher	2	
	11	Block diagram, basic working mechanism and maintenance of Vacuum cleaner.	3	
III		**Air Condition and Refrigerators**	**10**	**17**
	12	Air conditioning, Components of air conditioning systems	2	
	13	Basic principle and components of All air-air conditioning system,	3	
	14	Basic principle and components of Unitary and central air conditioning systems, Basic principle of Split air conditioners.	2	
	15	Refrigerator Block diagram , working mechanism and maintenance	3	
IV		**Electronic Gadgets and Domestic Appliances**	**10**	**17**
	16	Basic Structure of a calculator.	1	
	17	Internal organization of a calculator	1	
	18	servicing electronic calculators	1	
	19	Basics of barcode scanner and decoder.	1	
	20	Block diagram and working mechanism of Digital clocks	2	
	21	Block diagram and basic details of Xerographic copier	2	
	22	Home security system, CCTV.	2	
V			**30**	

	Electronics Practical Hardware implementation or Simulation Lab			
	1	1) Understand the steps to diagnose the common issues with the microwave oven 2) Understand the steps to diagnose the common issues with the washing machine. 3) Understand the steps to diagnose the common issues with the AC 4) Understand the steps to diagnose the common issues with the Refrigerator. 5) Study the parts/components of calculator and barcode scanner 6) Understand the steps to diagnose the common issues with the Photocopier. 7) Market survey of microwave oven, 8) Market survey of washing machines. 9) Market survey of AC. 10) Market survey of refrigerators.	30	

Note: The syllabus has five modules.There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

1. Bali S.P. Consumer Electronics, Pearson Education India, latest edition.

2. The Washing Machine Manual: DIY Plumbing, Fault-finding, Repair and Maintenance, Graham Dixon, J H Haynes & Co Ltd; 4th edition, 2006.

3. A Textbook of Refrigeration & Air Conditioning by R. K. Rajput , S.K. Kataria & Sons

4. Textbook of Refrigeration and Air Conditioning by R. S. Khurmi, Joyeeta Gupta , S Chand & Co Ltd ,R.S.Khurmi and Joyeeta.Gupta

5. HP41 Repair: A beginner's guide to repairing your HP41 calculator by The Calculator Store

6. B. R. Gupta, V. Singhal, “Consumer Electronics”, S. K. Kataria & Sons, 2013

7. Microwave oven user manual.

https://www.lg.com/cac/support/products/documents/3%20KROWM000001993.pdf

8. User manual dishwasher

file:///C:/Users/user/Downloads/DT8B.pdf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	1			1	
CO 2	2	3	-	-	-	-	1	1			1	
CO 3	-	-	1	-	-	-	1	1			1	
CO 4	-	-	2	3	-	-	1	1			1	
CO 5	-	1	-	-	-	-	1	1			1	
CO 6	-	-	-	3	-	-	1	1			1	

Correlation Levels:

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

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE				
Type of Course	**Vocational Minor**				
Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in computer.				
Course Summary	This course structure aims to provide a thorough introduction to AI, catering to beginners and those looking to consolidate their understanding of the field				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand what AI is and recognize its impact across different sectors.	U	C	Instructor-created exams / Quiz/ Assignment
CO2	Differentiate between human intelligence and artificial intelligence	Ap	P	Practical/ Viva Voce
CO3	Gain an appreciation for the evolution of AI technology and its pioneers.	Ap	C	Observation of Practical Skills / assignments
CO4	Understand the multidisciplinary contributions that form the basis of AI.	U	P	Practical / Viva Voce / Asignments
CO5	Identify how AI is applied in different industries and its potential to solve real-world problems.	An	P	Practical / Viva Voce / Asignments
CO6	Learn various AI strategies for solving complex problems and making decisions..	Ap	p	Viva Voce/Practical/Project

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

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs 45	Mark (70)
I		**Introduction**	**15**	
	1	Introduction to Artificial Intelligence (AI)	2	
	2	Difference between Intelligence and AI	2	
	3	History of AI	2	
	4	Foundations of AI	2	
	5	Applications of AI	2	**20**
	6	Comparison of AI with data science	3	
	7	Need of AI in machine Learning	2	
II		**Intelligent Agents**	**12**	
	8	Introduction of Agents	2	
	9	Structure of Intelligent Agent	2	
	10	Properties of Intelligent Agent	2	**22**
	11	Configuration of Agents	2	
	12	Types of Agents	2	
	13	Environment Types	2	
III		**Problem Solving**	**8**	
	14	Problem Solving by Searching and Agents	2	
	15	Problem Formulation	2	
	16	Search Strategies	2	**15**
	17	Games As Search Problem	2	
IV		**Specialization Tracks**	**10**	
	18	AI in business	2	
	19	AI in Engineering	2	
	20	AI in Cybersecurity	2	
	21	AI in Social Science	2	
	22	AI in Research	2	
V		**Open Ended Module: Practical Applications**	**30**	
	1	Familiarization of the following AI tools 1.openai 2.Gamma 3.playwallhub 4.debug code.ai	20	

		5.gemini 6.yoodli.ai 7.playgroundai 8.merlin-ai 9. formula.dog		
	2	Assign project using AI tools	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Text Books

1. Patrick Henry Winston, **Artificial Intelligence**, Third Edition, Addison-Wesley Publishing Company, 2004.
2. Nils J Nilsson, **Principles of Artificial Intelligence**, Illustrated Reprint Edition, Springer Heidelberg, 2014.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	3	2	3	-	-	3	2	-	2	-	-
CO 3	3	3	2	3	-	-	3	2	-	2	-	-
CO 4	3	3	2	3	-	-	3	2	-	2	-	-
CO 5	3	2	2	2	2	1	3	2	-	2	2	-
CO 6	3	2	2	2	3	3	2	-	-	3	2	-

Correlation Levels:

Level	Correlation
-	Nil

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

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

Programme	B.Sc. Electronics				
Course Code					
Course Title	MOBILE PHONE TECHNOLOGY				
Type of Course	**Vocational Minor**				
Semester	II				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Principles of Communication				
Course Summary	This course introduces the Basic conceptual and practical skills in Mobile Phone servicing and enables the aspiring students to exploit the area of mobile phone servicing.				

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Identification of Parts and functions in the handset.	R	C	Internal Exam
CO2	Understand the Peripherals and attachments of handsets.	U	C	Internal Exam
CO3	Diagnosing the symptoms and repair the common faults in the Mobile handset	R	C	Discussion/ Assignment
CO4	Troubleshooting hardware and software problems.	Ap	P	Internal Exam
CO5	Assembly and Disassembly of mobile devices.	Ap	P	Discussion/ Quiz

CO6	Familiarize to repair and service a handset professional	Ap	P	Internal /Assignment
* Cognitive Level: R - Remember, U - Understand, Ap - Apply, An - Analyze, E - Evaluate, C - Create				
# Knowledge Level: F - Factual, C - Conceptual, P - Procedural, M - Metacognitive				

Detailed Syllabus:

Module	Unit	Content	Hours (45)	Marks (70)
I	**Mobile Phone Fundamentals**		**10**	**15**
	1	Evolution of mobile phone generations, types and it Working	2	
	2	Cell Phone Opening Mechanisms: *Screw Type,Lock Type,Screw with Lock Type,Slider Type,Flip Top Mobile,Palmtop Mobile*	3	
	3	Mobile Phone Accessories: *Headphone, Handsfree with Microphone, Double-Sided Handsfree,Bluetooth Handsfree*	3	
	4	Memory Cards and Readers, Types of Memory Cards, Memory Card Readers, Screen Guards	2	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
II	**Inside Components**		**12**	**20**
	5	Displays:*LCD Display, TFT Display, STN Display*	2	
	6	Display Components: *Display Flex Cable, Display Cleaners, Display Connectors*	1	
	7	Input Devices: *Cell Phone Inner Keypads, Cell Phone Keypads, Joysticks*	2	
	8	Integrated Circuits (ICs): Function-Specific ICs (*Power IC,Charging IC ,Audio IC , FM IC, Bluetooth IC, Camera IC, Keypad Light Controller IC ,SIM Card Control IC , Display Control IC)*	3	
	9	Network and Processing ICs:*PF IC, RF IC, Network IC, CPU, RAM, ROM, UEM IC*	2	
	10	Mobile Camera Resolutions: *QCIF, QVGA, CIF, VGA, SVGA, XGA, SXGA, UXGA*	2	

	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications			
III	**Mobile Phone Repair Techniques**		**15**	**25**
	11	Component Testing:Soldering and Desoldering, Speaker Testing:*External Speaker Testing Method, Buzzer Testing Method*, Microphone Testing Method, Vibrator Motor Testing	3	
	12	Battery Connector Testing, LED Testing: Keypad LED, SMD LED types, Damaged LED Finding Method	2	
	13	Testing Other Components:*MMC Port, Cracked Screw*	1	
	14	Jumper Tools ,Jumpering Techniques: *Audio Jumpering, Ringer Jumpering, Vibrator Jumpering, Keypad Jumpering, Display Jumpering, Keypad LED Jumpering, On-Off Switch Jumpering*	3	
	15	Common Mobile Phone Issues: Ripped Keypads, Water Damage, Power Problems, Network Problems,Insert SIM Problems, Locking Problems	3	
	16	Charging Problems, LED Problems, Display Problems,Ringer Problems, Incoming Voice Not Heard Problems, Outgoing Voice Not Sending Problems, Auto Shut Off Problems, Camera Not Working Problems	3	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
IV	**Mobile Phone Software Maintenance**		**8**	**10**
	17	Mobile Device Drivers and Flashing: Installation of UFS Driver,UFS Suite and its functionalities (brief overview) Flashing Files (concept and basic understanding)	2	
	18	Mobile Network and Identity Management: IMEI Number Detection Methods, Introduction to Mobile GSM Utility Codes	1	
	19	Wireless Technologies: Introduction to different Wireless Options (Bluetooth, Wi-Fi, etc.)	1	
	20	Mobile Operating Systems: Mobile OS Introduction (brief overview of common mobile operating systems like Android, iOS), OS Formatting (concept and basic understanding)	2	
	21	Computer Connections: SIM Card Reader, Memory Card Reader	1	

	22	Mobile Security: Virus Prevention Techniques, Removing Viruses from Mobile Phones (basic methods)	1	
	Sections from References: 1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications.			
V	**Hands-on: Practical Applications**		**30**	**20**
	1	Operating the Hot air gun and the soldering station		
	2	Operating the Rework station to Desolder a component		
	3	Demonstration to replace SMD, Exchange SMD components.		
	4	Skill of Soldering a resistor onto a circuit board and then desoldering it safely.		
	5	Troubleshooting a faulty LED (e.g., keypad LED) on a phone, learning proper soldering and component handling techniques		
	6	Troubleshooting a faulty Microphone and the speaker		
	7	Troubleshooting the battery terminal and Charging Pin		
	8	Replacement of Filter cap and display		
		The students shall undergo the inplant training. The training center should be the authorized service center		

Resources:

Text Book	1. Modern Mobile Phone Repair: Using Computer Software and Service Devices- M. Lotia, Pradeep Nair- BPB Publications. 2. Modern Mobile Phone Introduction & Servicing- Manahar Lotia - BPB Publications. 3. Smartphones and Tablets Repairs: Money Making Venture Skill,Chukky Oparandu, Mondraim Books
Reference Books	1. 'Wireless Communication Principles and Practices', Rappaport T. S, Pearson Education, Asia, New Delhi, 3rd Ed.2003. 2. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications 3. 'Mobile communication', JochenSchiller, Pearson Education,Asia.
Online Resource	1. http://www.mobilecellphonerepairing.com/mobile-phone-repairing-tutorial.html 2. https://www.lesics.com/how-does-your-mobile-phone-work.html

Mapping of COs with PSOs and POs :											
	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

CO 1	3	3	1	2	-	-	3	-	-	-	-	-
CO 2	2	2	1	2	-	-	3	-	-	-	-	-
CO 3	3	1	3	2	-	-	2	2	-	-	1	-
CO 4	3	1	3	2	-	-	2	2	-	-	1	-
CO 5	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/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

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		✓		

Programme	B. Sc. Electronics				
Course Code					
Course Title	ROBOTICS & DRONE TECHNOLOGY				
Type of Course	**Vocational Minor**				
Semester	III				
Academic Level	200 - 299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basic knowledge of electronics, including understanding circuits, microcontrollers, and interfacing with sensors and actuators. 2. Proficiency in at least one programming language (e.g., Python, C++, Java) is essential. 3. Knowledge of matrices, vectors, and linear transformations is essential for understanding robot kinematics, dynamics, and computer vision.				
Course Summary	Learn about the fundamental principles of robotics and drones. Understand the components and systems that make up drones. Explore the applications and impact of drone technology across various industries. Discuss the ethical, legal, and social implications of drone technology.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Gain a solid foundation in the principles of robotics and drone technology, including mechanics and electronics	U	C	Instructor-created exams / Quiz
CO2	Learn to select appropriate sensors, actuators, and controllers for different types of robotic and drone projects.	U	C	Practical Assignment / Observation of Practical Skills
CO3	Gain experience with software tools for simulation, design, and testing of robotic systems and drones.	An	P	Practical Assignment / Observation of Practical Skills
CO4	Understand how machine learning and artificial intelligence can be applied to enhance the capabilities of robotic systems and drones.	Ap	P	Instructor-created exams / Home Assignments
CO5	Explore the ethical, legal, and societal implications of robotics and drone technology, including privacy, safety, and regulatory considerations.	U	P	One Minute Reflection Writing assignments
CO6	Gain insights into current research	U	P	Viva Voce

	trends and challenges in robotics and drone technology, setting a foundation for further education and innovation.			

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Introduction to Robotics and Drones**		**10**	**15**
	1	Overview of robotics and drone technology	2	
	2	History and evolution of drones	3	
	3	Types of drones	3	
	4	Applications of drones	2	
II	**Fundamentals of Flight**		**10**	**15**
	5	Principles of flight and aerodynamics	3	
	6	Drone components and systems	3	
	7	Introduction to Unmanned Aerial Vehicle	2	
	8	UAV design and engineering	2	
III	**Sensors and Navigation**		**15**	**25**
	9	Sensors used in drones (GPS, IMU, LiDAR, cameras)	2	
	10	Basics of navigation and control systems	2	
	11	Introduction to remote sensing and data collection	1	
	12	Understanding flight controllers	2	
	13	Basics of drone piloting and manual control	2	
	14	Introduction to autopilot systems and software	2	
	15	Principles of autonomous flight	1	
	16	Path planning and obstacle avoidance	1	
	17	Machine learning and AI in drones	2	
IV	**Drone Applications and Safety**		**10**	
	18	Surveying and mapping	2	
	19	Agriculture and environmental monitoring	2	
	20	Search and rescue, surveillance, and delivery services	2	
	21	Privacy concerns and surveillance, Regulatory and safety considerations	2	
	22	Future of drone technology and societal impact	2	
V	**Hands-on: Practical Applications, Case Study and Course Project**		**30**	
	1	1. Study of safety guidelines, especially when working with power tools, electronics, and flying drones 2. Study of local regulations regarding drone flying, especially concerning no-fly zones, altitude limits, and privacy laws 3. Build a simple robot that can follow a black line on a white surface with Arduino Uno, IR sensors, motors, motor driver board etc. 4. Create a robot that can autonomously navigate around obstacles using Arduino Uno, ultrasonic sensor, servo motor, wheels, motor driver. 5. Build a robot that can be controlled remotely using a smartphone or a remote controller using Arduino Uno, Bluetooth module (HC-05), DC motors, motor driver. 6. Learn the basics of drone flight without the risk of crashing an actual drone.	20	

		using Drone flight simulator software (many are available for free or have trial versions). 7. Study about DOF of a robotic arm to determine its ability to position and orient its end-effector in space. 8. Study the various sensors (encoders, force sensors, vision systems) used to monitor the state of the robotic arm and provide feedback for control. 9. Understand the different types of actuators used in robotic arms, including electric motors, hydraulic and pneumatic systems, and how they are controlled.		
	2	Case study: Medical Robotics: Explore the use of robotic arms in surgery and rehabilitation, focusing on the requirements for precision and safety.	3	
	3	Capstone Mini Project: Industrial Automation: Study how robotic arms are used in manufacturing for tasks like assembly, welding, and painting.	7	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

Text Books:

1. Internet of Things: Robotic and Drone Technology, Edited ByNitin Goyal, Sharad Sharma, Arun Kumar Rana, Suman Lata Tripathi, CRC Press

2. Drone Technology: Future Trends and Practical Applications Editor(s):Sachi Nandan Mohanty, J.V.R. Ravindra, G. Surya Narayana, Chinmaya Ranjan Pattnaik, Y. Mohamed Sirajudeen, Wiley Publ.

3. "Drone Technologies and Applications" authored by Koç Mehmet Tuğrul, edited by Dragan Cvetković https://www.intechopen.com/books/1002775

4 "Drones - Applications" edited by George Dekoulis https://www.intechopen.com/books/6465

5. "Introduction to Robotics: Mechanics and Control" by John J. Craig, Pearson Publ.

6. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009.

7. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012).

8. Ganesh S Hegde, “A textbook on Industrial Robotics”, University science press, 3rdedition, 2017.

Web resources:

1. https://robotsguide.com
2. https://roboticscasual.com/best-online-resources-to-learn-robotics/

3. https://www.coursera.org/specializations/robotics
4. https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-2005/
5. https://ardupilot.org/
6. https://px4.io/
7. https://dronecode.org/
8. https://diydrones.com/
9. https://www.edx.org/
10. https://www.youtube.com/user/sparkfun

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	2	-	-	3	-	-						
CO 2	1	3	-	-	3	-						
CO 3	-	-	-	-	2	-						
CO 4	-	1	2	3	-	-						
CO 5	-	1	-	2	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	AI AND FLUTTER				
Type of Course	**Vocational Minor**				
Semester	VIII				
Academic Level	300- 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Fundamentals of AI, Basic knowledge of programing				
Course Summary	This course provides a comprehensive introduction to Flutter development and the integration of AI, covering fundamental concepts and practical implementation within mobile applications.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand AI fundamentals and Flutter framework features, facilitating their ability to integrate AI functionalities effectively into Flutter apps.	U	P	Instructor-created exams / Quiz
CO2	To explore Flutter app development concepts such as widgets, UI components, state management, user input handling, navigation, and routing.	U	P	Seminar Presentation / Group Tutorial Work
CO3	To gain knowledge in machine learning concepts, explore ML's role in mobile app development, and provide an overview of popular AI frameworks and libraries compatible with Flutter.	U	P	Practical Assignment / Observation of Practical Skills
CO4	To integrate AI functionalities proficiently into Flutter apps, leveraging their understanding of AI concepts and Flutter framework features to develop innovative and intelligent mobile applications.	Ap	P	Practical Assignment / Observation of Practical Skills s

CO5	To acquire a comprehensive understanding of implementing text classification and language translation features within Flutter applications using ML Kit's natural language processing capabilities.	U	P	Viva Voce
CO6	To develop proficiency in designing and implementing advanced text classification and language translation features within Flutter applications, fostering their ability to create intelligent and dynamic user experiences.	Ap	P	Practical Assignment / Observation of Practical Skills s
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**Basic of AI and Flutter**		**5**	**10**
	1	Introduction to AI and its subsets	1	
	2	Introduction to Flutter	1	
	3	Overview of artificial intelligence and its applications.	1	
	4	Introduction to Flutter framework and its features.	1	
	5	Setting up the development environment for Flutter.	1	
II	**Intermediate Flutter Development**		**12**	**15**
	6	Basics of Flutter App Development	1	
	7	Flutter widgets	2	
	8	UI components	2	
	9	State management in Flutter apps	3	
	10	Handling user input and gestures	2	
	11	Handling navigation and routing	2	
III	**Machine Learning in Flutter**		**12**	**15**
	12	Introduction to AI in Mobile Apps	2	
	13	Concepts of machine learning.	3	
	14	Role of ML in mobile app development.	3	
	15	Overview of popular AI frameworks	2	
	16	AI libraries compatible with Flutter.	2	
IV	**AI Services in Flutter**		**16**	**30**
	17	Text Classification with Flutter	2	
	18	Text Classification with ML Kit	2	
	19	Introduction to ML Kit for Flutter.	3	
	20	Text classification using ML Kit's natural language processing capabilities.	3	

	21	Developing a text classification feature within a Flutter app.	3	
	22	Implementing language translation in Flutter	3	
	Hands-on practical with PLC		**30**	
V	1	Setting up Flutter development environment.	2	
	2	Creating a simple Flutter app to understand the basic structure.	2	
	3	Building UI components using Flutter widgets.	2	
	4	Implementing state management in a Flutter app.	2	
	5	Handling user input and gestures within a Flutter app. Navigating between screens and handling routing in a Flutter app.	4	
	6	Exploring machine learning concepts through practical examples.	2	
	7	Exploring popular AI frameworks and libraries compatible with Flutter.	4	
	8	Setting up and integrating ML Kit for Flutter.	4	
	9	Implementing text classification features in a Flutter app. Hands-on practice with ML Kit's natural language processing capabilities for text classification.	4	
	10	Integrating language translation functionalities into a Flutter app.	4	

REFERENCES

1. Beginning App Development with Flutter, Rap Payne
2. Beginning Flutter: A Hands On Guide to App Development, Marco L. Napoli
3. Flutter for Beginners, Thomas Bailey, and Alessandro Biessek
4. https://www.tutorialspoint.com/flutter/flutter_tutorial.pdf
5. https://www.classcentral.com/report/best-flutter-and-dart-courses/
6. https://www.youtube.com/watch?v=VPvVD8t02U8

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 45 instructional hours for the fixed modules and 30 hours for the open-ended one. Module Vis designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V.Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks).The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1		1	2	-	1	1						
CO 2	-	2	1	-	1	1						

CO 3	-	2	1	-	1	1						
CO 4	-	2	1	-	1	1						
CO 5	-	1	1	-	1	-						
CO 6	-	3	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 (20%)
- Final Exam (70%)

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			✓	✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	BASICS OF ELECTRICAL AND ELECTRONICS				
Type of Course	**Vocational Minor**				
Semester	I				
Academic Level	100 - 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic Knowledge in Physics.				
Course Summary	This course provides students with a foundational understanding of electrical and Electronic circuits and equipping them with practical skills essential for designing and analyzing electronic systems in a professional context.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the safety and reliability of electrical installations based on compliance with safety standards and regulations.	U	C	Instructor-created exams / Quiz/ Assignment
CO2	To design wiring layouts and circuit diagrams for various electrical installations.	Ap	P	Practical/ Viva Voce
CO3	To apply the principles of AC power generation and measurement to calculate power and energy consumption.	Ap	C	Observation of Practical Skills / assignments
CO4	To evaluate the efficiency and performance of transformers and motors based on their specifications.	An	P	Practical / Viva Voce / Asignments
CO5	To construct and test electronic circuits and systems for specific applications.	Ap	P	Practical / Viva Voce / Asignments
CO6	To apply the understanding of electrical and electronic principles in practical applications and projects.	Ap	p	Viva Voce/Practical /Project

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

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs 45	Mark (70)
I		**Basics of Electricity**	**14**	**20**
	1	Identify Different Circuit Elements: Resistor, Capacitor and Inductor, Measure Resistor values with multimeter.	1	
	2	Concepts of Voltage & Current, AC and DC Power Sources, Use of analog and digital meters, Connection of Ammeters and Voltmeters in the circuit.	2	
	3	Ohm's Law , Analysis of simple circuits with dc excitation.	1	
	4	AC power generation,Time period,Frequency,Amplitude,RMS Value.Average Value.	2	
	5	Phase and Phase difference, Types of loads-Resistive, Inductive and Capacitive	1	
	6	AC Power : kW, kVA, kVAR, Power and energy measurement,Use of Tong tester, Power factor, Power factor improvement.	3	
	7	Connection of Wattmeter and Energy meter, Calculation of Energy Bill	2	
	8	Three Phase Circuits, Star and Delta connections, Phase and Line values, Three phase power.	2	
Circuits and Networks-Sudhakar and Shyam Mohan,Electrical Technology by B.LTheraja and A.K Theraja.				
II		**Electrical Wiring Fundamentals**	**16**	**22**
	9	Electrical Wiring : Safety precautions, First aid practice, I.E rules related to house wiring, Tools and Accessories.	2	
	10	Types of wires: Line, Neutral, Earth, Ratings ,Voltage drops in cables, Testing of wiring installation,Use of Megger.	2	
	11	Electrical accessories : Switches,outlets and sockets,plugs,junction boxes,light fixtures and lamp holders.Fuses: re-wireable & HRC, MCB, MCCB, ELCB. Relays and contactor.	3	
	12	Types of house wiring: PVC Conduit, Casing and capping, Lay out and circuit diagrams , Series, Parallel, Stair case, Master control, Bell and buzzer-Hospital wiring.	3	
	13	Earthing: Importance, Size of earth electrodes, Pipe earthing and Plate earthing.	2	
	14	Transformer : function, parts, rating, losses ,efficiency and application.	1	
	15	AC motors: single and three phase induction motors, rating, losses and efficiency, circuit diagram of star and delta connected motors.	3	
Circuits and Networks- Sudhakar and Shyam Mohan,Electrical Wiring Residential-Ray C Mullin and Phil Simmons				
III		**Basic Electronic Devices**	**7**	**15**
	16	Identify and test: PN junction Diode,Zener Diode and LED.	1	
	17	Bipolar Junction Transistor,Types,Construction,Operation and application as an amplifier.	3	
	18	Identification and Applications of LCD,photodiode,photo transistor, Thermistor and LDR.	3	
Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis				

		Nashelsky		
IV		**Applications**	**8**	
	19	Soldering and De soldering techniques, tools and materials for soldering, Soldering of electronic components in PCB.	3	**13**
	20	Assembling of LED lamps,LED strip construction, working, testing, identifying and rectifying LED strip level fault.	3	
	21	LED and LCD Display Modules :Types and Applications	1	
	22	Battery Charging Circuit:Block Diagram and Working.	1	
		"Practical Electronics for Inventors" by Paul Scherz and Simon Monk.		
V		**Hands-on: Basics of Electrical and Electronics**	**30**	
	1	1. Safety precautions for electrical installations and handling tools. 2. Introduction and use of measuring instruments -Voltmeter, Ammeter, Multimeter, Oscilloscope and Function generator 3. Wiring practice of single switch and single lamp. 4. Series, Parallel and Stair case wiring practice. 5. Identify and test the circuit breaker . 6. Build a dc Power supply using Zener Diode and calculate percentage regulation. 7. Construct and test a transistor based switching circuit. 8. Construct an amplifier using BJT.	20	
	2	Mini Project:1. Soldering and testing of simple circuits . 2. Design and build a 12 Volt Battery Charging Unit.	10	

Note: The syllabus has five modules. There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

Text Books	1. "Circuits and Networks"- A Sudhakar and Shyam Mohan S Palli 2. Electrical Technology by B.LTheraja and A.K Theraja. 3. "Electrical Wiring Rsidential"-Ray C Mullin and Phil Simmons. 4. Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky,Pearson Education Publications. 5. "Practical Electronics for Inventors" by Paul Scherz and Simon Monk.
Web Resources	1. Dr. Mahesh B Patil, Department of Electrical Engineering, IIT Bombay: https://youtu.be/IoDoW5kykkw?si=20su7DXd3gMoGNt3 2. https://www.learnabout-electronics.org

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO 5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	3	2	2	2	2	1	3	2	-	2	2	-
CO 2	3	3	2	3	-	-	3	2	-	2	-	-
CO 3	3	3	2	3	-	-	3	2	-	2	-	-
CO 4	3	3	2	3	-	-	3	2	-	2	-	-
CO 5	3	2	2	2	2	1	3	2	-	2	2	-
CO 6	3	2	2	2	3	3	2	-	-	3	2	-

Correlation Levels:

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

Assessment Rubrics:

- Quiz / Assignment/ Discussion / Seminar
- Midterm Exam
- Programming Assignments (20%)
- Final Exam (70%)

Mapping of COs to Assessment Rubrics :

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

Programme	B. Sc. Electronics				
Course Code					
Course Title	SOLAR POWER TECHNOLOGY				
Type of Course	Vocational Minor				
Semester	II				
Academic Level	100- 199				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1. Basics of electrical and electronics.				
Course Summary	Master the principles and applications of solar photovoltaic technology, including cell types, system configurations, auxiliary equipment, and design considerations for efficient solar energy integration in both on-grid and off-grid settings				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	To understand the fundamentals of electrical concepts, wiring techniques, safety protocols, and equipment usage to ensure efficient and safe electrical installations	U	P	Instructor-created exams / Quiz
CO2	To explore solar photovoltaic technology, from cell functions to module parameters, enabling the understanding and implementation of diverse solar energy applications and system configurations.	U	P	Seminar Presentation / Group Tutorial Work
CO3	To gain comprehensive knowledge of essential components and their functions in solar PV systems, covering batteries, converters, inverters, and MPPT technology, with focus on selection, maintenance, and optimization for efficient energy conversion and management.	U	P	Practical Assignment / Observation of Practical Skills
CO4	To apply the principles of solar PV system components, including batteries, converters, inverters, and MPPT technology, to effectively design, select, and maintain systems	Ap	P	Practical Assignment / Observation of Practical Skills s

	for optimal performance and efficiency.			
CO5	To develop proficiency in designing solar PV systems, incorporating technical standards, capacity limitations, site considerations, metering arrangements, and grid connectivity for both on-grid and off-grid applications.	Ap	P	Practical Assignment / Observation of Practical Skills s
CO6	To acquire a comprehensive understanding of battery fundamentals, types, parameters, and configurations, enabling proficient selection, maintenance, and fault detection in solar PV systems.	U	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45+30)	Marks (70)
I	**Basic Terms and Electrical Wiring**		**5**	**10**
	1	Voltage, Current, DC Power, AC Power, Energy, Harmonics	1	
	2	Electrical Wiring, Types of Wire, Wire Sizing, DC cabling, AC cabling.	1	
	3	Junction Box, Array Combiner Box, AC Distribution Box	1	
	4	Electrical Grounding, Earth Resistance and Insulation Resistance Measurements.	1	
	5	Electrical Safety, Electrical Safety Rules, Simple First Aid, General Safety of Tools and Equipment, Fire Extinguishers.	1	
II	**Solar Photovoltaic Cell and Module**		**15**	**20**
	6	Solar Cell and its function, Solar Technologies –Thermal and Photovoltaic.	1	
	7	Solar Energy Applications - solar cooking, solar water heater, solar powered water pumps, solar Lighting system, Roof top solar system.	4	
	8	Types of Solar PV Systems – On-grid, Off-grid and Hybrid.	3	
	9	Solar Cell technologies, Crystalline Cells: Mono- crystalline and poly – crystalline cells,	1	
	10	Solar Cell Parameters, Efficiency of Solar Cell	1	
	11	Solar PV Module, Rating of Solar PV Module, PV Module Parameters, Efficiency of PV Module,	2	
	12	Solar Photovoltaic Module Array, Connection of PV Module in Series and Parallel, Estimation and Measurement of PV Module Power, Selection of PV Module.	3	

III	**Solar PV System Auxiliary Equipments – Batteries, Charge Controller, MPPT and Inverter**		**15**	**20**
	13	Basic functions of Battery, Charge controller, MPPT and Inverter in Solar PV System.	2	
	14	Battery function, Types of Batteries, Battery parameters, Series Parallel combination of Batteries	2	
	15	Selection of Batteries in Solar PV system, Battery Maintenance and Measurements, Battery Fault Detection and Test.	2	
	16	AC to DC Converter, Battery Charge controller	2	
	17	DC to DC power converter, Buck and Boost Converter, Fly back Converter	2	
	18	DC to AC Converter, Full Bridge Inverter, Specification of Inverter and charger.	3	
	19	Function of Maximum Power Point Tracking (MPPT) in SPV system	2	
IV	**Solar PV System Design and Integration**		**10**	**20**
	20	Design methodology for SPV system, Technical Standards and Specification of roof top solar system, Capacity Limiting, Technical and site Considerations	3	
	21	Design considerations of On-grid Rooftop Solar System, Design considerations of Off Grid Solar Power Plant.	5	
	22	Various types of metering arrangements, Solar Radiation, Energy Measurements, Net Metering.	2	
	Hands-on practical		**30**	
V	1	Measurement of electrical and non-electrical quantities using instruments such as, ammeter, voltmeter, clamp on-meter, tong tester, irradiance meter and temperature sensors.	4	
	2	Measuring SPV cell/ Module Parameters and plotting Voc, Isc, Vmp, Imp and Pmp on the I-V curve.	2	
	3	Solar PV Module Efficiency and Maximum power point determination.	2	
	4	Economic analysis of solar photovoltaic systems based on the current Rooftop Solar Programme by Government of India and State Government schemes.	2	
	5	Installation of on-grid PV system and measure current, voltage, power and energy from the system, Monitoring of incoming and outgoing power at junction box & inverter output. Analysis on import, export energy units.	4	
	6	Design and Development of Solar Street Light and Solar Lantern	2	
	7	Check list preparation and Installation of small off-grid PV system and testing of PV panel, inverter, charger and storage devices.	4	
	8	Battery Installation for PV system and fault detection of battery cell.	4	
	9	Making and reading sun path diagrams, Shading Analysis with Solmetric SunEye.	2	

	10	Project: Installing, testing and commissioning on-grid 3KW Solar PV Power Plant – Site considerations, Safety factors, Maintenance activities, Metering, Energy credits, Payback period calculation.	4	

REFERENCES

1. Solar Power Hand Book, Dr. H. Naganagouda (2014)

2. Solar Photovoltaic; Chetansingh solanki; PHI, Learning private ltd., New dehli- 2018.

3. Rai. G.D," Solar energy utilization", Khanna publishers, 5th Edition, 2008..

4. Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017

5. Renewable Energy Sources and Emerging Technologies, Kothari D.P. and Signal K.C New Arrivals –PHI; 2 Edition (2011)

6. Non-conventional energy sources, B.H. Khan, McGraw Hill., 3rd Edition, 2017

7. Solar Energy: Resource Assessment Handbook, P. Jayakumar, e-book., 2009.

8. Solar energy- Principles of Thermal collection and Storage. Suhas P Sukhatme, 15th Edition, TMH., 2006

9. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press. 3rd edition, 2012

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 45 instructional hours for the fixed modules and 30 hours for the open-ended one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V.Internal assessments (30 marks) are split between the practical module (20 marks) and the first four modules (10 marks).The end-semester examination for the theory part will be based on the 22 units in the first four modules. The 70 marks shown in the last column, distributed over the first four modules, is only for the external examination.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	2	1	-	-						
CO 2	-	2	1	2	-	-						
CO 3	-	-	1	2	-	-						
CO 4	1	2	1	1	-	-						
CO 5	2	1	3	1	-	-						

CO 6	-	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 (20%)
- Final Exam (70%)

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		✓		✓

Programme	B. Sc. Electronics				
Course Code					
Course Title	CONSUMER ELECTRONICS				
Type of Course	**Vocational Minor**				
Semester	III				
Academic Level	200-299				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Basic knowledge in science				
Course Summary	This course introduces some of the basic consumer electronics equipment like microwave oven, washing machine, air condition and refrigerator.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the working and maintenance of microwave Oven,	U	C	Instructor-Demonstration
CO2	Understand the working and maintenance of washing machines and vacuum cleaners.	U	C	Instructor-created exams /
CO3	Understand the working and maintenance of AC and Refrigerator.	U	C	Instructor-created exams / Quiz
CO4	Understand the working and maintenance of Facsimile machine, barcode scanner, calculator and digital clocks.	U	C	Instructor-created exams / Quiz
CO5	To identify components or parts of various consumer electronics equipment.	Ap	P	Practical Work
CO6	To troubleshoot problems in various consumer electronic equipment.	Ap	P	Practical work
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P)				

Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks
I		**Microwave oven**	**10**	**16**
	1	Microwave Oven block diagram and principle of operation	2	
	2	Concept of LCD timer with alarm used in Microwave Oven.	2	
	3	Use of Single-chip Controllers in Microwave Oven.	2	
	4	Types of Microwave Oven	2	
	5	Wiring and Safety Instructions for a microwave Oven.	1	
	6	Care and Cleaning for Microwave Oven.	1	
II		**washing machine**	**15**	**20**
	5	Electronic controller for washing machines	2	
	6	Washing machine hardware and software	2	
	7	Types of washing machines	2	
	8	Fuzzy logic washing machines	2	
	9	Features of washing machines	2	
	10	Block diagram, basic working mechanism, maintenance of Dishwasher	2	
	11	Block diagram, basic working mechanism and maintenance of Vacuum cleaner.	3	
III		**Air Condition and Refrigerators**	**10**	**17**
	12	Air conditioning, Components of air conditioning systems	2	
	13	Basic principle and components of All air-air conditioning system,	3	
	14	Basic principle and components of Unitary and central air conditioning systems, Basic principle of Split air conditioners.	2	
	15	Refrigerator Block diagram , working mechanism and maintenance	3	
IV		**Electronic Gadgets and Domestic Appliances**	**10**	**17**
	16	Basic Structure of a calculator.	1	
	17	Internal organization of a calculator	1	
	18	servicing electronic calculators	1	
	19	Basics of barcode scanner and decoder.	1	
	20	Block diagram and working mechanism of Digital clocks	2	
	21	Block diagram and basic details of Xerographic copier	2	
	22	Home security system, CCTV.	2	
V		**Electronics Practical**	**30**	

	Hardware implementation or Simulation Lab			
	1	1) Understand the steps to diagnose the common issues with the microwave oven 2) Understand the steps to diagnose the common issues with the washing machine. 3) Understand the steps to diagnose the common issues with the AC 4) Understand the steps to diagnose the common issues with the Refrigerator. 5) Study the parts/components of calculator and barcode scanner 6) Understand the steps to diagnose the common issues with the Photocopier. 7) Market survey of microwave oven, 8) Market survey of washing machines. 9) Market survey of AC. 10) Market survey of refrigerators.	30	

Note: The syllabus has five modules.There should be total 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module Vis designed to equip students with practical skills. The 20marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules.

References

1. Bali S.P. Consumer Electronics, Pearson Education India, latest edition.

2. The Washing Machine Manual: DIY Plumbing, Fault-finding, Repair and Maintenance, Graham Dixon, J H Haynes & Co Ltd; 4th edition, 2006.

3. A Textbook of Refrigeration & Air Conditioning by R. K. Rajput , S.K. Kataria & Sons

4. Textbook of Refrigeration and Air Conditioning by R. S. Khurmi, Joyeeta Gupta , S Chand & Co Ltd ,R.S.Khurmi and Joyeeta.Gupta

5. HP41 Repair: A beginner's guide to repairing your HP41 calculator by The Calculator Store

6. B. R. Gupta, V. Singhal, “Consumer Electronics”, S. K. Kataria & Sons, 2013

7. Microwave oven user manual.

https://www.lg.com/cac/support/products/documents/3%20KROWM000001993.pdf

8. User manual dishwasher

file:///C:/Users/user/Downloads/DT8B.pdf

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-	1	1			1	
CO 2	2	3	-	-	-	-	1	1			1	
CO 3	-	-	1	-	-	-	1	1			1	
CO 4	-	-	2	3	-	-	1	1			1	
CO 5	-	1	-	-	-	-	1	1			1	
CO 6	-	-	-	3	-	-	1	1			1	

Correlation Levels:

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

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			✓	

Programme	B. Sc. Electronics				
Course Code					
Course Title	LIGHT AND SOUND ENGINEERING				
Type of Course	**Vocational Minor**				
Semester	VIII				
Academic Level	300 - 399				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Fundamentals of Electrical and Electronics				
Course Summary	This course offers an immersive introduction to lighting and sound engineering, blending foundational theory with hands-on application. Through a combination of lectures, lab experiments and projects, the course aims to equip students with the practical skills and creative insights necessary for a successful career in audiovisual engineering.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Students will be able to identify and describe the basic properties of light and sound	U	C	Instructor-created exams / Quiz
CO2	Students will comprehend the functions and applications of various lighting fixtures and sound equipment	An	P	Practical Assignment / Observation of Practical Skills
CO3	Students will be able to determine optimal illumination levels for various settings. They will also apply knowledge of loudspeaker specifications and power requirements to set up a sound system for live events.	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Students will analyse and design advanced lighting and sound systems	An	P	Instructor-created exams / Home Assignments
CO5	Students will synthesize knowledge from various areas to create innovative projection mappings and other projection technologies.	C	P	Practical Assignment / Observation of Practical Skills
CO6	Students will critically evaluate the advantages and disadvantages of different types of projectors and sound systems	E	P	Viva Voce

* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)
# - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs	Marks (70)
I		**Fundamentals of Lighting**	**11**	**14**
	1	Basics of light: color temperature, brightness, and intensity	2	
	2	Overview of lighting fixtures and their functions	1	
	3	Types of Lighting -Ambient, task and accent lighting; understanding different light sources (LED, fluorescent, halogen, etc.)	3	
	4	Lighting Calculations and Measurements-Calculating illumination levels, understanding lumens, lux and foot-candles, using light meters.	3	
	5	Lighting Controls and Systems - Dimmers, motion sensors and smart lighting systems	2	
	"Lighting Design Basics" by Mark Karlen and James R. Benya. "IES Lighting Handbook" by Illuminating Engineering Society. "Lighting Control: Technology and Applications" by Robert S. Simpson.			
II		**Introduction to Projection Techniques**	**12**	**18**
	6	Understanding different types of projectors	2	
	7	Projection surfaces and aspect ratios.	2	
	8	Projection Mapping- techniques for mapping video content to irregular surfaces	3	
	9	Creating interactive displays using projectors and motion sensors.	2	
	10	3D and holographic projections	2	
	11	cutting-edge projection technologies	1	
	"Projection Displays" by Edward H. Stupp and Matthew S. Brennesholtz. “Projection mapping A Complete Guide” by Gerardus Blokdyk			
III		**Introduction to Sound**	**12**	**20**
	12	Sound waves- amplitude, frequency and phase.	2	
	13	Room acoustics and soundproofing	2	
	14	Microphones, mixers and amplifiers	2	
	15	Loudspeakers specifications and power requirements.	2	
	16	Placement strategies for optimal sound, use of SPL meters for calibration.	2	
	17	Setting up a sound system for a live event	2	
	"The Sound Reinforcement Handbook" by Gary Davis and Ralph Jones "Modern Recording Techniques" by David Miles Huber and Robert E. Runstein			
IV		**Introduction to Advanced Sound Systems**	**11**	**18**
	18	Principles of surround sound, 5.1 and 7.1 setups.	3	
	19	Concepts of Object-based audio	2	
	20	Basics of Dolby Atmos	2	
	21	Overview of DTS:X and other DTS sound systems	2	
	22	Comparison between DTS and Dolby Atmos.	2	
	"Surround Sound: Up and Running" by Tomlinson Holman. Dolby Atmos / DTS official documentation and guides.			
V		**Practical:**	**30**	
	1	• Understand the concepts of ambient, task, and accent lighting and their practical applications. • Explore different lighting fixtures and understand their		

		specific functions and applications. • Explore the functionality and benefits of dimmers, motion sensors, and smart lighting systems. • Compare and contrast the functionality and applications of various types of projectors, including DLP (Digital Light Processing), LCD (Liquid Crystal Display), and LED (Light Emitting Diode) projectors. • understand the impact of different projection surfaces and aspect ratios on image quality. [various surfaces (white wall, specialized screen, textured fabric), and content in different aspect ratios (16:9, 4:3, 21:9)] • explore the technique of projection mapping by projecting video content onto irregular surfaces. [mapping software (e.g., MadMapper, VPT7), objects with irregular surfaces (e.g., mannequin, small architectural model)] • Record natural sounds and voices, then visualize the waveforms using audio editing software to identify parameters like frequency, amplitude, and phase. • Create a simple sound system setup with microphones, mixers, amplifiers, and speakers • Set up a live sound system and experiment with microphone and speaker placement to control feedback.		

Note: The syllabus has five modules. There should be a total of 22 units in the first four modules composed of the theory topics. The number of units in the last module can vary. There are 45 instructional hours for the first four modules and 30 hrs for the final one. Module V is designed to equip students with practical skills. The 20 marks for the evaluation of practical will be based on Module V. The end-semester examination for the theory part will be based on the 22 units in the first four modules

References

1. "Lighting Design Basics" by Mark Karlen and James R. Benya.
2. "IES Lighting Handbook" by Illuminating Engineering Society.
3. "Lighting Control: Technology and Applications" by Robert S. Simpson.
4. "Projection Displays" by Edward H. Stupp and Matthew S. Brennesholtz.
5. “Projection mapping A Complete Guide” by Gerardus Blokdyk
6. "The Sound Reinforcement Handbook" by Gary Davis and Ralph Jones
7. "Modern Recording Techniques" by David Miles Huber and Robert E. Runstein
8. "Surround Sound: Up and Running" by Tomlinson Holman.
9. Dolby Atmos / DTS official documentation and guides.

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	2	3	-	-	-	-						
CO 3	-	-	1	-	-	-						

CO 4	-	-	2	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Programme	B. Sc. ELECTRONICS				
Course Code					
Course Title	**Research Methodology in Electronics**				
Type of Course	**Major**				
Semester	VIII				
Academic Level	400-499				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	4	-	-	60
Pre-requisites	1. Students should have a solid understanding of basic concepts in electronics, including circuits, digital systems, semiconductor devices, and electromagnetic theory. 2. Requires students to critically evaluate existing literature, design experiments, analyse data, and draw conclusions.				
Course Summary	This course provides students with the knowledge and skills required to conduct research in the field of electronics effectively. Through lectures, discussions, practical exercises, and assignments, students learn various research methodologies, techniques, and ethical considerations relevant to electronics research.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Demonstrate a thorough understanding of fundamental research concepts and apply to the field of Electronics	U	C	Instructor-created exams / Quiz
CO2	To apply appropriate research methods and techniques to formulate research questions, design experiments, collect and analyse data, and draw conclusions	Ap	P	Practical Assignment / Observation of Practical Skills
CO3	To develop critical thinking skills and the ability to identify research gaps, evaluate existing literature, and propose innovative solutions	U	P	Seminar Presentation / Group Tutorial Work
CO4	To exhibit awareness of ethical principles and guidelines governing research conduct.	U	C	Instructor-created exams / Home Assignments
CO5	Work effectively in teams to collaborate on research projects, share ideas, delegate tasks, and resolve conflicts, fostering a collaborative research environment conducive to innovation and productivity.	Ap	P	Instructor-created exams / Home Assignments
CO6	To disseminate research findings effectively through various channels, including academic publications, conference presentations, and technical reports.	C	P	Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C)				

- Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)

Detailed Syllabus:

Module	Unit	Content	Hrs
I	**Introduction to Research Methodology**		**10**
	1	Meaning, importance, and objectives of research	2
	2	Characteristics of good research	3
	3	Research methods vs Methodology	3
	4	Types of research: basic research, applied research, quantitative research, qualitative research, conceptual, empirical	2
II	**Research Formulation**		**10**
	5	Research Formulation, Defining and formulating the research problem	3
	6	Selecting the problem, Importance of literature review in defining a problem	3
	7	Literature review, Primary and secondary sources	2
	8	Identifying research gap - Development of working hypothesis	2
III	**Research design and Data Collection Methods**		**20**
	9	Definition and types of research design, experimental, descriptive, exploratory	2
	10	Research design and methods, Basic Principles, Need of research design	3
	11	Features of good design – Important concepts relating to research design	1
	12	Development of Models, Developing a research plan	3
	13	Observation and Collection of data, Methods of data collection Sampling Methods, Data Processing and Analysis strategies	3
	14	Secondary data collection methods, literature review, archival research, Data collection instruments: design and validation	3
	15	Descriptive statistics: measures of central tendency, measures of dispersion	1
	16	Inferential statistics: hypothesis testing, analysis of variance (ANOVA), regression analysis, Generalization and Interpretation	1
	17	Statistical software for data analysis (e.g., SPSS, MATLAB, R)	3
IV	**Research Ethics and Research Writing**		**8**
	18	Structure and components of a research paper	2
	19	Literature review: searching, reviewing, and synthesizing existing literature, Citation styles and referencing (APA, MLA, IEEE, etc.), Avoiding Plagiarism	2
	20	Ethical considerations in research human subjects, Informed consent, confidentiality, privacy, and integrity in research	2
	21	Reporting and report writing, Structure and components of scientific reports	1
	22	Layout, structure and Language of typical reports, Illustrations and tables , Bibliography, referencing	1
V	**Open Ended Module: Understanding Group Behaviour Model**		**12**
	1	**Case studies:** 1. Select a specific topic or research question within electronics aligned within academic and career interests **Open-Ended Exploration and Assessment:** Identify a research question, design and conduct experiments or investigations, analyse data, and present findings in a written report and oral presentation	12

Note: The course is divided into five modules, with four having total 22 fixed units and one open-ended module with a variable number of units. There are total 48 instructional hours for the fixed modules and 12 hours for the open-ended one. Internal assessments (30 marks) are split between the open-ended module (10 marks) and the fixed modules (20 marks). The final exam, however, covers only the 22 units from the fixed modules.

References

Text Books:

1. Research Methodology, C.R Kothari, New Age International Publishers

2.Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar

3.Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell, J. David Creswell

4.Research Methods for Engineers by David V. Thiel

Web resources:

1. https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf
2. https://ieeexplore.ieee.org/
3. https://scholar.google.com/
4. https://www.researchgate.net/
5. https://pubmed.ncbi.nlm.nih.gov/

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6
CO 1	1	-	-	-	-	-						
CO 2	3	2	-	-	-	-						
CO 3	-	-	1	-	-	-						
CO 4	-	-	1	3	-	-						
CO 5	-	1	-	-	-	-						
CO 6	-	-	-	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 (20%)
- Final Exam (70%)

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			✓	

Online Courses:

Students can acquire additional credits from 3 credit / 4 credit courses with appropriate level of the semester concerned without any repetitions of courses in the field of:

Electronics & Electronic Communication, Artificial Intelligence, Robotics, Power Electronics, Solar Energy, EV Technology, Computer Technology, Microwave Technology.

Up to VI semester level 300 and from VI to VIII level 400.

The courses shall be of 12-week duration with online assessment. Certificates upon passing the courses shall be considered for awarding the credits as per the stipulations of the University of Calicut.

Online Platforms:

https://swayam.gov.in/

https://nptel.ac.in/

https://www.classcentral.com/tag/electronics

https://www.coursera.org/courses?query=electronics

https://www.edx.org/learn/electronics

https://collegedunia.com/courses/electronics/electronics-certification-courses

https://alison.com/tag/electronics

Example of courses:

1.Communication Networks

2.Virtual Reality

3.Embedded Linux and RTOS

4.Tiny ML

**A supplementary basket list of courses will be provided by the board of studies