Government of Karnataka
Department of Technical Education

C-25 Diploma in Electronics & Communication Engineering

Scheme of Studies

(Effect from the AY 2025-26)

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

III Semester Scheme of Studies

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	**T**	**P**			**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	
Integrated Courses															
1	EC	25EC31I	Digital Electronics - II	4	0	4	8	6	50	20	50	20	-	-	100
2	EC	25EC32I	Communication systems	4	0	4	8	6	50	20	50	20	-	-	100
3	EC	25EC33I	Applied Electronics -II	3	0	4	7	5	50	20	-	-	50	20	100
4	EC	25EC34I	C - Programming	3	0	4	7	5	50	20	-	-	50	20	100
Audit Course															
5	KA	25KA31T	Kannada –I (ಸಾಮಾನ್ಯ ಸಂವಹನ-I/ಬಳಕೆ ಕ□□□□-I)	2	0	0	2	2	50	20	-	-	-	-	50
Total				**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**III**
Course Name	**Digital Electronics-II**	**Type of Course**	Integrated
Course Code	**25EC31I**	**Contact Hours**	08 Hours/week 104 Hours/Sem
Teaching Scheme	L: T:P: 4:0:4	**Credits**	06
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. **Rationale:**

Digital electronics emphasizes the design and analysis of circuits using Boolean algebra, logic gates, and sequential logic. This encourages students to develop strong problem-solving skills, as they must translate complex real-world problems into solvable logic models. These skills are transferable to many fields of study and career paths.

As emerging technologies such as the Internet of Things (IoT), artificial intelligence (AI), machine learning (ML), and autonomous systems continue to grow, knowledge of digital electronics becomes crucial. These technologies often require highly efficient, specialized digital circuits and systems to process and communicate data in real-time.

The demand for professionals skilled in digital electronics is high across industries such as semiconductor manufacturing, telecommunications, consumer electronics, automotive, aerospace, and defense. Understanding digital circuits opens up a wide range of career opportunities, from circuit design and verification to embedded system development and hardware-software integration.

2. **Course Outcomes:** At the end of the Course, the student will be able to:

CO 1	Construct, analyze and verify the functioning of simple digital circuits/ICs using suitable Electronic design automation (EDA) tools.
CO 2	Design a sequential circuit for a specific application and test the circuit to obtain the desired result/output
CO 3	List the various types of A to D, D to A converters along with memory and for a specific application select the appropriate converters and/or memory types to be used to obtain the specific result/output
CO 4	Comprehend the need of VLSI ,hardware description language (HDL) and its role in modern electronic applications.

3. Course Content.

Week	CO	PO	Theory	Practice
1	**1,2**	**1,4**	1. **Sequential Circuits:** Introduction to sequential circuits, applications. 2. Comparison between Combinational and Sequential circuits. 3. Basic concepts of clock pulses. Triggering (positive and negative level and edge triggered). 4. T_{on}, T_{off} and Duty cycle (2 different duty cycles), Periodic Time Interval, and timing diagrams.	1. Familiarization of lab view software with simple experiments (any two). 2. Familiarization of other open source software that can be used for simulation.
2	**1,2**	**1,3, 4**	1. **Flip flops**: Introduction and applications of Flip flops. 2. SR flip flop- Operation, Gate level circuit (NAND gates), Truth table, timing diagram. 3. JK flip flop- Operation, Gate level circuit (NAND gates), Truth table and timing diagram. 4. Race around condition – concept. steps to avoid race around conditions.	1. Verify the truth table of the following experiments using simulation software. i. SR Flip flop. ii. JK Flip flop. 2. Verify the truth table of the following experiments using Digital Trainer Kit. i. SR Flip flop (using NAND gates) ii. JK Flip flop (7476 IC)
3	**1,2**	**1,3, 4**	1. Master slave JK Flip flop – circuit diagram, working principle. 2. D Flip flop- Operation, Gate level circuit (NAND gates), Truth table and timing diagram. 3. T Flip flop- Operation, Gate level circuit (NAND gates), Truth table and timing diagram. **4.** Implement D and T flip flop using JK flip flop	1. Verify the truth table of the following experiments using simulation software. i. D flip flop. ii. T flip flop. 2. Verify the truth table of the following experiments using Digital Trainer Kit. i. D flip flop using JK flip flop. ii. T flip flop using JK flip flop.
4	**1,2**	**1,3, 4,5**	1. **Shift Registers** – concept, applications. Types of Shift Registers –SISO - block diagram, working principle & truth table.	1. Verify the truth table of the following experiments using simulation software.

			2. SIPO - block diagram, working principle & truth table. 3. PISO - block diagram, working principle & truth table 4. PIPO - block diagram, working principle & truth table.	i. SISO shift registers. ii. PIPO shift registers. 2. Verify the truth table of the following experiments using Digital Trainer Kit with suitable IC's. i. SIPO shift registers. ii. PISO shift registers.
5	**1,2**	**1,3, 4,5**	1. **Counters** – concept, types, applications. 2. Concept of ripple, synchronous and asynchronous counters, Concept of up/down counters, Modulus counter. **3.** 3-bit asynchronous counter operation, truth table and timing diagram of up counters. **4.** 4 bit asynchronous counter operation, truth table and timing diagram of down counters.	1. Verify the truth table of the following experiments using simulation software. i. 3-bit Ripple counter. ii. Decade counter. 2. Verify the truth table of the following experiments using Digital Trainer Kit. i. 3-bit Ripple counter using 7476 IC. ii. Decade counter using IC7490.
6	**1,2**	**1,3, 4,5**	1. 3-bit Synchronous counter operation, truth table and timing diagram. 2. 4-bit Synchronous counter operation, truth table and timing diagram. 3. Mod N Counter-Mod 5 - operation, truth table. 4. Mod N Counter- Mod 8 - operation, truth table.	I Verify the truth table of the following experiments using simulation software. i. Ring counter ii. Johnson counter II Verify the truth table of the following experiments using Digital Trainer Kit with suitable IC's. i. Ring counter. ii. Johnson counter
7	**2,3**	**1,3, 5**	1. **Memories**: Classification of Memories, Comparison of ROM and RAM, 2. ROM – types (PROM, EPROM, EEPROM), applications. 3. EPROM- working principle. **4.** Comparison of ROM, PROM, EPROM	Illustrate the storing and retrieving of data in ROM using decoder & OR gates.(read and write operation)
8	**2,3**	**1,3, 5**	1. RAM – types, (static and dynamic RAM cells) working principle,	

			applications. 2. Comparison SRAM and DRAM. 3. Flash Memory- Operation and applications. 4. Features of SDRAM, DDRAM.	Illustrate the storing and retrieving of data in RAM using suitable IC. (read and write operation)
9	**2,3**	**1,3, 5**	1. **Data convertors**- concept and significance. **A/D converters-** concept, types, applications. 2. specifications-resolution, accuracy, non-linearity and conversion time. 3. Successive approximation ADC– block diagram, working principle. 4. Identify ADCs IC's and list their features.	i. Construct/Simulate and verify the working of 3-bit flash ADC. ii. Interpret the data sheets of ADC IC's (any two). List the alternate IC's that perform similar operation.
10	**2,3**	**1,3, 4,5**	1. **D/A converters-** concept, types, and applications. 2. specifications- resolution, accuracy, settling time, speed, linearity and monotonicity. 3. R-2R Ladder DAC – block diagram, working principle. 4. Identify DAC IC's and list their features.	i. Construct/Simulate and verify the working of 4-bit weighted resistor DAC. ii. Interpret the data sheets of DAC IC (any two). List the alternate IC's that perform similar operation.
11	**1,2 ,3**	**1,3, 4,5**	1. Introduction to PLDs- PAL, PLA, CPLD, FPGA, ASIC. 2. PAL- block diagram, components, applications. 3,4. Implementation of Boolean expressions using PAL (any two).	i. Implement a combinational with 3-Inputs and 2-Outputs using PAL in simulation software. ii. Implement the following Boolean expression using PAL, F1= $\sum$ m (3,5,7) and F2 = $\sum$ m (4,5,7).
12	**1,2 ,3**	**1,3, 4,5**	1. PLA- block diagram, components, applications. 2. Comparison between PAL & PLA. 3,4. Implementation of a Boolean expressions using PLA (any two).	i. Implement full adder circuit using PLA in simulation software. ii. Implement a 3 bit binary-to-Gray code converter using PLA.

13	**1,3 ,4**	**1,4, 5,7**	1. CMOS Inverter – schematic diagram & operation. 2. VLSI – concept, significance, applications. 3,4 Hardware Description Languages(HDL) – types, comparison between VHDL & Verilog, applications.	i. Construct/Simulate and verify the working of CMOS Inverter. ii. List the simulation software's (EDA tools) used for digital design of VLSI circuits.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problems statement to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

a. Digital principles and applications. Donald P Leach, Albert Paul Malvino, Goutam Saha, McGraw Hill Publisher, 8th edition, ISBN 10: 9339203402 ISBN 13: 9789339203405

b. Digital Systems-principles and applications. Ronald J. Tocci, Neal S.Widmer, Gregory L.Moss, 10th edition,ISBN : 0131725793

c. Digital Electronics –principles and integrated circuits. Anil K. Maini. Wiley publications,first edition . ISBN: 978-0-470-03214-5

d. Digital Computer Fundamentals, - Thomas C Bartee ,McGraw-Hill Publisher,6th edition.ISBN 10: 0070038996 / ISBN 13: 9780070038998

e. Digital fundamentals –Floyd and Jain, PEARSON EDUCATION publication, 8th Edition , ISBN-13: 978-0132359238 ,ISBN-10: 0132359235.

5. CIE Assessment Methodologies

Sl. No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note:

Portfolio evaluation includes average of (a) and (b)

a) Any one of the suggested activity model with report and presentation / simulation evaluated for 50 marks.

b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1. Written description of the experiment in the observation book.
2. Conducting the experiment and the associated learning outcomes.
3. The results obtained from the experiment.
4. Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE - Theory Assessment Methodologies.

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper.

Program	**Electronics and Communication Engineering**			Semester -III	
Course Name	**Digital Electronics-II**			Test	I/III
Course Code	**25EC31I**	**Duration**	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No		Questions	Cognitive Level	Course Outcome	Marks
Section - 1					
1	i.	Given the circuit of a **ring counter**, analyze how the addition of a reset mechanism affects the stability and correctness of the counting sequence.	L3		10
	ii.	Explain the operation of S-R flip flop using NAND gates with its Truth Table	L3	CO 2	10
	iii.	Compare the functionality of a D flip-flop and a JK flip-flop. Under what conditions can they be considered equivalent?	L2		05
2	i.	Explain the operation of JK flip flop using NAND gates with its truth table.	L2		10
	ii.	How does the behaviour of an edge-triggered flip-flop differ from a level-triggered flip-flop? Analyse their impact on circuit performance.	L3	CO 2	10
	iii.	Illustrate the purpose of the preset and clear	L3		05

	inputs in a flip-flop.			
	Section 2			
3	a) Examine a shift register circuit that fails to produce the expected output. Identify the possible sources of error (e.g., clock issues, flip-flop malfunction, incorrect wiring).	L3	CO1	10
	b) Interpret the operation of SISO shift register with block diagram and truth table	L3		10
	c) Why are shift registers classified as sequential circuits rather than combinational circuits	L2		05
4	a) If one flip-flop in a shift register malfunctions (e.g., fails to hold data), how will this impact the overall operation of the circuit?	L3	CO 1	10
	b) Illustrate the operation of PISO shift register with its block diagram and truth table	L2		10
	c) Establish the usage of shift registers in digital counters.	L2		05

Note for the Course coordinator:

1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	3
Course Name	**Digital Electronics-II**			**Test**	**II/IV**
Course Code	**25EC31I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	CO	Marks
write up for 2 experiments & conduction of any one experiment.	2,3	**50**
Scheme of assessment **a) Writing the Circuit diagram, tabular column, calculations etc for two experiments.** **b) Rigup and conduction of any one** **c) Result/output** **d) Troubleshooting steps** **e) Viva-voce**		**20M** **10M** **05M** **05M** **10M**
Total Marks		**50 M**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic.

Sl.No.	**Suggestive Activities for Tutorials**
01	Give a presentation on how counters can be used in a simple car parking system.
02	Mini project on implementation of footfall counter for various purposes in your institution.
03	Building an elevator controller system using sequential circuits.
04	Developing a digital clock with programmable features.
05	Designing a simple CPU or a memory controller.
06	Study the latest technological changes in VLSI and present the impact of these changes on industry.
07	Prepare a block diagram approach to construct a digital clock or a frequency counter or a digital voltmeter or any other similar digital electronic circuits and analyze the cost of the application

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. **Equipment/software list with Specification for a batch of 30 students.**

Sl.No.	Particulars	Quantity
1	Digital Trainer Kits	15
2	Dual trace oscilloscope. – CRO. (20MHz)	15
3	Digital mustimeters	10
4	ICs - 7400,7402,7404,7408,7432,7486,7442,7445,7446,7474,7476,7427,7489, 7490,7494,7495,74141,74148,74153,74157,74155,74193,74194, DAC0808, ADC-0800,741,	20 each
5	Patch cards(different lengths)	300
6	Digital IC Tester	5
7	Computers	15
8	Free simulation software	

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and communication**	**Semester**	**3**
Course Name	**Communication Systems**	**Type of Course**	Integrated
Course Code	25EC32I	**Contact Hours**	8 hours/week
Teaching Scheme	L: T:P :: 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

Communication systems form the foundation of modern technology in Electronics and Communication Engineering, as it provides a foundational understanding of how information is transmitted, received, and processed across various mediums, enabling the transmission of data across vast distances. It helps ECE engineers to design, optimize, and maintain modern systems, which include everything from cellular networks and wireless communication to satellite systems and the Internet of Things (IoT). They are involved in key areas such as signal processing, network design, and ensuring data security in communications. These systems are crucial for technological advancements like 5G, high-speed data transfer, and global connectivity. As communication technologies evolve, Communication systems play an essential role in shaping innovations and addressing the growing demand for reliable, fast, and secure communication networks.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify and Explain the different components and modulation techniques of Analog Communication systems.
CO-02	Design passive filters and attenuators for signal conditioning, apply network theorems to analyze electrical networks.
CO-03	Analyze components and modulation techniques of digital communication system.
CO-04	Comprehend the working principles of transceivers and multiplexing techniques, error detection and correction codes.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	**1**	**1, 2**	**Analog Communication system:** • Introduction to Communication, Block diagram Explanation of Analog communication system. • Noise, Sources of Noise, signal to noise ratio(S/N) (only concept) • Analog Modulation Techniques: Need for Modulation, Definitions of Message signal and carrier signal. Amplitude Modulation: Concept of AM, Sketch AM wave for given carrier and message signal. • Mathematical expressions for message signal, Carrier signal and AM output. (No derivation).	• Generate a sine wave using a function generator and display the signal on an oscilloscope to understand its time-domain representation. Measure the Time, amplitude for different Audio frequencies and radio frequencies and tabulate them. • Study the working of AM Modulation and Demodulation using kit/Simulation. Sketch the AM wave for a given message and carrier signals in time - domain. Sketch the Frequency – domain representation of AM wave.

2.	**1**	**1,2**	• AM modulation Index, Modulation Index in case of simultaneous Modulations, • Frequency Spectrum and Bandwidth. Power in AM wave. • Working of AM modulator circuit using diode with waveforms. • Working of AM Linear Diode Detector Circuit with waveforms.	• Video demonstration and documentation on real-world applications of AM. • Video demonstration and documentation on different types of AM (DSB-SC, SSB, VSB) and their applications.
3	**1**	**1,2**	• Frequency Modulation: Concept, Sketch FM wave for given carrier and message signal, Definitions and Mathematical expressions for Frequency deviation, Modulation Index, Frequency Deviation Ratio and Bandwidth for FM. (No derivation) • Types of FM, Spectrum and sidebands. Carson's rule for Bandwidth. • Varactor diode method of Generating FM, Foster seeley FM Discriminator. • Illustrate Advantages and Disadvantages of FM over AM, real-world applications of AM and FM.	1. Study the working of FM Modulation and Demodulation using kit/Simulation. Sketch the FM wave for a given information and carrier signal in time-domain. Draw the Frequency–domain representation of FM wave. 2. Video demonstration and documentation on real-world applications of FM.
4	**1,2**	**1,2,3**	**Filters and attenuators:** • **Passive filters**: Types based on the passband and stop band. Passive Pi -type Low pass filter: Frequency response, Expression for cut-off frequency. (No derivation) • Simple problems on Passive Pi - type Low pass filter. • Passive Pi -type High Pass Filter: Frequency response, Expression for cut-off frequency. (No derivation). • Simple problems on Passive Pi - type High pass filter.	1. Design and Construct a passive Pi-type Low pass filter and determine its bandwidth by plotting its frequency response. 2. Design and Construct a Passive Pi -type High pass filter and determine its bandwidth by plotting frequency response.
5	**1,2**	**1,2,3**	• Band pass filter: Block diagram and Frequency response. • Band stop filter: Block diagram and Frequency response. • Attenuator: Introduction and applications, working of symmetrical PI-(π)– type attenuator, Expression for R1 and R2 given N and Ro. (No derivation). • Simple problems on symmetrical π-type attenuator.	1. Design and Simulate Band pass filter using Passive Pi –type Low pass and Passive Pi –type High pass filter using simulation software. 2. Design and construct Symmetrical PI (π)–type attenuator for given N and Ro.

6	**2**	**1,2,3**	**Network theorems** Necessity of Network theorems in communication system. Thevenin's theorem: Statement, steps to solve network using Thevenin theorem. • Solve simple problems Thevenin's theorem. • Maximum Power Transfer theorem: Statement, steps to solve network using Maximum Power transfer theorem. • Solve simple problems on Maximum Power transfer theorem.	1. Construct and verify Thevenin's theorem. 2. Construct and verify maximum power transfer theorem.
7	**2**	**1,2,3**	• Simple problems on thevinin and maximum transfer theorem. • Superposition theorem: Statement, steps to solve network using Superposition theorem. • Solve simple problems Superposition theorem. (Two voltage sources) • Solve simple problems Superposition theorem. (Two maximum sources)	1. Verify superposition theorem for a simple circuit consisting of two voltages sources.(4 Hrs).
8	**3**	**1,2**	**Digital Communication system:** • Functional Block diagram of digital communication system. • Discuss advantages of digital communication over analog communication. Sampling process, Sample and hold circuit • Sampling theorem for Low pass and band pass signals. • Niquist criterion, aliasing, Effect of under sampling and over sampling.	1. Video demonstration and documentation on real-world applications of Digital Communication systems. 2. Verify sampling theorem using kit / Perform sampling using Sample and Hold circuit using simulation. Sketch samples for the given analog signal.
9	3	1,2	• Uniform Quantization with neat diagram, Quantization Noise. • Pulse Code Modulation System: Introduction, Block diagram of PCM system. Advantages and disadvantages of PCM. • DPCM system: Introduction, Block diagram of DPCM transmitter, Receiver. • Discuss advantages and disadvantages of DPCM over PCM, Applications of DPCM.	1. Perform an experiment to study Pulse Code Modulation and Demodulation using kit/Simulation. 2. Video demonstration and documentation on practical applications of PCM and DPCM.

10	**3**	**1,2**	**Digital modulation techniques:** ● ASK: Concept, waveforms, frequency spectrum. ● ASK transmitter and coherent receiver. ● FSK: Concept, waveforms, frequency spectrum, transmitter and coherent receiver. ● Discuss ASK and FSK with respect to bandwidth and noise, Illustrate the Concept of PSK.	1. Perform an experiment to generate and detect BASK signals using kit/simulation. Sketch BASK signal for the given digital input. 2. Perform an experiment to generate and detect BFSK signal using kit/simulation. Sketch BFSK signal for the given digital input.
11	**4**	**1,2**	**Error detection and correction:** ● Errors-types (Single bit errors, Burst/Multiple bit errors), Redundancy. ● Error control schemes: Error detection with transmission, Forward error detection and correction. ● Error control codes: Block codes, its applications. ● Error detection scheme: Vertical Redundancy Check(parity check method) , CRC and their applications.	1. Perform an experiment to generate and detect BPSK signal using kit/Simulation. Sketch BPSK signal for the given digital input. 2. Design and implement an 4-bit Odd Parity generator using logic circuit/using suitable IC.
12	**4**	**1,2**	**Multiplexing Techniques:** ● Multiplexing: Concept, types and Need in communication. ● FDM –Explanation, advantages. ● TDM - concept, block diagram with explanation. ● Discuss Comparison and Applications of FDM and TDM.	1. Video demonstration and documentation on FDM. 2. Demonstrate TDM using Fiber Communication System.
13	**4**	**1,2**	**Transceivers:** ● Features and functions of transceivers. ● Transceiver structure and working. Principle ● Discuss the Types and applications of transceivers. ● Comparison between Transceiver and transmitter.	Industrial Visit to 1. Telephone exchange **or** 2. Any BTS station **or** 3. Fibre DSLAM of BSNL/other telecom operator and prepare a reports on the communication system, modulation techniques, multiplexing techniques, error detection and correction techniques employed in these systems.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problem statement to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

a) Electronic communication - George Kennady
b) Advanced Electronics Communication System. - Wayne Tomosi
c) Understanding communication systems - Texas Instruments
d) Fiber Optic Communication Systems, - Dr.R.K.Singh, Wiley India
e) Principles of Electronic Communication Systems - Louis E. Frenzel, Tata McGraw Hill
f) Digital and analog communication systems - K.Sham Shanmugam, Wiley India
g) https://www.geeksforgeeks.org/transceivers.

5. CIE Assessment Methodologies

Sl.No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: -

Portfolio evaluation may include average of (a)and (b)

a) Any one of the suggested activity model with report and presentation / **s**imulation evaluated for 50 marks.

b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components.

1. Written description of the experiment in the observation book.
2. Conducting the experiment and achieving the associated learning outcomes.
3. Result of the experiment.
4. Correction and evaluation of the experiment completed in the previous class, documented in the record book.

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. **CIE Theory Test model question paper**

Program	**Electronics and Communication Engineering**			**Semester -3**	
Course Name	**Communication systems**			**Test**	**I**
Course Code	25EC32I	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Describe the functional block diagram of an analog communication system. b) Make use of the concept of AM modulation with mathematical expressions and sketch AM signal. c) Discuss the need for modulation.	L2 L3 L2		10 10 5
2	a) Explain the AM modulator circuit using diode. b) Discuss the impact on communication with Modulation index less than 1 in Amplitude Modulation. c) Interpret the Bandwidth requirement of an AM signal with its frequency spectrum.	L2 L3 L2		10 10 5
	Section – 2			
3	a) Describe the concept of Frequency modulation. b) Design Constant-K PI type Low pass filter for cut-off frequency of 4KHz and Ro of 600 Ohms. c)Identify advantages of FM over AM.	L2 L3 L2		10 10 05
4	a) Explain Foster seeley FM discriminator. b) Design Constant-K PI type High pass filter for cut-off frequency of 10 KHz and Ro of 600 Ohms. c) Infer on the relation between Frequency deviation and Bandwidth of FM.	L2 L3 L2		10 10 05

Note for the Course coordinator:
1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes. 2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator	**Signature of the HOD**	**Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	3
Course Name	Communication Systems			**Test**	**II/IV**
Course Code	25EC32I	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
Write-up of any two experiments and conduction of one experiment.		**50**
Scheme of assessment **a) Write-up of any two experiments** **b) Rig up the circuit and conduction of any one /simulation** **d) Result** **e) Viva-voce**		 **20** **15** **05** **10**
Total Marks		**50**

Signature of the Course Coordinator	**Signature of the HOD**	**Signature of the IQAC Chairman**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	**Suggestive Activities for Tutorials**
01	Build an FM receiver and check how many FM channels are received without any noise at your college.
02	Build an AM modulator and demodulator models and test its working.
03	Develop 8 bit ADC using TLC5540 to convert voltage into digital signal and display on the LCD display.
04	Develop 8 bit DAC model and demonstrate its working.
05	Build a basic PCM encoder and decoder system using a microcontroller. Test the system with real audio or data signals.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
01	RPS	Dual Channel 30V,2A	30
02	CRO	30 Mhz	30
03	Signal Generator	2Mhz	30
04	AM KIT,FM KIT,ASK KIT, FSK KIT, PSK KIT		10 EACH
05	SAMPLING THEOREM KIT, Fibre optic Communication KIT, TDM KIT		10 EACH

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	Electronics & Communication	**Semester**	**III**
Course Name	**Applied Electronics-II**	**Type of Course**	Integrated
Course Code	**25EC33I**	**Contact Hours**	7 hours/week 91 hours/semester
Teaching Scheme	L: T:P :: 3:0:4	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

Applied electronics is a branch of electronics that deals with a continuously variable signal. It is widely used in radio and audio equipment along with other applications where signals are derived from analog sensors before being converted into digital signals for subsequent storage and processing. Applied Electronics offers a very elegant design with many components and would effectively act as an impetus to the digital world.

Printed Circuit Boards (PCBs) are the core component in almost all the electronic gadgets used either for domestic or industrial purposes. PCBs hold almost all electronic components necessary for a device to function. Using a PCB has many advantages such as compact design, ease of testing and repair, low noise and interference, and improved reliability.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify the components in a given analog electronic circuit and list their characteristics and uses.
CO-02	Construct an analog electronic circuit for a specific application using discrete analog components and demonstrate working either in a Real or Simulated environment.
CO-03	Construct an analog electronic circuit for a specific application using ICs and demonstrate its working either in a Real or Simulated environment.
CO-04	Design the schematic and PCB layout for simple analog circuits, and fabricate them using appropriate PCB design techniques.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1,2	1,2, 3,4	1. Power Supplies: Need, Types – Unregulated, Regulated – Linear, Switched. Selection criteria for different Power Supplies. Difference between Unregulated and Regulated power supply. 2. Regulated Power Supply (RPS) - Block Diagram and its working principle.	1. Build 5V/12V Regulated Power Supply using discrete components. 2. Video demonstration of Solar based UPS. Discuss the necessity of UPS in labs.

			3. Uninterrupted Power Supply (UPS) – Online & Offline – Block Diagram and its working principle.	
2	1,2	1,2, 3,4	1. Switched Mode Power Supply (SMPS) – Block diagram and its working principle. 2. Wave Shaping Circuits: Discuss the necessity and Applications, RC Integrator & RC Differentiator. 3. Clippers - Concept, Types - Series, Shunt & Biased.	1. Identify the components in an SMPS and measure the voltages at different stages. Discuss why SMPS is needed in computers. 2. Generate the following waveforms from sinusoidal waveforms. a. Trapezoidal waveform. b. Positive Cycle.
3	1,2	1,2, 3,4	1. Clampers – Concept, Types - Positive & Negative. 2. Voltage Multipliers – Types, Advantages, Voltage doubler circuit diagram & working principle. 3. Voltage Tripler - circuit diagram & working principle.	1. Construct and test positive and negative clamper circuits using discrete components. 2. Construct and verify voltage doubler and tripler circuit to multiply the input voltage using discrete components.
4	1,2	1,2, 3,4	1. Power amplifiers - Introduction, Difference between Voltage amplifiers and power amplifiers. 2. Classification of Power amplifiers, Comparison between different types of Power amplifiers. 3. Working & Characteristics of Class A & Class B - Push pull amplifier.	1. Demonstrate and document the working of a power amplifier using Video or Simulator. 2. Construct and Demonstrate/ Simulate the working of push pull Amplifier.
5	1,3	1,2, 3,4	1. Compare and contrast Voltage amplifier, Power amplifier & Operational amplifier. Op-amp: Block diagram, Symbol, Parameters. 2. Ideal characteristics of Op-amp, Open loop configurations - Differential, Inverting and Non Inverting Amplifiers. 3. Closed loop configurations - Inverting and Non Inverting Amplifiers. Constant gain multiplier.	1. Identify Op-amp IC741, its pins, power supply and Interpret its data sheet. 2. Construct and test an Op-amp circuit to obtain Inverting & Non inverting output.
6	1,3	1,2, 3,4	1. Op-amp as Voltage follower & Schmitt trigger	1. Construct a circuit to obtain the sum of all input voltages using IC

			2. Op-amp as Summing and Subtractor amplifier 3. Op-amp as Comparator	741. 2. Construct a circuit to obtain the difference of all input voltages using IC 741.
7	1,3	1,2, 3,4	1. Op-amp as Differentiator 2. Op-amp as Integrator 3. Op-amp as Instrumentation amplifier	1. Construct a circuit to obtain a triangular wave from square wave using IC 741. 2. Construct a circuit to obtain spike from square wave using IC 741.
8	1,2, 3	1,2, 3,4	1. Oscillators - Concept, Types, LC Tank circuit and stability. 2. Concept of feedback, types, Barkhausen criteria. 3. Types of Oscillators, Working of Hartley oscillator using BJT and its applications.	1. Construct/Simulate Hartley oscillator using BJT. 2. Construct/Simulate Hartley oscillator using Op-amp.
9	1,2, 3	1,2, 3,4	1. Working of Colpitts oscillator using BJT and its applications. 2. Filters: Classification, Applications & Advantages of Active over Passive Filters. 3. Filter Terminology, frequency response of 1st order Butterworth active LPF and HPF (No Derivation).	1. Construct/Simulate Colpitts oscillator using BJT/Op-amp. 2. Conduct an experiment to plot the frequency response of active LPF and HPF using IC 741.
10	1,3	1,2, 3,4	1. IC 555 Timer: Internal diagram, Pin Configuration. 2. IC 555 timer as Astable multivibrator. 3. IC 555 timer as Monostable multivibrator	1. Interpret Datasheets of IC 555 Timer. 2. Verify the working of IC 555 timer as Astable multivibrator. 3. Verify the working of IC 555 timer as Monostable multivibrator.
11	1,4	1,2, 3,4, 7	1. Introduction to PCB, need and evolution of PCBs. 2. Classes of PCB – First Class (RF, microwave, and analog PCB) & Second Class (digital based PCB) – characteristics. 3. Types of PCB - Single sided, double sided and multilayer PCBs, rigid and	1. Introduction to PCB Design software. 2. Design Schematic and PCB layout for 5 V, 1A Mobile Charger using IC 7805.

			flexible PCBs.	
12	1,4	1,2, 3,4, 7	1. Terminology used in PCB design. 2. Steps involved in layout design, Importance of grounding in PCBs, impedance matching. 3. Design specification standards	1. Design Schematic and PCB layout to realize IC 555 timer as Astable multivibrator.
13	1,4	1,2, 3,4, 7	Steps involved in fabrication of single sided PCB.	1. Fabricate the 5V, 1A Mobile charger using IC 7805 2. Fabricate IC 555 timer as Astable multivibrator.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problems statement to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

- Principles of Electronics, Rohit Mehta & V K Mehta, S. Chand Publishing ISBN: 9788121924504
- Fundamentals of Electrical and Electronics Engineering, B. L. Theraja, S. Chand and Company. REPRINT 2013, ISBN 8121926602
- "A Textbook of Applied Electronics" by R. S. SEDHA.
- Electronic Components, Dr. K. Padmanabhan and P. Swaminathan, Lakshmi Publications, 2006.
- Electronic Devices and Circuits, David A. Bell, Oxford University Press, ISBN: 9780195693409.
- Electronic Devices and Circuits, S. Salivahanan , N. Sureshkumar , McGraw Hill Education (India) Private Limited, ISBN – 9781259051357
- Op-amps and linear integrated circuits, Ramakanth A. Gayakwad, ISBN- 9780132808682
- Printed Circuits Handbook - 6th edition Clyde F. Coombs,Jr.
- PCB Design & Technology - Walter C. Bosshart
- Printed Circuit Board by RS Khandpur, Tata McGraw Hill Education Pvt Ltd., New Delhi

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note:- Portfolio evaluation includes average of (a) and (b)

(a) Any one of the Suggested activity model with report and presentation evaluated for 50 marks

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1. Written description of the experiment in the observation book.
2. Conducting the experiment and the associated learning outcomes.
3. The results obtained from the experiment.
4. Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	**Electronics and Communication Engineering**			**Semester -III**	
Course Name	Applied Electronics-II			**Test**	**I/III**
Course Code	**25EC33I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Classify the power amplifiers	L2	CO 1	5
	b) Differentiate DC regulated power supply with SMPS	L2	CO 1	10
	c) Interpret Online & Offline UPS and explain its working principle.	L3	CO 1	10
2	a) Explain the concept of feedback and list various feedback methods.	L2	CO 1	5
	b) Identify the circuit that doubles the input voltage and explain it with a relevant circuit diagram.	L2	CO 1	10
	c) Determine the role of a Silkscreen, Solder mask, Pads, Via and Footprints in PCB manufacturing.	L3	CO 1	10
	Section - 2			
3	a) Illustrate the use of Op-amp to add and amplify the given voltages.	L3	CO 2	5
	b) Identify and explain the circuit which blocks low frequency signals and amplifies high frequency signals.	L3	CO 2	10
	c) Illustrate an RC Integrator circuit.	L2	CO 2	10
4	a) Outline the advantages of Active filters over Passive filters	L2	CO 2	5
	b) Identify the oscillator to generate radio frequency oscillations and briefly describe any one of them with a circuit diagram.	L3	CO 2	10
	c) Develop a circuit to configure the IC 555 timer to get Astable output.	L3	CO 2	10

Note for the Course coordinator:

1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	**III**
Course Name	Applied Electronics-II			**Test**	**II/IV**
Course Code	**25EC33I**	Duration	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	CO	Marks
Write-up for two experiments and conduction of any one experiment.	CO 3,CO 4	**50**
Scheme of assessment **a) Writing the Circuit diagram, tabular column, calculations etc. for two experiments.** **b) Rigup and Conduction of any one** **c) Troubleshooting** **d) Result/Output** **e) Viva-voce**		**20 M** **10 M** **05 M** **05 M** **10 M**
Total Marks		**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities:

The List is an example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to 5 students.

Sl.No.	**Suggestive Activities**
01	Automatic door bell ringer application
02	LED Flasher circuit application
03	Burglar's alarm application
04	Rain alarm application
05	Temperature monitor application
06	PCB based application
07	And all such simple circuits/projects that have scope to integrate multiple concepts learnt and for which circuits/boards/components are easily available.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities.

11. SEE- Model Practice Question Paper

Program	**Electronics and Communication Engineering**		Semester	**III**
Course Name	Applied Electronics-II	**Course Code: 25EC33I**	**Duration**	**180 min**
Questions			CO	Marks
Write-up for two experiments and conduction of any one experiment.			CO 3,CO 4	50
Scheme of assessment **a) Writing the Circuit diagram, tabular column, calculations etc. for two experiments.** **b) Rigup and Conduction of any one** **c) Troubleshooting** **d) Result/Output** **e) Viva-voce**				**20 M** **10 M** **05 M** **05 M** **10 M**
			Total Marks	**50**

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
01	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
02	MATLAB /PSPICE/Electronic Workbench Software for simulation		
03	Regulated Power Supply (Single)	1A/2A 0-30V	10
04	Regulated Power Supply (Dual)	1A/2A 0-30V	10
05	DC Voltage supply	+/-5v, +/-12V, +/-15V	10
06	Digital multimeters		20
07	Function/Signal generator		10
08	Dual trace oscilloscope	Upto 20-30MHz	10
09	Electronic consumables (Diode, Transistor (npn and pnp), Resistors, Inductors, Capacitors, Special purpose diodes etc)		Consumables as Required
10	Step down transformers	(6-0-6) V (12-0-12) V	10 each
11	OP-amps IC 741		30
12	IC 555 Timer		10
13	Single stand wire/ patch cards	Different lengths	
14	Breadboard/Tag Board/ Regular PCB/ Analog trainer kit		10
15	Open source EDA Tool KiCad.		

16	Single-sided copper clad sheet.		50
17	Diluted Acidic solution for copper etching purpose with plastic tray.		10
18	Glossy paper		50
19	Hand drilling/Power drilling machine.		10
20	Tool kit (Tray, Brush, PCB Laminate, tong, hand gloves etc.)		20
21	LASER Jet Printer, Iron Box		02 each

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	ELECTRONICS AND COMMUNICATION	**Semester**	**III**
Course Name	**C-Programming**	**Type of Course**	Integrated
Course Code	25EC34I	**Contact Hours**	7 Hours/Week
Teaching Scheme	L: T:P :: 3:0:4	**Credits**	6 Credits
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

The C programming language serves as a fundamental tool for enhancing logical reasoning and problem-solving abilities. This course aims to build students confidence in programming skills while fostering a strong understanding of programming concepts and methodologies for addressing engineering challenges. The syllabus offers a solid foundation in programming principles, practical problem-solving and hands-on experience with both C and Arduino, effectively preparing diploma students for successful careers in electronics and communication.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Implement C programming and algorithms to solve problems logically using loops, decision-making statements and functions.
CO-02	Apply arrays, structures, and pointers in C for data storage and management.
CO-03	Develop basic Arduino programs for sensor interfacing and control using the Arduino IDE.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	**1**	**1, 4, 7**	**Overview of Programming Languages** 1. Need for Programming languages. 2. Types of programming languages-Low level, assembly and high-level languages. 3. Features of Procedure Oriented Programming (POP) and Object Oriented Programming (OOP).	1. Installation of C Programming Software (GCC, Code Blocks, Turbo C, Dev-C++). 2. Familiarization of C software.
2	**1**	**1,2, 3,4**	1. Flowcharts and Algorithms. 2. Development tools – Introduction to Assembler, Linker, Compiler, and	1. Write Flowchart and Algorithm for displaying the personal address and official address. 2. Write C program for printing

			Interpreter. 3. Structure of 'C' Program.	your mailing address. (File Management-Create a new folder and save the programs in the folder.)
3	**1**	**1, 2, 4**	1. Character set, Keywords, identifiers, Constants and variables. 2. Data types: Predefined (Integer, signed and unsigned, long, float, double, character). **3.** User defined datatypes (Arrays and structures).	1. Write C program to read and display the variables of different data types. 2. Write C program to input the radius of a circle as an integer, convert it to a float, and calculate the circumference**.**
4	**1**	**1, 2, 4**	**1.** Operators: Arithmetic, Logical, Relational, increment and decrement, bitwise, assignment operator. **2.** Special operators-unary, ternary operators. Precedence and associativity. **3.** Formatted input and output statements.	1. Write C program for addition of three numbers. 2. Write C program to find the biggest of three numbers using ternary operator.
5	**1**	**1,2, 3,4**	**Decision making statements** **1.** if-else, if-else-if statements with simple examples. **2.** nested if statement with simple examples. **3.** Switch statement with simple examples.	1. Write a C program to check whether the alphabet is vowel or not using switch statement. 2. Write a C program that checks if a number is even or odd using if-else.
6	**1**	**1,2, 3,4**	**Looping and Branching statements** 1. for statement with simple examples. 2. while, do-while statements with simple examples. **3.** break, continue statements with simple examples.	1. Write a C program to print first 20 even numbers using for loop. 2. Write a C program to find the sum of numbers from 1 to N using while loop
7	**1**	**1, 2, 3,4, 5,7**	**Functions** 1. Concept and Need of a Function. 2. Declaration, definition and Calling of function. **3.** Passing values between functions: Call by value and Call by reference.	1. Write a C program to implement swapping of two integers by using functions Call by value. 2. Write a C program to implement swapping of two integer by using functions call by reference.
8	**1**	**1, 2, 3,4, 5,7**	1. Library functions: Math function like: mod(), sqrt(), pow(),exp(), sum(), round(). 2. Character functions like islower(), isupper(), isdigit(), tolower(). **3.** Recursive functions-Factorial of a number.	1. Write a C program to find the roots of the quadratic equations using Math function (only for real roots). 2. Write a C program to implement the following character functions islower(), isupper(), isdigit(), tolower().
9		**1, 2,**	**Arrays** 1. Concept and need of arrays.	1. Write a C Program to store 10 numbers in an array and find the

	2	**3,4, 5,7**	2. Declaration, Initialization, Storing of Array Elements in Memory, Displaying array elements 3. Two-Dimensional Arrays: Initialization, Adding elements to 2-D array and display elements of 2-D array.	sum and average of 10 numbers. 2. Write a C Program to perform the following operation on matrix using 2-D array: Addition & Subtraction.
10	**2**	**1, 2, 3,4, 5,7**	**Strings** 1. Declaration, Initialization and display of string. 2. Standard Library String functions Strlen(), strcpy(), strcat(),strcmp(). 3. Simple example programs.	1. Write a C program to check if the string is Palindrome or not. 2. Write a C program to concatenate two strings and find the length of the concatenated string.
11	**2**	**1, 2, 3,4, 5,7**	**Structures & Pointer** 1. Introduction to structures, declaring a structure. 2. Accessing structure elements, displaying structure elements. 3. Concept of pointer: Pointer variables, Declaration of pointer.	1. Write a C program to store and display the student record using structure. 2. Write a simple C program for demonstration of & and * in pointers.
12	**3**	**1, 2, 3,4, 5,7**	**Introduction to Arduino** 1. Overview of Arduino and its applications and introduction to the Arduino IDE. 2. Arduino Programming Basics.Basic syntax and structure of Arduino code. **3.** Understanding functions: setup (), loop ().Variables, data types and operators.	1. Write an Arduino Program for blinking LED with different delays. 2. Write an Arduino Program to turn ON and OFF the buzzer.
13	**3**	**1, 2, 3,4, 5,7**	1. Introduction to sensors and actuators. 2. Working of IR sensor and ultrasonic sensor. 3. Working of a relay and buzzer.	1. Write an Arduino Program to interface IR sensor/Ultrasonic sensor for obstacle detection. Turn ON the buzzer when the obstacle is detected. 2. Write an Arduino program to read temperature using LM35 and display on the serial monitor. Also, turn ON the 5V fan using Relay when the temperature is above certain value.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problems statement to be collected from the relevant industries, resolve and submit it to

the course coordinator.

4. References:

1. C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie
2. "Programming in ANSI C" by E. Balaguruswamy
3. "C: A Modern Approach" by K. N. King
4. "C Programming: A Problem-Solving Approach" by Forouzan, Gilberg
5. "C Programming Absolute Beginner's Guide" by Greg Perry and Dean Miller
6. "The C Programming Language (2nd Edition)" by Brian W. Kernighan and Dennis M. Ritchie
7. "C Programming in Easy Steps" by Mike McGrath
8. "C Programming: A Comprehensive Approach" by B. R. D. H. A. Dhananjay
9. "Arduino Projects for Beginners" by M. J. T. C. Anaya
10. "Arduino Project Handbook: 25 Practical Projects to Get You Started" by Mark Geddes
11. "Getting Started with Arduino" by Massimo Banzi

5. CIE Assessment Methodologies

Sl.No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

a) Any one suggested activity with report /presentation and simulation evaluated for 50 Marks.

b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

(i) Written description of the experiment in the observation book.
(ii) Conducting the experiment and the associated learning outcomes.
(iii) The results obtained from the experiment.
(iv) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	**ELECTRONICS AND COMMUNICATION**			**Semester -III**	
Course Name	**C-Programming**			**Test**	**I/III**
Course Code	**25EC34I**	**Duration**	**90min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognit ive Level**	**Course Outcome**	**Mark s**
	Section - 1			
1	a) Compare low-level, assembly, and high-level languages with examples. b) Write a flowchart and algorithm to calculate the sum of two numbers. c) Discuss the roles of an assembler, linker, compiler, and interpreter in the software development process. Provide examples of each.	L2 L3 L2	CO1 CO1 CO1	5 10 10
2	a) Explain the primary characteristics of Object- Oriented Programming (OOP)? b) Write a flowchart and algorithm to illustrate the process of finding the largest of three numbers. c) Describe the structure of a C program and write a simple program that prints "Hello, World!"	L2 L3 L2	CO1 CO1 CO1	5 10 10
	Section - 2			
3	a) Develop a program to input the radius of a circle as an integer, convert it to a float, and calculate the circumference. b) Discuss the significance of variables and constants in C programming with examples. c) Interpret the concept of operator precedence and associativity with examples in C.	L3 L2 L2	CO1 CO1 CO1	5 10 10
4	a) Write a program to calculate the area and perimeter of a rectangle using arithmetic operators. b) Explain the concept of data types in C. Compare predefined and user-defined data types? c) Describe logical and relational operators in C.	L3 L2 L2	CO1 CO1 CO1	5 10 10

Note for the Course coordinator:

1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE-2 Practice Test model question paper

Program	**ELECTRONICS AND COMMUNICATION**			**Semester**	**III**
Course Name	**C-PROGRAMMING**			**Test**	**II**
Course Code	**25EC34I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Give two 'C' programs for students to write and any one program for execution				**CO1**	**50**
Scheme of assessment: **a) Writing two programs** **b) Execution of any one program.** **c)Result** **d)Viva-voce**					 **20** **15** **05** **10**
Total Marks					**50**

Signature of the Course Coordinator **Signature of the HOD**

9. **Suggestive Activities:**

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to five students.

Sl.No.	Suggestive Activities for Tutorials
01	Write a C program that prints your mailing address using variables for different components.
02	Measure the distance to an object using an ultrasonic sensor and display the result on the Serial Monitor using Arduino.
03	Implement a number guessing game where the user has to guess a randomly generated number within a range.
04	Relay-Controlled Home Automation using Arduino.
05	Develop a calculator program that performs basic arithmetic operations
06	Implement a program that stores and displays student records (name, roll number, marks) using structures.
07	Create a simple ATM simulation program that allows users to check balance, deposit, and withdraw money.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities.

11. **CIE-4/SEE- Model Practice Question Paper**

Program	**ELECTRONICS AND COMMUNICATION**		**Semester**	**III**
Course Name	**C-PROGRAMMING**	**Course Code**	**25EC34I**	**180 min**
Questions			CO1,CO2,CO3	Marks
				50
Scheme of assessment: **PART A** **a) Writing two C programs** **b) Execution of any one program.** **c)Result** **PART B** **a) Writing arduino program** **b) Execution** **c) Result** **Viva-voce**				 **10** **10** **05** **05** **05** **05** **10**
			Total Marks	**50**

Signature of the Examiner **Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computers	Dual core/i3/i5/i7/i9/i10 processor, 8 GB RAM, 1TB hard disk/SSD	30
02	Software Code::Blocks for C-Programming	-	-
03	Software Code Turbo C++ for C-Programming	-	-
04	Software Arduino IDE	-	-
05	Arduino board (e.g., Arduino UNO)		30 Each
06	Ultrasonic sensor , IR sensor module, relay, buzzer ,LM35 Temperature sensor		30 Each

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

IV Semester Scheme of Studies

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	EC	25EC41I	Power Electronics	4	0	4	8	6	50	20	50	20	-	-	100
2	EC	25EC42I	Electronic Measurements and Analysis	4	0	4	8	6	50	20	50	20	-	-	100
3	EC	25EC43I	Microcontroller and Applications	3	0	4	7	5	50	20	-	-	50	20	100
4	EC	25EC44I	Verilog Programming for Digital Circuits	3	0	4	7	5	50	20	-	-	50	20	100
Audit Course															
5	KA	24KA41T	Kannada –II (ಸಾಮಾನ್ಯ ಕನ್ನಡ-II/ಬಳಕೆ ಕನ್ನಡ-II)	2	0	0	2	2	50	20	-	-	-	-	50
Total				**16**	**0**	**16**	**32**	**24**	**250**	**-**	**100**	**-**	**100**	**-**	**450**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**IV**
Course Name	**Power Electronics**	**Type of Course**	Integrated
Course Code	**25EC41I**	**Contact Hours**	8 Hours/week 104 Hours/semester
Teaching Scheme	L: T:P: 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

The Power Electronics course is designed to provide students with a deep understanding of the principles and applications of power electronic systems. This knowledge is critical in modern engineering, where efficient power management and conversion are essential for various industries, including renewable energy, transportation, and industrial automation.

This course equips students with the theoretical knowledge and practical skills necessary to excel in the field of power electronics. By understanding the components, design principles, control techniques, and applications of power electronic systems, students will be prepared to innovate and develop efficient solutions for energy conversion and management. This comprehensive approach ensures that graduates are ready to meet the challenges of modern engineering and contribute to advancements in technology and sustainability.

2. Course Outcomes: At the end of the course, the student will be able to

CO-01	Explain the principles and applications of power semiconductor devices.
CO-02	Illustrate the SCR operation with protection methods.
CO-03	Construct or simulate the single-phase controlled rectifiers and chopper circuits and test or troubleshoot for the required output.
CO-04	Construct or simulate the inverter, SMPS and cycloconverter circuits and test or troubleshoot for the required output.
CO-05	Infer the emerging trends in power electronics.

3. Course Content:

WEEK	CO	PO	Theory	Practice
1	**1**	**1**	1. Overview of Power Electronics: Scope, importance and applications. video demonstration on application of power electronics in industrial Automation. 2. Basics of power semiconductor devices with examples: Power Diodes, Power Transistors - symbol,	1a. Interpret the datasheets of Power diode and Power MOSFET. 1b. Interpret the datasheets of SCR and IGBT.

			function, characteristic and application. Compare ordinary diodes and power diodes. Compare ordinary transistors and power transistors. 3. Thyristors: SCR & TRIAC - symbol, function, application. 4. DIAC & GTO - symbol, function, application.	2. Identify all the power semiconductor devices and list them with symbols.
2	**1**	**1,2**	Power MOSFET: 1.Power MOSFET - symbol, applications. 2. N channel enhancement power MOSFET - working, characteristics. 3. Summary of advantages of N channel enhancement power MOSFET over all other types of MOSFET. 4. Compare power BJT and power MOSFET.	1. Conduct / simulate an experiment to obtain VI characteristics of any power MOSFET. Compare the results with its datasheet. 2. Video demonstration on working of N channel MOSFET.
3	**1**	**1,2 ,3**	Power IGBT: 1. IGBT - symbol, list of various terminologies, importance. 2. Explain the best features of power BJT and power MOSFET used in power IGBT. 3. Advantages and disadvantages of power IGBT. 4. Discuss and list the Real time applications of power IGBT.	1.Conduct / simulate an experiment to obtain VI characteristics of any IGBT. 2. Video demonstration on applications of IGBT.

4	**2**	**1,2,3**	1. Silicon Controlled Rectifier (SCR) - VI characteristics, latching current, holding current and breakdown voltage of SCR. 2. Turn ON methods of SCR - Explanation for each method. 3. SCR Triggering circuits: R-triggering, RC-triggering (only Full wave). 4. SCR Protection circuits - Over voltage, over current, di/dt & dv/dt (Snubber circuit) and Gate protection.	1. Conduct an experiment to obtain forward VI characteristics of SCR and determine the holding and latching currents. Compare the results with its datasheet. 2a. Construct R-triggering circuits and verify the working. 2b. Discuss and construct a pulse triggering circuit using UJT relaxation oscillator and verify the working.
5	**2**	**1,2,3,4**	1. Commutation of SCRs: Definition, Need and conditions for commutation, types -Natural or Line & Forced. 2. Natural or Line commutation methods - Circuit, waveform & working. Forced commutation methods - Classification. 3. Explanation of Class A and Class B - Circuit, waveform & working. 4. GTO - VI characteristics and working principle.	1. Conduct the experiment to turn ON and OFF an LED bulb using a single channel 5V/12V Solid State Relay module. Performance comparison with Electromagnetic relay. 2. Conduct the experiment to verify the light dimmer circuit using DIAC and TRIAC.
6	**3**	**1,2,3,4**	1. AC-to-DC Converters: Introduction to phase-controlled rectifiers or converters. Single-phase half-wave controlled rectifiers with R load - Circuit diagram, waveform & working. 2. Single phase converters: Single-phase full-wave mid-point controlled rectifiers with R load - Circuit diagram, waveform & working. 3. Single-phase fully-controlled bridge converters with R load - Circuit Diagram, waveform and explanation. Illustration of Single-phase semi converters.	1. Conduct an experiment to study the performance of single-phase half-wave controlled rectifiers with resistive load. 2. Conduct an experiment to study the performance of single-phase full-wave controlled rectifiers with resistive load.

			4. Concept of freewheeling diode. Comparison between half controlled and full controlled rectifiers.	
7	**3**	**1,2,3,4**	1. DC-to-DC Converters: Introduction to choppers - definition, principle of operation, Concept of Step-down and Step-up choppers. 2. Classification of choppers: Class A choppers - Circuit diagram, quadrant diagram and working. 3. Class B choppers - Circuit diagram, quadrant diagram and working. 4. Class E choppers - Circuit diagram, quadrant diagram and working, Applications of choppers.	1. Conduct / simulate an experiment to study the working of a step-up chopper. 2. Conduct / simulate an experiment to study the working of a step-down chopper.
8	**4**	**1,2,3,4**	1. DC-to-AC Converters: Introduction to inverters - working principle. 2. Inverters - classification, applications. 3. Half-bridge inverters- Circuit diagram, waveform and explanation. 4. Full-bridge inverters - Circuit diagram, waveform and explanation.	1. Construct / simulate the half-bridge inverters. 2. Conduct the experiment to study the working of an inverter using Arduino and MOSFET/ IGBT.
9	**4**	**1,2,3,4**	1. Series inverters - Circuit diagram and working. 2. Voltage control in inverters - Need and Listing of different methods. 3. Introduction to PWM techniques: Single-pulse PWM - definition and waveform. 4. Multiple-pulse PWM - definition and waveform.	1. Construct / simulate an experiment to study the Series inverter circuit. 2. Construct an experiment to study the generation of PWM signals using kit / simulation.
10	**4**	**1,2,3,4**	1. AC to AC converters: Introduction to cycloconverter. Classification - Step down and Step up cycloconverter.	1. Conduct the experiment to study the Single-phase cycloconverter operation with resistive load.

			2. Principle of operation of single phase cycloconverters - Circuit diagram, operation and waveforms. 3. Bridge type cycloconverter. Applications of cycloconverter. 4. Difference between cycloconverters, choppers, rectifiers and inverters.	2. Build a 12V Battery charger circuit using SCR with all protective components. https://www.academia.edu/9138297/Battery_Charger_Circuit_Using_SCR
11	**4**	**1,2,3,4**	1. Applications of Thyristors: Light dimmer circuit using DIAC and TRIAC. 2. Burglar alarm using SCR - Circuit diagram and explanation. 3. Photo-electric control of SCR - Circuit diagram and explanation. 4. Switched-Mode Power Supply (SMPS) - Block diagram and working. List the safety devices used in SMPS.	1. Build a FAN speed regulator using DIAC & TRIAC. 2. Build / simulate a simple 5V/12V 1 Amp SMPS circuit. https://www.electronicsforu.com/electronics-projects/simple-12v-smps
12	**4**	**1,2,3,4,7**	1. Metal Oxide Varistors (MOV) - working principle, characteristics & specifications. 2. Application of Gas Discharge Tubes (GDTs) in Power Circuits - working principle, features & specifications. 3. Video demo on working of AC/DC motors. Electronic control of AC/DC motors: Need for electronic control of motors. 4. Armature voltage control of DC shunt motor.	1. Collect and analyse the datasheets of all the safety components/ devices used in power applications. (MOV, GTD etc.) 2. Conduct the experiment to control the direction of rotation of a DC motor using any H-Bridge Motor Driver Module.
13	**5**	**1,2,3,4,7**	1. Emerging Trends in Power Electronics: Introduction to wide bandgap semiconductors: Silicon Carbide (SiC) Devices and Gallium Nitride (GaN) Devices - energy band diagram, construction diagram-explanation.	1. Industrial visit to any SMPS/ Power supply development/ Inverter manufacturing industry and submit a report.

			2. Renewable energy applications: Solar inverters, wind energy converters. 3. Application of power electronics in electric vehicles (EV) and smart grids. 4. Future trends: Wireless power transfer and power electronics in automation - brief introduction.	2.Industrial visit to any power station and submit a report.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problem statements to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

- POWER ELECTRONICS HANDBOOK by MUHAMMAD H. RASHID.
- "GaN and SiC Power Devices: From Fundamentals to Applied Design and Market Analysis" by Maurizio Di Paolo Emilio (2024).
- Power Electronics (Second Edition) by M D Singh, K B Khanchandani, McGrawHill (2015) publishers .
- Power Electronics by P.S. Bimbhra 2022 Jan edition.
- Principles of Power Electronics by John G. Kassakian, David J. Perreault, George C. Verghese, Martin F. Schlecht 2023 edition.
- Power Electronics by Soumitra Kumar Mandal Mc GrawHill publishers.
- https://www.youtube.com/watch?v=XKc1LyCmosM&list=PL_mruqjnuVd9_mwhgK3nAy-cHyslXCnRk&index=4
- https://www.youtube.com/watch?v=i_WxKve1eqw&list=PL_mruqjnuVd9_mwhgK3nAy-cHyslXCnRk&index=5
- https://www.youtube.com/watch?v=HI4Z6imxUIM

5. CIE Assessment Methodologies

Sl. No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1 Theory Test	4	90	50	
2.	CIE-2 Practice Test	7	180	50	Average of all CIE=50 Marks
3	CIE-3 Theory Test	10	90	50	

4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: -
Portfolio evaluation includes average of (a) and (b).

(a) Any one of the Suggested activity model with report and presentation evaluated for 50 marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1. Written description of the experiment in the observation book.
2. Conducting the experiment and the associated learning outcomes.
3. The results obtained from the experiment.
4. Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper

Program	**Electronics and Communication Engineering**			**Semester -IV**	
Course Name	Power Electronics			**Test**	**I/II I**
Course Code	**25EC41I**	Duration	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Describe the working principle of an IGBT.	L2	1	10
	b) Compare ordinary diodes and power diodes.	L2	1	5
	c) Illustrate the working of protection circuits in SCR application.	L3	2	10

2	a) Describe the working principle of a power MOSFET. b) Compare ordinary transistors and power transistors. c) Construct R-triggering circuit for SCR and explain with waveform.	L2 L2 L3	1 1 2	10 5 10
	Section - 2			
3	a) Illustrate the latching current, holding current and breakdown voltage of SCR. b) Explain the turn ON methods of SCR. c) Compare the functions of SCR and ordinary DIODE.	L2 L2 L3	2 2 2	10 10
4	a) Construct and explain a pulse triggering circuit using UJT relaxation oscillator. b) Explain the construction and VI characteristics of GTO. c) Discuss the need for commutation SCRs.	L2 L2 L3	2 2 2	5 10 10 5

Note for the Course coordinator:
1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	**IV**
Course Name	Power Electronics			**Test**	**II/IV**
Course Code	**25EC41I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Write-up for two experiments and conduction of any one experiment.					**50**
Scheme of assessment **a) Writing the Circuit diagram, tabular column, calculations etc..for two experiments.** **b) Rig up the circuit (Any one)** **c) Conduction** **d) Result** **e) viva-voce**					**10** **10** **15** **05** **10**
Total Marks					**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. Suggestive Activities for Tutorials:

The List is an example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to 5 students.

Sl. No.	Suggestive Activities
01	Build a FAN speed regulator using DIAC & TRIAC on general purpose PCB and submit a detailed analysis report.
02	Build a 5V/12V 1A SMPS on general purpose PCB and submit a detailed analysis report.
03	Build a 12V Battery charger circuit using SCR with all protective components on general purpose PCB and submit a detailed analysis report.
04	Build a simple BLDC motor controller circuit Using IRFZ44N MOSFET. https://www.youtube.com/watch?v=LU_6lCu8uTs
05	Build an Inverter circuit using IRFZ44N MOSFET & CD4047. https://www.youtube.com/watch?v=ux6xuhfdSyw
06	Build any one real time application of SCR/TRIAC.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	30
02	POWERSIM simulation software		
03	Dual trace oscilloscope	20-30MHz	30
04	Function generator		30
05	SCR, TRIAC, DIAC, IGBT, GTO		30 each
06	Universal Motor (AC/DC)	FHP/230V	30

07	DC Motor, H-Bridge		30 each
08	Solid State Relays	5V/12V	30
09	Pedestal Fan	230VAC 50Hz	1
10	Protection devices (MOV, GTD etc.)		30each
11	Rechargeable Battery	Sealed Lead Acid Battery 12V, 1.3 Ah or 7Ah	10
12	Arduino development boards	Arduino UNO	10
13	Transformers	6-0-6, 12-0-12/1A	20
14	Decade Resistance Box (DRB), Potentiometers		20

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**IV**
Course Name	**Electronic Measurements and Analysis**	**Type of Course**	Integrated
Course Code	**25EC42I**	**Contact Hours**	8 Hours/week 104 Hours/semester
Teaching Scheme	L: T:P :: 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

The primary focus of this course is to develop understanding of various instruments used for measuring, monitoring and recording physical phenomena. The scope of this course is vast and appears to be growing due to increased use of sensors and automatic control in manufacturing and process control applications. However, the measurement of temperature, pressure, level and flow is common among most of the engineering industries including petrochemical, power plants, Biomedical field, Integrated circuit manufacturing and aircraft engines industry.

The instruments used to measure any Electrical/Electronic quantity are known as measuring instruments. The standards of measurements are very useful for calibration of measuring instruments. They help in minimizing the errors in the measuring systems. Testing Techniques are means of enhancing troubleshooting and the ability to learn skills. It keeps electronic equipment in working condition and ensures safety. The damage of the equipment can be significantly reduced.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify different measurement techniques, standards in electronic measuring systems and validate measurement results without any errors.
CO-02	Identify the suitable sensor or transducer, use it to measure and record the readings for a specific application.
CO-03	Choose the right meter or analyser, use it to measure and record the readings for a specific measurement.
CO-04	Identify different electrodes or sensors used and explain the principle of measurements in the biomedical field.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	**1**	**1**	1. Necessity of measurements, direct and indirect methods, generalized electronic measurement system - block	1. Submit a report on electronic and electrical components inside all the measuring instruments available in your laboratory.

			diagram. 2. Static characteristics: Definition. Errors in measurements, Sources of errors. 3. Types of errors. Dynamic characteristics: Definition. 4. Video demo on measuring instruments used in R&D labs of any Product development industry.	2a. Find the static characteristics of analog voltmeter/ Multimeter. 2b. Understand the concept of continuity test and its importance.
2	**1**	**1,2,3**	1.Standards- primary, secondary, working and IEEE standards. 2. Bridges: Concept of Bridges, Types of bridges- Introduction to DC Bridges - Types. 3. Wheatstone bridge - Principle, working, applications and simple problems. 4. Introduction to AC Bridges - Types Comparison of AC and DC bridges.	1. Build a Wheatstone bridge to find unknown resistance. 2. Prepare and present a PPT on different IEEE standards used in R&D labs of any Product development industry and submit the report. (Refer Instrument Specification sheets and User manuals)
3	**2**	**1,2,3**	1. Electrical transducers - necessity, characteristics, selection, advantages. 2. Classification of transducers - active, passive, analog and digital, primary and secondary transducers. 3. Strain gauge - Working principle, gauge factor, Types of strain gauge. 4. Load cell (Pressure cell) - Working principle and application.	1. Design an electronic weighing machine using Load cell & Arduino. https://projecthub.arduino.cc/boaz/electronic-weighing-machine-96f635 2. Discuss Proximity sensors and build a circuit to detect objects using a capacitive proximity sensor.
4	**2**	**1,2,3**	1. Hall effect transducer: working principle and applications. 2. Linear Variable Differential Transformer (LVDT): Construction, working principle and applications.	1. Discuss and build a real time temperature sensor circuit using a Thermistor. 2a. Using Tinkercad software, build a smoke detector circuit using a gas sensor.

			3. Piezoelectric transducer: construction & applications. 4. Thermocouple: construction & applications.	2b. Using Tinkercad software, build a moisture detector circuit using a moisture sensor.

5	**3**	**1,2,3**	1. PIR sensors: working principle and applications. 2. PMMC meters: Construction & principle. 3. PMMC meter as DC Ammeter and DC Voltmeter by using Shunt and series resistors. 4. Ohmmeters- series and shunt type.	1. Make a video on transducers / sensors used in home appliances such as irons, air conditioners, remote controllers, etc. and upload it to Karnataka LMS/ Google Classroom/ Moodle/ Canvas. (Home work) 2a. Construct a circuit to verify KVL and measure voltages using an analog voltmeter. 2b. Construct a circuit to verify KCL and measure currents using an analog ammeter.
6	**3**	**1,2,3**	1. Concept of multi range voltmeters. 2. Problems on extending the range of Voltmeter. 3. Concept of multi range Ammeters/ Ohmmeters. 4. Problems on extending the range of Ammeter.	1. Test the LDR, Thermistors, Potentiometer, Relays using Multimeter. 2. Demonstrate the usage of Multimeter to use it in optimal range for optimal performance.
7	**3**	**1,2,3**	1. Electrodynamometer: Basic circuit and working. 2. Digital voltmeter-types & advantages. Working of Ramp type digital voltmeter. 3. Automatization in digital meters-mechanism of automatic zeroing, polarity indication and auto ranging. 4.Instrument calibration: Need for calibration, Calibration of Voltmeter, Calibration of Ammeter.	1. Find out the different sensors that are used in mobile phones and give a presentation on it with specification sheets/data sheets. 2. Find out the different sensors that are used in smart watches and give a presentation on it with specification sheets/data sheets.

8	**3**	**1,2 ,3**	1. Digital multimeter - Block diagram and its working, advantages and applications. 2.Digital LCR meter - advantages and applications. 3. Comparison of Digital LCR meter with Digital multimeter. 4. Digital frequency meter - Principle of Operation.	1. Collect and analyse the specification sheets of different models of LCR and Digital Multimeters available in the market by browsing various manufacturers websites. 2. DO IT YOURSELF (DIY) a probe and use the probe to test the circuit continuity in any PCB.
9	**3**	**1,2 ,3**	1. Cathode Ray Oscilloscope - Block diagram, working of CRT. 2. Concept of dual tracing. CRO probes: direct, high impedance, active and current probes. 3. Function generator: Features and applications. 4. Spectrum analyzer - Need and applications.	1. Demonstrate the use of CRO to obtain Lissajous patterns and to find the unknown frequency. https://youtu.be/-B8e5NdNWF8?feature=shared 2. Discuss and demonstrate the use of DSO for the measurement of any waveform.
10	**3**	**1,2 ,3**	1. Outline the features of distortion analyser and wave analyser. 2. Concepts and need of electrical grounding and shielding. 3. Precautions to prevent instrument damage, general precautions for instrument safety. 4. Basics of electronic system troubleshooting techniques: Key aspects- Visual inspection, Power Supply verification, Continuity testing, Signal tracing, Component testing.	1. Perform a test lamp experiment to find the health of the earthing. https://youtu.be/IOxcXTqLjLo?feature=shared 2. Analyze the specification sheets and user manuals of different instruments available in the laboratory. or Demonstrate the troubleshooting of any Lab equipment by using suitable techniques.
11	**4**	**1,2 ,3**	1. Fundamentals of Medical Instrumentation- General Block diagram of Medical instrumentation system. 2. Introduction to Physiological Transducers: Electrodes- Types 3. Block diagram of ECG Machine.	1. Collect and analyze specification sheets or datasheets of different Electrodes/ sensors used in ECG and EEG systems. 2. Collect and analyze datasheets and user manuals of different models of ECG and EEG systems from major manufacturers.

			4. Block diagram of EEG machine, 10-20 electrode placement system for EEG.	
12	**4**	**1,2 ,3**	1. Cardiac Pacemakers - Definition & Types, Pulse Oximeter - working principle. 2. Defibrillator - AC and DC Defibrillators. 3. Haemodialysis Machines- Concept of Dialysis, working of haemodialysis machine. 4. BP measurement-systolic & diastolic pressure, direct method and indirect methods.	1. Measure the Blood Pressure using a sphygmomanometer (Digital BP Monitor) and document the different sensors used. 2. Measure the oxygen level with a Pulse Oximeter and document the different sensors used. 3. Guest lecture by Lab technician/ Person operating in ICU: Importance of maintenance of electronic instruments in ICU.
13	**4**	**1,2 ,3**	1. Ultrasonic imaging systems - Basic pulse echo apparatus - Block diagram and working. 2. Computerized tomography - basic principle, block diagram of a typical CT imaging system. 3. Applications of latest imaging techniques- MRI, PET. 4. List Laser applications in the Medical field.	1. Case study: List the precautions that should be taken when performing an ECG, EEG, CT, MRI & PET and justify these precautions. 2. Visit a nearby Hospital/ Diagnostics centre to get hands-on experience/ feel of operating electronic medical instruments.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problem statements to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

- Electronic Measurements and Instrumentation -2nd Revised Edition, R. K. Rajput, ISBN: 81- 2192917-2 234.
- Electronic Measurements and Instrumentation-3rd Edition, Sanjay Talbar & Akhilesh Upadhayaya, ISBN :81-874-3335-3
- Electronic Instrumentation -3rdEdition, Kalsi H. S., ISBN: 00-707-0206-3
- Modern Electronic Instrumentation and Measurement Techniques-2nd Edition, Albert Helfrick & William Cooper, ISBN:81-203-0752-6

- ELECTRONIC MEASUREMENTS AND INSTRUMENTATION by Dr. R.S. SEDHA.
- Handbook of Biomedical Instrumentation: by R S Khandpur.

5. CIE Assessment Methodologies

Sl.No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note:- Portfolio evaluation includes average of (a) and (b).

(a) Any one of the suggested activity model with report and presentation evaluated for 50 marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1. Written description of the experiment in the observation book.
2. Conducting the experiment and the associated learning outcomes.
3. The results obtained from the experiment.
4. Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper

Program	**Electronics and Communication Engg.**			**Semester -IV**	
Course Name	**Electronic Measurements and Analysis**			**Test**	**I/III**
Course Code	**25EC42I**	**Duration**	**90 min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	**Questions**	**Cognitive Level**	**Course Outcome**	**Marks**
	Section - 1			
1	a) Outline the role of measurements to ensure safety and compliance in manufacturing?	L2	1	5
	b) The expected value of voltage across a resistor is 100 V. However, the voltmeter reads a value of 99V. Calculate (a) absolute error, (b) % error, (c) relative error, and (d) % accuracy.	L3	1	10
	c) Describe the differences between active and passive transducers.	L2	2	10
2	a) Imagine you're performing a lab experiment and need the most accurate measurements possible. Which type of standards would you rely on to ensure the highest precision and why are they crucial in this context?	L3	1	10
	b) A Wheatstone Bridge has resistances R1=100 Ω, R2=200 Ω and R3=50 Ω. Calculate the value of R4 required to balance the bridge.	L3	1	5
	c) Explain the factors which decide the selection of a transducer with an example for each factor.	L2	2	10
	Section - 2			
3	a) Outline the role of PIR sensors in a home security system.	L3	2	10
	b) Explain the working principle of a PMMC meter when used as a DC ammeter.	L3	3	10
	c) Illustrate the working of ramp type DVM.	L2	3	5
4	a) Explain the need for calibration of measuring instruments in the laboratory.	L2	2	10

	b) A PMMC ammeter with a full-scale deflection of 100 mA has an internal resistance of 50 ohms. Calculate the value of the shunt resistor required to extend the range of the ammeter to 10 A. c) Select an appropriate transducer for measuring blood pressure and justify your choice.	L3 L3	3 3	10 5
Note for the Course coordinator: 1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes. 2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.				

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engg.**			**Semester**	**IV**
Course Name	**Electronic Measurements and Analysis**			**Test**	**II/IV**
Course Code	**25EC42I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Write-up for two experiments and conduction of any one experiment.				**1,2,3,4**	**50**
Scheme of assessment: **a) Writing the Circuit diagram, tabular column, calculations etc. for two experiments.** **b) Rig up the circuit (Any one)** **c) Conduction** **d) Result** **e) Viva-voce**					**10** **10** **15** **05** **10**
Total Marks					**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. **Suggestive Activities for Students:**

The List is an example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic

Note: Activity can be undertaken by either an individual or a team comprising up to 5 students.

Sl.No.	Suggestive Activities for Students
01	Visit 5 different places of electronic measurement (Shops, Industries, Diagnostic centers, Laboratories etc.) and make a report on different measurements performed, possible errors in measurement, type of sensor used, collect datasheet of the sensor, analysis of different characteristics of the sensor, manufacturer & cost of the measuring instrument.
02	Build a LPG Cylinder weight measuring device using Arduino with Low Gas Alert. https://www.youtube.com/watch?app=desktop&v=I6Z3DeamVfU&t=0s
03	Build a Motion Based Power Saver. https://www.electronicsforu.com/electronics-projects/hardware-diy/motion-based-powersaver
04	Build a digital speedometer. https://www.electronicsforu.com/electronics-projects/hardware-diy/digital-speedometer

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
01	Computers:	Intel Core i5 11th gen/8GB RAM/256GB SSD/ Graphics 2 GB	30
02	**System Requirements to access Tinkercad.** Operating system:	Microsoft Windows 10	30
03	Internet Browser:	Google Chrome version 50 (or newer) or Microsoft Edge (Chromium)	30
04	Internet connection:	At least 2 Mbps download and 512 Kbps upload.	1
05	Dual trace oscilloscope	20-30MHz	30
06	LCR meter		20
07	Resistors, Capacitors, Inductors, Thermistors, Relay, LDR		Consumables as required
08	Digital multimeter		30
09	Analog Voltmeter		20

10	Analog multimeter		20
11	Galvanometer		30
12	Function generator		30
13	Position and Proximity sensors		30
14	Transducer		30
15	Load cell	10KG, 100KG	30
16	Decade Resistance Box		30
18	Precision Potentiometers	1KΩ, 10K Ω, 100K Ω	30
19	Assorted Electronic Measuring Tool kit		05
20	Soldering set		30

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**IV**
Course Name	**Microcontroller & Applications**	**Type of Course**	**Integrated**
Course Code	**25EC43I**	**Contact Hours**	**7 hours/week**
Teaching Scheme	**L: T:P :: 03:0:4**	**Credits**	**6**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

A microcontroller is a small computer designed to control the functions of embedded systems in various fields like automotive, aerospace, robotics, mobile communication, household electronics, industrial automation, defense, space, and healthcare. Learning of microcontroller applications helps us to design innovate smart systems to meet the requirement of fast- growing electronics industry and modern technology.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Discuss the features of MCS-51variants and identify the suitable microcontroller for different applications.
CO-02	Study the 8051 instructions and develop programs for control applications using assembly language and embedded C.
CO-03	Make use of I/O ports for interfacing peripherals and utilize timers and counters for delay generation and event counting.
CO-04	Design and implement microcontroller-based solutions for simple and practical real-world applications.

3. Course Content.

WEEK	CO	PO	Theory	Practice
1	**1**	**1,2**	● Introduction to the concepts of Microprocessors, Microcontrollers and their comparisons. ● Embedded systems. Video demonstration on use of embedded systems in real-world. ● RISC and CISC, Von Neumann and Harvard Architectures.	1. List of different Microprocessor and Microcontroller ICs from various manufacturers. 2. Interpretation of data sheet of MCS 8051 controller. Identification and Selection of 8 bit, 16 bit, 32 bit, 64-bit microcontrollers for different application.
2	**1**	**1,2**	● Variants of MCS-51 family and their features. Applications of Microcontrollers. ● Introduction to	1. Identification of program development tools (Linker, Loader, Assembler and Interpreter).

			8051microcontroller, Architecture, Pin details of 8051 microcontrollers. ● PSW register, A & B registers	Familiarization of program development using Keil. 2. Familiarize with the structure of the 8051 assembly program and Execute simple program (using MOV instruction).
3	**1**	**1,2,3**	● Special function registers (PC, DPTR), Memory organization. ● General purpose RAM, bit addressable RAM, register banks and stack. ● Interfacing external data and code memory.	1. Write and execute an ALP using general-purpose registers. 2. Write and execute an ALP using special function registers. (ex. moving data from A to B, adding data and storing result).
4	**2**	**1,2,3**	● 8051 Addressing modes-Definition, Types of addressing modes with examples. ● Instruction set- classification. ● Date transfer instruction-syntax and functions with examples.	1. Write and execute an ALP to Move a block of data within internal RAM. 2. Write and execute an ALP to Exchange a block of data between internal RAM and external memory.
5	**2**	**1,2,3**	● Arithmetic instructions: Syntax and functions. ● Logical Instructions: Syntax and functions. ● Arithmetic instructions and Logical Instructions examples.	1. Write an ALP to evaluate simple arithmetic expression such as y= (((5*2)-(4+1))/3) %2. 2. Evaluate simple logical expression such as Y= (a&&b||c^! d) where a, b, c, d are 8-bit data.
6	**2**	**1,2,3**	● Bit level instructions. ● Program control instructions - jump instructions. ● Program control instructions - call instructions.	1. Write an ALP to Rotate or shift 16-bit data. 2. Write an ALP Toggle a LED connected to Pin 1 of Port 1.
7	**2**	**1,2,3**	● Interrupts programming. ● Polling and Interrupt methods, executing an interrupt, different types. ● IE and IP registers. Enabling, disabling, and priority setting.	1. Write ALPs to enable, disable and priority setting of interrupts and verify it in IE and IP registers. 2. Assume that INT1 pin is connected to a switch that is normally high. Whenever it goes low, it should ON an LED. Write an ALP to turn on turn ON the LED as long as the switch is pressed.

8	**2**	**1,2,3**	● Introduction to Embedded C and its applicability to 8051. ● General structure of embedded C program. ● Embedded C data types.	1. Write and execute an assembly and embedded C program to convert Packed BCD to unpacked BCD. 2. Write and execute an assembly and embedded C Program Unpacked BCD to packed BCD.
9	**2, 3**	**1,2,3**	● Memory types and models, pointers, pointer's memory type. ● Time-delay generation using loops, example program. ● Arithmetic and logical operators, example programs.	1. Write and execute an embedded C program to toggle a particular bit in the internal RAM with the use of delay subroutine. 2. Write and execute a program to search a given 8-bit number in an array of N numbers using embedded C.
10	**2, 3**	**1,2,3**	**I/O ports** ● Features of I/O ports, Byte size I/O, bit addressability and configuring I/O ports. ● Interfacing of I/O devices: LED, buzzer. ● Interfacing of I/O devices: Push button switch, relay.	1. Write and execute an embedded C program to toggle the LED/buzzer with tone using push-button switch. 2. Familiarization of downloading the program to Microcontroller kit. Deploy the above-developed program and verify its output through testing.
11	**2, 3, 4**	**1,2,3**	**Timers /Counters and Serial I/O** ● Bit structure and function of timer registers (Timer 0 and timer 1 registers), TMOD and TCON registers. ● Mode 1 & mode 2 operations of timers. ● Counters, time delay generation.	1. Write and execute an embedded C program to generate a square wave on P1.2 using timer 0 in mode 1 to generate delay and observe the square wave of the above program on CRO by downloading the program to the microcontroller kit. 2. Configure counter 0 as 8-bit counter taking inputs from port 3.4. Each time port 3.4 goes low, the 8-bit counter increments by 1. Display values of counter 0 on 7-segment/LCD display.
12	**2, 3, 4**	**1,2,3**	**Serial Communication** ● Bit structure and function of SCON register, SBUF register. ● TI and RI flags, Baud rate, working of serial port. ● Connecting 8051 to RS232, serial data transmission and reception.	1. Write an ALP to transfer letter "A" serially at 9600 baud rate, continuously. 2. Write an ALP to receive bytes of data serially and put them in P1. Set the baud rate at 9600, 8-bit data, 1 stop bit.
13	**2, 3, 4**	**1,2,3 ,7**	● Interfacing of 8051 to DC motor using C program. ● Interfacing of 8051 Stepper motor using C program.	1. Write and execute an embedded C program to control direction and speed of a stepper motor/ dc motor.

			Interfacing 8051 to ADC 0804, with C program. ● Need for higher-bit Microntrollers. Compare features of 8051 and LPC2148 ARM Microcontrollers.	2. Write and execute an embedded C program to control traffic Lights. **OR** Discuss DAC 0800 and interface 8051 to generate sine/ rectangular / triangular waveforms.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problems statement to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

1. "The 8051 Microcontroller and Embedded Systems" by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin McKinley.
2. "Microcontroller Theory and Applications: HC12 and S12" by Daniel J. Pack and Steven F. Barrett
3. "Programming and Customizing the 8051 Microcontroller" by Myke Predko.
4. "8051 Microcontroller: Hardware, Software, and Applications" by V. Udayashankara and M. S. Mallikarjunaswamy.
5. "Embedded Systems: Architecture, Programming, and Design" by Raj Kamal.
6. “The 8051 microcontroller” by Kenneth J. Ayala

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: - **Portfolio evaluation may include average of (a)and (b)**

a) Any one of the suggested activity model with report and presentation / simulation evaluated for 50 marks.
b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will

include the following components.

1. Written description of the experiment in the observation book.
2. Conducting the experiment and achieving the associated learning outcomes.
3. Result of the experiment.
4. Correction and evaluation of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics and Communication Engineering			Semester –IV	
Course Name	Microcontroller and Applications			Test	I
Course Code	25EC43I	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Given a microcontroller with a Harvard architecture, explain how its separate data and instruction buses would improve the system's performance in a data-intensive application.	L3	1	7
	b) Describe the block diagram of 8051 microcontroller	L2	1	10
	c) Compare microprocessor and microcontroller.	L2	1	8
2	a) Explain the function of the 8051 microcontroller in a simple device like a washing machine.	L3	1	7
	b) Illustrate PSW register with respect to 8051 microcontrollers.	L2	1	10
	c) Differentiate between RISC and CISC architectures.	L2	1	8
	Section – 2			
3	a) Discuss the RAM memory space allocation in 8051.	L2	1	10
	b) Explain the procedure to access a specific memory location in the 8051 using direct addressing mode.	L3	2	7
	c) Describe classification of 8051 instruction set.	L2	2	8

4	a) Outline the accessing of different register banks in the 8051. b) Write an ALP that uses the data transfer instruction to move data from one register to another. c) Illustrate immediate addressing mode with an example.	L2 L3 L2	1 2 2	10 7 8

Note for the Course coordinator:
1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator Signature of the HOD Signature of the IQAC Chairman

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	**IV**
Course Name	**Microcontroller and Applications**			**Test**	**II/IV**
Course Code	**25EC43I**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
Provide two programs for students to write and execute any one of them.	**2**	
Scheme of assessment **a) Writing of two Programs** **b) Executing any one Programs** **c) Result in IDE/downloading** **d) Viva**		 **20** **10** **10** **10**
	Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. Suggestive Activities:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to five students.

Sl.No.	Suggestive Activities
01	Moving message display on LCD using microcontroller
02	Water level indicator using microcontroller
03	Automatic lamp controller using 8051

04	Automatic bell for college
05	Visitor counter
06	Digital alarm

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Student Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
	Average Marks=(40+50+40+30)/4=40						**40**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. **SEE- Model Practice Question Paper**

Program	**Electronics and Communication Engineering**		**Semester**	**IV**
Course Name	**Microcontroller and Applications**	**Course Code: 25EC43I**	**Duration**	**180 min**
Questions			**CO**	**Marks**
				50
Scheme of assessment **1. a) Writing one ALP/Embedded C program** **b) Executing ALP/Embedded C program** **c) Result** **2. a) Writing the interfacing program** **b) Interfacing with microcontroller** **c) Result** **3. Viva-voce**				**10** **05** **05** **10** **05** **05** **10**
			Total Marks	**50**

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
01	Computers	i3/i5/i10 processor , 8 GB RAM, 1TB HD/512GB SSD	30
02	Micro vision Keil software	-	For 30 systems
03	Microcontroller Kits with interfacing modules	-	30

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and communication**	**Semester**	**IV**
Course Name	**Verilog Programming for Digital Circuits**	**Type of Course**	Integrated
Course Code	25EC44I	**Contact Hours**	7 hours/week
Teaching Scheme	L: T:P :: 3:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

Verilog HDL is essential for understanding and implementing modern digital systems. It equips learners with the skills to design, simulate, and synthesize combinational and sequential circuits. Practical experience with Xilinx software and FPGA/CPLD kits bridges the gap between theoretical concepts and real-world applications. Advanced topics like loops, conditional statements, tasks, and functions enhance design efficiency, while an introduction to VLSI and FPGA architecture prepares individuals for careers in electronics, embedded systems, and VLSI design.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-1	Interpret the basics of Verilog HDL and digital concepts.
C0-2	List the types of Verilog Modelling and the use of each model for Specific application.
CO-3	Construct, simulate, and synthesize Combinational Circuits using FPGA to obtain the desired output.
CO-4	Construct, simulate, and synthesize Sequential Circuits using FPGA to test for the desired result.

3. Course Content

WEEK	**CO**	**PO**	**Theory**	**Practice**
1	1	1,4,5,6,7	1. VLSI - Introduction, Importance & need. Introduction of HDL and Types of HDL. 2. Introduction to Verilog HDL and Why Verilog HDL. Real applications of Verilog, Typical HDL based design flow. 3. Structure of Verilog HDL.	1. Familiarization of Xilinx Software 2. Familiarization of FPGA/CPLD Kits

2	1,2	1,2,3,4	1. Design Methodologies - Top down and bottom up design methodology with examples. 2. Types of modeling- Dataflow modeling, Behavioral modeling, Gate level modeling. 3. Switch level modeling and Structural level modeling.	1. Demonstrate and Practice the Half adder digital circuit using Dataflow, Behavioral modeling. 2. Demonstrate and Practice the Half adder digital circuit using Gate level modelling.
3	1,2	1,2,4	1. Basic Concepts of Lexical tokens- White space, Comments, Keywords, Identifiers, Strings, and Numbers. 2. Data types of Verilog- Value Set/Net, Wires, Registers, Vectors, Integers and Real Time, Parameters, Arrays, Strings. 3. Operators- Arithmetic, Logical, Relational, Bitwise.	1. Write the Verilog code, Simulate and download to FPGA/CPLD Kit for any simple basic Arithmetic expressions. 2. Write the Verilog code, Simulate and download to FPGA/CPLD Kit for any basic Logical expressions.
4	1,2	1,2,4	1. Reduction, Shift, Concatenation, Replication. 2. Conditional Operators, Operator Precedence. 3. Program structure of Verilog- Module Declaration, Port Declaration, Port Connection.	1.Write the Verilog code, Simulate and download to FPGA/CPLD Kit: Simple program using Reduction, Shift, Concatenation Operators. 2.Write the Verilog code, Simulate and download to FPGA/CPLD Kit: Simple program using replication, Conditional Operators.
5	2,3	1,2,3,4,6	1. Instantiation of gates, symbols and truth tables. 2. Gate level (Structural) modeling for Basic gates, Half adder, Half Subtractor. 3. Gate level Verilog description for Full adder and Full Subtractor.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following 1. Two input Basic gates using Gate level modeling. 2. Full adder using Structural level modeling.
6	2,3	1,2,3,4,6	1. Data flow modeling- Continuous assignment, Module Instantiations. 2. Net declaration, delays, expressions. 3. Data flow Verilog description for 4:1 MUX, 1:4 DEMUX.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following: 1. 2:1 MUX using Data flow modeling. 2. 1:2 DEMUX using Data flow modeling.
7	2,3	1,2,3,4,6	1. Behavioral Modeling- Always and Initial blocks. 2. Procedural Assignments - Blocking and Non-Blocking Assignments with simple examples. 3. Delay based Timing controls	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following: 1. 4:1 MUX using Behavioral modeling. 2. 1:4 DEMUX using Behavioral modeling.

8	2,3	2,3,4,6	1. Describe Conditional Statements if, if-else, Case statements with simple examples. 2. Describe Looping statements- "while" and "for" loop with simple examples. 3. Repeat a block of code forever using loops. "begin" and "end" keywords with simple examples.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following 1. 2-bit Comparator using Behavioral modeling (Using if-else). 2. 2-bit ALU with 3 arithmetic and 3 logical operations using conditional statements.
9	2,3	1,2,3,4,6	**Behavioral Verilog description examples for Conditional statements** 1. BCD to Seven Segment Decoder for Common Cathode display using **if-else**. 2. BCD to Seven Segment Decoder for Common Anode display using **case** statement. 3. Verilog Code description for n-bit Parallel adder using Behavioral modeling.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following 1. BCD to Seven Segment Decoder using case statement. 2. 3-bit Parallel Adder using looping statements.
10	2,3	1,2,3,4	1. Test bench- Need, Importance and test bench examples. 2. To implement switch level modeling for inverter. 3. To implement switch level modeling for AND, OR gates.	1. Write the Verilog code, Simulate test bench for Half adder and 2:1 Multiplexer. 2. Write Verilog code and Simulate inverter using switch level modeling.
11	2,4	1,2,3,4,6,7	**Verilog Description for Sequential Circuits** 1. SR flip-flop- Gate level circuits using NAND gates, truth table, working, timing diagram. 2. JK flip-flop, Master slave JK flip-flop- Logic circuit, truth table, working, timing diagram. 3. D, T flip-flops- Logic circuits, truth table, working, timing diagram.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following 1. SR flip-flop using data flow modeling. 2. JK flip-flop using behavioral modeling.
12	2,4	1,3,4,7	**Verilog System Tasks and Functions** 1. Task declaration and Task invocation with examples 2. Function declaration and Function invocation with examples. 3. Compare Tasks and Functions.	Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following: 1. D flip flop using behavioral modeling. 2. T flip flop using Function.
13		1,2	1. Video demonstration on Internal Structure of an FPGA and CPLD.	1. Write the Verilog code, Simulate and download to FPGA/CPLD Kit for the following:

	2,3	,3, 4,5 ,7	2. Comparison between FPGA and CPLDs. 3. Selection criteria between CPLD and FPGA while designing any application.	Simple Calculator to perform addition, subtraction, multiplication and division.

Note:

1. In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.

2. Online course completion certification to be done on relevant topics on Swayam/NPTEL/Infosys Springboard platforms or any other platform.

3. Problems statement to be collected from the relevant industries, resolve and submit it to the course coordinator.

4. References:

1 . Verilog HDL- Sameer Palnitkar.

2 . Nazeih M Botros, ―HDL Programming, VHDL and Verilog, Dreamtech Press, 2007.

3 . FPGA Design, Architecture and Applications **URL:https://www.logic-fruit.com/blog/fpga/fpga-design- architecture-and-applications/**

4 . Design through Verilog HDL –T R Padmanabhan & B Bala Tripura Sundari, Wiley India Pvt. Ltd.

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

(a) Any one suggested activity with report /presentation and simulation evaluated for 50 Marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:
   (i) Written description of the experiment in the observation book.
   (ii) Conducting the experiment and the associated learning outcomes.
   (iii) The results obtained from the experiment.
   (iv) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics and communication			Semester -IV	
Course Name	Verilog Programming for Digital Circuits			Test	I/III
Course Code	25EC44I	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Discuss the types of Hardware Description Languages (HDLs)? Briefly explain any one type of HDL. b) Outline flowchart to develop the HDL-based design flow. c) Describe the types of modeling in Verilog.	L2 L3 L2	1 1,2 2	8 7 10
2	a) Describe the basic structure of a Verilog HDL program. b) Write a Verilog code for a half-adder using Dataflow modeling. c) Compare Dataflow, Behavioral, and Gate-level modeling.	L2 L3 L2	1 1,2 2	8 7 10
	Section - 2			
3	a) Describe different data types in Verilog. b) Develop a Verilog program to compare two 4-bit numbers using relational operators. c) Develop a Verilog program to shift a 4-bit binary number to the left and right using shift operators.	L2 L3 L3	1,2 1,2 1,2	8 8 9
4	a) Compare arithmetic and relational operators in Verilog. b) Create a module in Verilog to add two 8-bit numbers using appropriate data types. c) Develop a Verilog module for a 2-input XOR gate, demonstrating proper module declaration and port connections.	L2 L3 L3	1,2 1,2 1,2	8 8 9

Note for the Course coordinator:
1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator	Signature of the HOD	Signature of the IQAC Chairman

8. CIE Practice Test model question paper

Program	**Electronics and communication**			**Semester**	IV
Course Name	**Verilog Programming for Digital Circuits**			**Test**	**II/ IV**
Course Code	25EC44I	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Provide two Verilog programs for students to write and execute any one of them.					**50**
Scheme of assessment **a) Writing two programs** **b) Simulation of any one program and its result** **c) Downloading to FPGA kit and its result** **e) Viva-voce**					 **20** **10** **10** **10**
Total Marks					**50**

Signature of the Course Coordinator	Signature of the HOD	Signature of the IQAC Chairman

9. **Suggestive Activities for Tutorials**:

The List is an Example and not inclusive of all possible activities of the course.
Student and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to five students.

Sl.No.	Suggestive Activities for Tutorials
01	Design a simple digital clock or counter using Verilog, implementing HDL basics.
02	Develop a simple voting system that uses Verilog operators to determine the majority vote.
03	Design a traffic light controller using Behavioral modeling with timing controls.
04	Design a simple stopwatch using a 7-segment display, where the time is displayed in minutes and seconds, and a start/stop button controls the timing.
05	Create a digital alarm system that triggers an alarm when a certain condition (like a threshold input) is met.
06	Create a digital pattern generator that outputs a predefined pattern on LEDs, such as alternating patterns, for a given clock signal.

10 Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11 SEE- Model Practice Question Paper

Program	**Electronics and communication**		**Semester**	IV
Course Name	Verilog Programming for Digital Circuits	Course Code: 25EC44I	Duration	180 min
Questions			CO	Marks
Provide two Verilog programs for students to write and execute any one of them.				**50**
Scheme of assessment **a) Writing two programs** **b) Simulation of any one program and its result** **c) Downloading to FPGA kit and its result** **e) Viva-voce**				 **20** **10** **10** **10**
			Total Marks	**50**

Signature of the Examiner **Signature of the Examiner**

12.Equipment/Software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Xilinx ISE 14.7 (Integrated Software Environment)	-	
02	FPGA KITS	-	30
03	COMPUTERS	Dual core/i3/i5/i7/i10 processor, 8 GB RAM ,1TB hard disk/SSD	30

Government of Karnataka

DEPARTMENT OFTECHNICAL EDUCATION

Curriculum Structure

V Semester Scheme of Studies- Electronics & Communication Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	EC	SP-1	Specialization Pathway-I	4	0	4	8	6	50	20	50	20	-	-	100
2	EC	SP-2	Specialization Pathway-II	3	0	4	7	5	50	20	-	-	50	20	100
3	EC	SP-3	Specialization Pathway-III	3	0	4	7	5	50	20	-	-	50	20	100
4	EC	25EC54I	Project Management and Entrepreneurship	4	0	4	8	6	50	20	50	20	-	-	100
Total				**14**	**0**	**16**	**30**	**22**	**200**		**100**	**-**	**100**	**-**	**400**

SP	Course code	Course Name	SP	Course code	Course Name	SP	Course code	Course Name
SP-1	25EC51IA	Industrial Automation	**SP-2**	25EC52IA	Sensors & Actuators	**SP-3**	25EC53IA	Automation & Robotics
	25EC51IB	Networking Systems		25EC52IB	Industrial Internet of things [IIoT]		25EC53IB	Agritech
	25EC51IC	Embedded Technology		25EC52IC	Integrated Communication Technologies		25EC53IC	Electric vehicles & Drone Technologies

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Curriculum Structure

VI Semester Scheme of Studies- Electronics & Communication Engineering

Sl. No.	Department	Course Code	Course Name	Hours per week	No of Weeks	Credits	CIE Marks		Practice SEE Marks		Total Marks
							Max	Min	Max	Min	
1	EC	25EC61I	Internship/Capstone Project	40	13	13	50	20	50	20	100
Total				**40**	**13**	**13**	**50**	**20**	**50**	**20**	**100**

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication Engg**	**Semester**	**V**
Course Name	**Industrial Automation**	**Type of Course**	**Integrated**
Course Code	**25EC51IA**	**Contact Hours**	**8 hours/week 104 hours/semester**
Teaching Scheme	**L:T:P :: 4:0:4**	**Credits**	**6**
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

Automation in the industrial workplace provides the advantages of improving productivity and quality while reducing errors and waste, increasing safety and adding flexibility to the manufacturing process. Industrial automation results in increased productivity, more efficient use of materials, increased safety, reliability, better product quality, shorter workweeks for labour, profitability and reduced factory lead times. Worker safety is an important reason for automating an industrial operation. A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. SCADA is a centralized system that monitors and controls field devices at remote sites.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Outline the significance of Industrial Automation and its types with suitable application.
CO-02	Explain the internal and external structure of PLC and use its programming functions and techniques to control Industrial processes.
CO-03	Troubleshoot PLC to get the desired output and explain network protocols used with PLC.
CO-04	Explain the concept of SCADA, DCS and HMI and list their various applications in industry.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,2	1. Introduction to Automation 2. Role & benefits of Automation in Industry. 3. Challenges faced by the manufacturing industry in Manual Process. 4. Present an Overview of Industry 4.0, 5.0 & 6.0 and Challenges in their implementation in India.	1. Visit a bricks manual production Enterprise/ a paper plate production Enterprise/ any local manual production Enterprise and Submit a report on the manual production adopted and the effectiveness of the company if automation process is used in the Enterprise visited.

2	1,2	1,2,3	1. Importance of industrial automation in the Indian manufacturing industry. 2. Types of automation in the industry: Permanent / Fixed automation, Programmable/ Flexible automation. 3. PLC - Introduction, compare Relay logic control and PLC logic control. 4. PLC Advantages and Disadvantages.	1. Video documentary of any production industry. 2. Demonstrate the types of automation with any suitable production industry.
3	2,3	1,2,3	1. Block diagram of PLC based industrial automation system, PLC scanning. 2. Internal architecture of PLC, memory organization of PLC. 3. PLC input devices – mechanical switches, proximity sensors, photoelectric sensors, temperature sensors, liquid level detectors. 4. PLC output devices – Relay, directional control valve, solenoid valve.	1. Familiarization of software for PLC simulation (Keyence/ Picosoft/ WPLSoft-Delta). 2. Study the features, Architecture and Pin details of PLC available in your lab.
4	2,3	1,2,3,4	1. Programming standards, Ladder diagram. 2. PLC Ladder Programming. Ladder diagram for logic gates. 3. PLC input instructions and outputs - coils, indicators. 4. Conversion of Boolean functions from word description to ladder diagram and vice-versa.	1. Write ladder diagrams and verify the truth table of all logic gates. 2. Convert the following Boolean functions from word description to ladder diagram and vice-versa (i) We have three pushbuttons. If A, B and C are pressed, the Red LED goes ON. If A and B are pressed, the Green LED goes ON. It means that only one LED is ON at a time. (ii) We have four push buttons. When A, B and C are pressed, output goes ON. OR When C and D are pressed, the same output goes ON.
5	2,3	1,2,3,4	1. PLC register basics – General characteristics of Registers, Module Addressing, Holding Registers. 2. Input Registers, Output Registers. 3. PLC arithmetic functions - addition,	1. Write a ladder diagram for DOL starter and test the output using PLC trainer kit module. 2. Write the ladder diagram and execute the Staircase light controller application using PLC

			subtraction, multiplication & division. 4. PLC Basic comparison functions and its applications	trainer kit module.
6	2,3	1,2,3,4	1. PLC Timer functions: On-Delay timers, Off-Delay timers, Pulse timers, Retentive timers, 2. Examples of Timer Function Industrial Applications (i) **On Delay** - Output B Comes on at a specific set time after output A is turned on. When A is turned off, B also goes off. (ii) **Off Delay** - Both A and B have been turned on at the same time. Both are in operation. When A is turned off, B remains on for a specific set time period before going off. (iii) **Repeat Cycling** - An output pulses on and quickly off at a constant preset time interval.	1. Write a ladder diagram, timing diagram and simulate a circuit for the following process control application. (i) There are 3 mixing devices on a processing line A, B and C. After the process begins mixer-A is to start after 7 seconds elapse, next mixer-B is to start 3.6 seconds after A. Mixer- C is to start 5 seconds after B. All of them remain ON until a master enable switch is turned OFF. (ii) For a grinding operation on a metal part, the coolant flow on the part must be on for an interval before the grinding process starts. When the process circuit is turned on, the coolant motor (CM) is turned ON. Eight seconds later the grinding process (GM) starts.
7	2,3	1,2,3,4	1. PLC Counter functions - Down-counter, Up-counter, and Up-down counter. 2. Examples of Counter Function Industrial Applications. (i) Straight counting in a process - The counter output goes on after the set count is received by repetitive pulses to the counter input. (ii) Two counters used with a common register to give the sum of two counts. (iii) A process where a count of events is to start after a fixed time interval.	1. Write a ladder diagram and simulate a circuit for a process control application in which a paint spray has to run for 40 seconds when the count reaches the value of 25. 2. Write a ladder diagram and demonstrate a basic counter function to count the number of products passing on a conveyor belt.
8	3	1,2,3,4	**PLC Installation Practices, Editing and Troubleshooting** 1. PLC Enclosures, Electrical Noise 2. Leaky Inputs and Outputs, Grounding. 3. Voltage Variations and Surges, Program Editing and Commissioning.	Simulate and test the following task using PLC 1. A signal lamp is required to be switched ON if a pump is running and the pressure is satisfactory, or if the lamp test switch is closed, otherwise the signal lamp should

			4. Programming and Monitoring.	remain OFF. 2. Consider a system where there has to be no output when any one of four sensors gives an output, otherwise there is to be an output.
9	3	1,2,3,4	**PLC Installation Practices, Editing and Troubleshooting** 1. Preventive Maintenance 2. Troubleshoot the Processor Module, and Input Malfunctions of a PLC 3. Troubleshoot the Output Malfunctions of a PLC. 4. PLC Programming Software	1. Write the ladder diagram and execute the Water level controller application using PLC trainer kit module 2. Write the ladder diagram and execute the Lift control application using PLC trainer kit module.
10	3	1,2,3,4	**Network in Automation** 1. Introduction to LANs, Introduction to Serial Interfaces, Common Industrial Buses 2. Industrial automation protocols - Explain the importance of using the following protocols and Demonstrate. ➢ EtherNet/IP ➢ Profibus ➢ Modbus ➢ ProfiNet ➢ DeviceNet	1. Perform networking experiment to provide wired and wireless (IP address and configuration) LAN connection 2. Perform crimping practice of CAT5 cables - Straight-Through and Crossover crimping
11	4	1,2,3,4	1. SCADA - Introduction, background, definition, features, typical SCADA system. 2. SCADA architecture, SCADA hardware & software. 3. SCADA protocols, interfacing PLC with SCADA. 4. Applications of SCADA.	1. Write the ladder diagram and execute the Conveyor control application using PLC trainer kit module. 2. Video demonstration and documentation of the SCADA systems.
12	4	1,2,3,4	1. Distributed Control System (DCS) - Introduction, features. 2. DCS Hierarchical architecture and advantages. 3. DCS application in chemical plants/ cement plants/ paper and pulp industries. 4. Introduction to HMI/MMI.	1. Video demonstration and documentation of DCS application in any plant. 2. Visit any nearby SCADA/ DCS based Industry.

13	1,2,3	1,2,3,4	1. Latest trends in PLC 2. IoT enabled PLC 3. Case study on PLC Applications in Industrial IoT.	1. Video demonstration and documentation of the IoT enabled PLC.

Note:

- **In practice sessions all video demonstrations should be followed by MCQ/Quiz/ Subjective questions and evaluation has to be documented.**
- **Problems statement to be collected from the relevant industries, resolve and submit it to the course coordinator.**

4. References:

1. "Programmable Logic Controllers Principles and Applications" by John W. Webb – Ronald A. Reis. 5th Edition, Published by PHI Publication.
2. "Introduction to PLC's" by Gary Dunning, 3rd Edition, Thomson India Edition
3. "Programmable Logic Controllers" by W. Bolton, 5th edition.
4. Programmable Logic Controllers by Frank D Petruzella, 5th Edition, McGraw Hill Publications.
5. SCADA-Supervisory Control and Data Acquisition System - Stuart A. Boyer, ISA publication (3rd Edition).
6. Practical SCADA for Industry- David Bailey, Edwin Wright, Newnes, (an imprint of Elsevier), 2003.
7. Distributed Computer Control for Industrial Automation- DobrivojePopovic and Vijay Bhatkar, Marcel Dekker Inc.,1990
8. Practical Distributed Control System for Engineers and Technicians- IDC Technologies.

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note:- Portfolio evaluation includes average of (a) and (b)

(a) Any one of the Suggested activity model with report and presentation evaluated for 50 marks

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1. Written description of the experiment in the observation book.
2. Conducting the experiment and the associated learning outcomes.
3. The results obtained from the experiment.
4. Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE - Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper

Program	Electronics & Communication Engg			Semester - V	
Course Name	Industrial Automation			Test	I/III
Course Code	25EC51IA	Duration	90 min	Marks	50

Name of the Course Coordinator:

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Identify and explain the various PLC Input devices b) Write the ladder diagram, truth table for AND, NAND, OR & NOR logic gates and explain c) Explain the importance of automation in automobile industries.	L3 L3 L2	CO 1	5 10 10
2	a) Summarize the overview of Industry 4.0, 5.0 & 6.0 b) Differentiate between the Permanent and Programmable automation system in industry. c) How does Industry 4.0 technologies help to increase productivity of manufacturing sector? Illustrate with an example.	L2 L3 L3	CO 1	5 10 10
	Section - 2			
3	a) Discuss Process Scanning of PLC. b) Sketch and explain the internal architecture of PLC. c) Explain the significance of the Ladder diagram in PLC programming.	L2 L3 L2	CO 2	5 10 10
4	a) Differentiate between Relay logic control & PLC based logic control. b) Explain PLC arithmetic functions with example c) Explain PLC Timer functions with example	L3 L2 L2	CO 2	5 10 10

Note for the Course coordinator:

1. Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.
2. All questions must be framed under Understand (L2) & Apply (L3) cognitive level using Revised Bloom's Taxonomy.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	Electronics & Communication Engg			Semester	V
Course Name	Industrial Automation			Test	II/IV
Course Code	25EC51IA	Duration	180 min	Marks	50
Name of the Course Coordinator:					

Questions	CO	Marks
Write-up for two experiments and conduction of any one experiment.	CO 2, CO 3	50
Scheme of assessment **a)** Writing the ladder diagram, ladder program with procedure for two experiments. **b)** Conduction/ Simulation of any one **c)** Interfacing to PLC kit **d)** Result/Output **e)** Viva-voce		**20** **10** **05** **05** **10**
Total Marks		**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities:

The List is an example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic.

Note: Activity can be undertaken by either an individual or a team comprising up to 5 students.

Sl.No.	Suggestive Activities
01	Traffic Light Control System - Simulate and control traffic lights using a PLC.
02	Conveyor Belt Automation - Automate a conveyor belt system for material handling.
03	Temperature Control System - Control and monitor temperature using PLC.
04	Parking Lot Management System - Use PLC to manage parking lot access and availability.
05	Home Automation System - Implement PLC for controlling lights, fans and security.
06	Automatic Street Lighting System - Implement PLC to control street lights based on real-time conditions.
07	Automatic Door Open and Closing System - Implement PLC to control Door based on human presence.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	30
02	PLC kit with suitable software	12/24V DC 6 Digital Inputs, 4 Digital Outputs, Ethernet card, standard micro SD card, integrated web server	15
03	PLC interfacing kits for Lift control, water level Control, DOL Starter, Staircase light controller, Conveyor control.	-	5 each
04	Patch cards (different lengths)		200

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**V**
Course Name	**Networking Systems**	**Type of Course**	Integrated
Course Code	**25EC51IB**	**Contact Hours**	8 hours/week 104 hours/ semester
Teaching Scheme	L:T:P :: 4:0:4	**Credits**	6
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

Networking systems are a critical component of modern technology, forming the backbone of communication, data transfer, and connectivity in industries such as IT, telecommunications, IoT, and industrial automation. Understanding networking concepts is essential for designing, implementing, and maintaining connected systems like smart devices, embedded systems, and industrial networks. Networking knowledge enables proficiency in emerging technologies like 5G, cloud computing, and IoT, while providing hands-on skills in configuring, troubleshooting, and optimizing networks. **These subject bridges** the gap between theoretical knowledge and real-world applications, ensuring readiness for industry demands and advanced certifications in networking and related fields.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Explain the key concepts of data communication, network components, transmission modes, guided and unguided media, network types, topologies, and architectures.
CO-02	Interpret data transmission methods, the OSI and TCP/IP models, functions of the data link layer, error control techniques, and methods for error detection and correction.
CO-03	Analyze Media Access Control (MAC) methods, IPv4 and IPv6 addressing schemes within the network layer.
CO-04	Apply the concepts of subnetting, IP address classes, routing algorithms, ARP and RARP protocols, and transport layer functionalities to simulate network scenarios using Cisco Packet Tracer.
CO-05	Demonstrate the implementation of various protocols and network configurations using simulation software.

3. Course Content:

WEEK	CO	PO	Theory	Practice
1	**1**	**1**	1. Introduction to data communication. 2. Components of communication systems (sender, receiver, medium, message, protocol). 3. Analog vs. Digital data.	1. Introduction to networking tools and hardware. 2. Basic commands: ping, tracert, ipconfig/ifconfig.

			4. Transmission modes: Simplex, Half-Duplex, Full-Duplex.	
2	**1**	**1**	1. Guided media: Twisted pair, Coaxial cable, Optical fiber. 2. Unguided media: Radio waves, Microwaves, Infrared. 3. Characteristics and applications of different media. 4. Definition: ROUTER, HUB, SWITCH, BRIDGE, GATEWAY.	1. Construction and testing of Ethernet cables (straight-through, crossover). 2. Use of cable testers to verify cable integrity. 3. Setting up and testing a network with different media types.
3	**1**	**1,3,4,7**	1. Definition and benefits of networking. Types of networks: LAN, WAN, MAN, PAN. 2. Types of networks: WLAN and VLAN. 3. Network topologies: Star, Bus, Ring, Mesh, Hybrid. 4. Introduction to network architecture (Client-Server, Peer-to-Peer).	1. Create physical layouts for each topology using network cables. 2. Testing and comparing network performance for each topology.
4	**2**	**1,3,4,7**	1. Different methods of transmitting data over a network. 2. Packet Switching. 3. Circuit Switching. 4. Define ping (Packet Internet Groper). Explain ICMP and echo-request/reply mechanism.	1. Simulate packet switching using software tools (like Cisco Packet Tracer). 2. Simulate circuit switching using software tools (like Cisco Packet Tracer).
5	**2**	**1,3,4,7**	1. OSI model: Functions of each of the 7 layers. 2. TCP/IP model. 3. Comparison between OSI and TCP/IP models. 4. Definition of TLS and explanation for TLS as a cryptographic protocol for secure communication.	1. OSI and TCP/IP model exploration using a packet capture tool e.g., Wireshark. 2. Assigning IP addresses and configuring a basic subnet using Cisco Packet Tracer.
6	**2**	**1,2, 3,4,7**	1. Functions of the Data Link Layer. 2. Framing, flow control, and error control. 3. Error detection and correction methods (CRC, Parity bit, Hamming Code).	1. Simulate framing using Cisco Packet Tracer. 2. Simulate flow control using Cisco Packet Tracer. 3. Simulate Error control using Cisco Packet Tracer
7			**MEDIA ACCESS CONTROL (MAC)** 1. Types of MAC Methods: **I. Random Access Methods:**	1. Understanding Media Access Control (MAC) and MAC Address Table in Switches using Cisco Packet

	3	**1,2, 4,7**	**1) Carrier Sense Multiple Access (CSMA)**: a) CSMA/CD (Carrier Sense Multiple Access with Collision Detection) b) CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance)	Tracer. 2. Simulate CSMA/CD in an Ethernet Network using Cisco Packet Tracer**.**
8	**3**	**1,2, 4,7**	**2) ALOHA** a) Pure ALOHA b) Slotted ALOHA **II. Controlled Access Methods** 1) POLLING 2) Token Passing	1. Simulate experiment on the ALOHA protocol using Cisco Packet Tracer. 2. Simulate Token Passing Protocol in a Network using Cisco Packet Tracer.
9	**3**	**1,2, 4,7**	**III. Channelization Methods** 1) Frequency Division Multiple Access (FDMA) 2) Time Division Multiple Access (TDMA) **NETWORK LAYER:** IP addressing: 1. IPv4 addressing scheme. 2. IPv6 addressing scheme.	1. Simulate Frequency Division Multiple Access (FDMA) using Cisco Packet Tracer. 2. Simulate Time Division Multiple Access (TDMA) using Cisco Packet Tracer.
10	**4**	**1,2, 3,4,7**	1. Subnetting and IP address classes. 2. Routing algorithms (Distance Vector, Link State). 3. Introduction to Address Resolution Protocol (ARP) protocol. 4. Introduction to Reverse Address Resolution Protocol (RARP) protocol.	1. Simulate IPv4 and IPv6 Addressing Schemes using Cisco Packet Tracer. 2. Simulate Distance Vector Routing using Cisco Packet Tracer. 3. Simulate Link State Routing using Cisco Packet Tracer
11	**4**	**1,2, 3,4,7**	1. Functions of the Transport Layer. 2. TCP vs UDP: Features and applications. 3. Port numbers and socket number basics. 4. Flow control and congestion control in TCP.	1. Simulate Flow Control TCP using Cisco Packet Tracer. 2. Simulate Congestion Control in TCP using Cisco Packet Tracer**.**
12	**5**	**1,2, 3,4,7**	**Application Layer:** 1. Application layer protocols: HTTP, FTP, SMTP, DNS, DHCP. 2. Introduction to nslookup: DNS troubleshooting. 3. Overview of client-server and peer-to-peer models. 4. Introduction to email protocols: POP3, IMAP.	1. Simulate FTP (File Transfer Protocol) using Cisco Packet Tracer. 2. Simulate POP3 (Post Office Protocol version 3) using Cisco Packet Tracer.

13	**5**	**1,2, 3,4,7**	**Network Security Basics** 1. Introduction to network security concepts. 2. Define proxies and their types (forward, reverse, transparent). 3. Introduction to ATM networks and BLOCKCHAIN. 4. Firewalls, Virtual Private Networks (VPNs).	1. Simulate Virtual Private Networks (VPNs**)** using Cisco Packet Tracer.

4. References:

- 1.Data Communications and Networks- 2nd edition -Achyut S Godbole- and Atul Kahate Tata McGraw-Hill
- 2. Data Communications & Networking– 5th Edition- B A Forouzan- Tata McGraw-Hill.
- Computer Networks- 4th Edition- Andrew S Tanenbaum- Pearson-Prentice Hall
- Computer Networking- James F. Kurose & Keith W. Ross- PEARSON
- Computer Communications and Networking Technologies- Michael A. Gallo & William M. Hancock- BROOKS & COLE.
- Computer Networks and Internets-Douglas E. Comer- PEARSON.
- Data and Computer Communications- Eighth Edition- William Stallings- Pearson Education.
- "Network+ Guide to Managing and Troubleshooting Networks" by Mike Meyers – Hands-on guide for managing and troubleshooting networks (great for certification).

5. CIE Assessment Methodologies

Sl.No	**CIE Assessment**	**Test Week**	**Duration (minutes)**	**Max marks**	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

6. SEE - Theory Assessment Methodologies

Sl. No	**SEE – Theory Assessment**	**Duration**	**Exam Paper Max marks**	**Exam Paper Max Marks scale down to (Conversion)**	**Min marks to pass**
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper:

Program	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester - V	
Course Name	Networking Systems			Test	I/III
Course Code	25EC51IB	Duration	90 min	Marks	50

Name of the Course Coordinator:

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Compare Simplex, Half-Duplex, and Full-Duplex transmission modes with suitable examples. b) Describe the structure and explain the working of the ring topology.c) Describe the differences between LAN, WAN, MAN, and PAN in terms of geographical coverage and typical use cases.	L2	1	8 10 7
2	a) Illustrate the structure and applications of coaxial cables. b) Illustrate the client-server architecture. c) Summarize the advantages and limitations of radio waves, microwaves, and infrared as unguided media.	L2	1	8 10 7
	Section - 2			
3	a) Make use of an example and explain the concept of circuit switching. b) Explain the layers of the TCP/IP model with their functions. c) In which layer of the TCP/IP model would you find the HTTP protocol, and why is this layer important for web communication?	L3	2	10 10 5
4	a) Compare the OSI and TCP/IP models. b) Identify and describe the functions of Data Link Layer to ensure error-free data transfer. c) How would TLS be used to secure a connection between a web browser and a server when transferring sensitive data?	L3	2	10 10 5

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks,cognitive level and course outcomes.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	ELECTRONICS AND COMMUNICATION ENGINEERING			Semester	
Course Name	Networking Systems			Test	II/IV
Course Code	25EC51IB	Duration	180 min	Marks	50
Name of the Course Coordinator:					

Questions	CO	Marks
Writing for two experiments and conduction of any one experiment.		50
Scheme of assessment A. Writing procedure for two experiments. B. Conduction of one experiment. C. Result D. Viva Voce		 20 10 10 10
Total Marks		50

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic.

Sl.No.	Suggestive activities
01	Construct and test Ethernet cables (straight-through, crossover) and use cable testers to verify cable integrity.
02	Set up and simulate a Virtual Private Network (VPN) and configure basic firewall rules using Cisco Packet Tracer.
03	Set up FTP and DNS servers and simulate file transfers and DNS lookups in Cisco Packet Tracer.
04	Simulate distance vector or link-state routing algorithms and configure routing tables.
05	Simulate data transmission with error detection and correction methods like CRC, Hamming Code, or Parity Bits using Cisco Packet Tracer.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40

2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
01	Computers	i5/i7/i10 processor, 8/16 GB RAM ,512 GB SSD, Integrated graphics card.	30
02	Cisco packet tracer software		
03	Wireshark software		

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and communication Engg.**	**Semester**	**V**
Course Name	**Embedded Technology**	**Type of Course**	**Integrated**
Course Code	**25EC51IC**	**Contact Hours**	**104 Hours/sem**
Teaching Scheme	**L: T:P :: 4:0:4**	**Credits**	**06**
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

This framework offers a comprehensive approach to understanding embedded systems and ARM controllers by combining foundational concepts, practical applications, and emerging technologies. It begins with an introduction to embedded systems, their classifications, and applications across various domains, followed by a detailed exploration of ARM architecture, instruction sets, and programming in both C and assembly.

Hands-on exercises, such as interfacing sensors, actuators, and motors, reinforce theoretical knowledge through practical implementation, while real-world applications like traffic light systems and cloud-based sensor data transfer ensure relevance to industry needs.

The focus on emerging trends, including AI, IoT, and edge computing, along with activities like hardware familiarization, simulation-based tasks, and report preparation, provides a holistic understanding of embedded system design and functionality.

2. Course Outcomes: At the end of the course, the student will be able to:

CO-01	Analyze the typical components of an embedded system focusing on communication interfaces.
CO-02	Summarize the architectural features of ARM controllers and their applications.
CO-03	Examine the ARM controller instruction set and develop programs in assembly and C to solve simple real-world problems.
CO-04	Evaluate exceptions and interrupt handling mechanisms and discuss emerging trends in embedded systems.

3. Course content:

WEEK	CO	PO	Theory	Practice
1	1	1,7	**Introduction to Embedded Systems** 1. Definition and characteristics. 2. Classification of embedded systems. 3. Applications of Embedded Systems in various fields, Differences between embedded and general-purpose systems with examples. 4. Block diagram of Embedded System.	Video Demonstration of working of any two Embedded Systems and prepare a report on it. 1. Smart watch 2. ATM 3. Smart vehicles
2	1	1,7	1. Core of embedded system. Memory: Types of ROM & RAM, Role of Sensors and Actuators. Communication Interfaces: 2. Onboard Interface: I2C, SPI, 3. Onboard Interface: UART, One Wire and Parallel interface. 4. External Interface: RS232, RS485, USB.	1. Visit the nearest Home Appliances shop to know the features and working of different embedded systems available in that shop and prepare a report on it. 2. a) Salient features of LPC2148 b) Interpretation of datasheet of LPC2148. (block diagram, pin description etc.)
3	1	1,4, 7	1. External Interface: IEEE1394, Infrared, Bluetooth, WiFi, Zigbee and GPRS. 2. Little Endian and Big Endian concept, CISC vs. RISC, Harvard vs. Von-Neumann architectures. 3. Timing circuits: reset, watchdog timer, 4. Timing circuits: Brownout protection and RTC.	1. Familiarization of ARM-7 Development Board Kit, I/O pin details of kit, Integrated peripherals/ports/bus, Interfacing modules. 2. Familiarization of a) Kiel µVision4 simulation IDE. b) Philips Flash Utility.
4	2	1,2, 3,4, 7	**Introduction to ARM controllers.** 1. ARM Definition, Importance. ARM Design Philosophy: Power Consumption, Code Density, Price, Size, Debug Technology, Core Processor. 2. Features of ARM Instruction Set: Listing and elaborating the features.	1. Structure of Embedded C syntax, defining Ports, directions, etc. 2. Sample Embedded C program e.g., Simulation of storing bytes in ports and verification.

			3. Embedded system Hardware: Block Diagram, ARM Processor, Controllers, Peripherals, Bus. 4. ARM Bus Topology : Block Diagram, Master/slave, Physical/protocol.	

5	2	1,2, 3,4, 7	1. AMBA Bus Protocol : ASB, APB, AHB. 2. Embedded System Software: Block Diagram, Hardware, Initialization, Device Drivers, Operation System, Application. 3. Applications of ARM Processor: Listing of application fields and usage. 4. ARM Core Dataflow model: Architecture and sub blocks.	1. Embedded C program to blink 8 LEDS at a time in ARM kit. 2. Embedded C program to blink alternate LEDs in ARM kit.
6	2	1,2, 3,4, 7	1. ARM Core Dataflow model: Architecture and sub blocks. 2. Registers: General Purpose Registers, CPSR/SPSR bit configuration. 3. Processor Modes : Privileged and Non-Privileged modes. 4. Banked Registers: 17 registers in user/system mode and 20 hidden registers.	1) Embedded C Program to ON/OFF relay for every 5 secs by interfacing relay card to ARM kit. 2) Embedded C program to ON buzzer for 2 secs and off for 3 sec by interfacing Buzzer to ARM kit.
7	2	1,2, 3,4, 7	1. Pipeline: Concept, 3-stage operation. 2. Pipeline Characteristics: Illustration with an example and Listing characteristics. 3. Exceptions, Interrupts and Vector Table. 4. Structure of ARM Assembly Module : Syntax, illustration with example.	1. Embedded C program to rotate stepper motor in clockwise and anticlockwise direction by interfacing Stepper motor to ARM kit. 2. Embedded C program to rotate DC motor in clockwise and anticlockwise direction by interfacing DC motor to ARM kit.
8	2	1,2, 3,4, 7	1. Assembler directives : Definition, syntax with examples. 2. Introduction to Thumb: Differences between ARM and Thumb Instructions, Thumb Register usage (only listing). 3. ARM CPU core Instruction set types: Thumb -16 bit, ARM-32 bit, ARM assembly Instruction format Syntax illustration with example. 4. Condition codes : Suffix, flags, Description.	1. Embedded C program to generate Triangular Wave by interfacing DAC to ARM kit. 2. Embedded C program to generate Sine Wave by interfacing DAC to ARM kit.

9	3	1,2, 3,4, 7	1. Barrel Shifter: Block diagram, LSL, LSR, ASR, ROR, RRX. 2. Classifications of Instruction Sets, Data processing Instructions with examples. 3. Arithmetic and Logical instructions with examples. 4. Simple Assembly Programs with logic and illustration of $6x^2 - 9x + 2$ mathematical equations and square of a number (1 to 9) using a lookup table.	1. Simulate Assembly Level Program (ALP) to compute $6x^2 - 9x + 2$. 2. Simulate Assembly Level Program (ALP) to find the square of a number (1 to 9) using a lookup table.

10	3	1,2, 3,4, 7	1. Branching and Load and Store instructions with examples Simple Assembly Programs with logic and illustration. 2. a) Program to find the sum of an array of 16-bit numbers and store the 32-bit result. b) Program to find the length of null terminated string. 3. a) Program to convert Hexadecimal to ASCII. b) Program to convert ASCII to Hexadecimal. 4. a) Program to find the smallest number. b) Program to find the largest number.	1. Simulate Assembly Level Program (ALP) to find the sum of an array of 16-bit numbers and store the 32-bit result. 2. Simulate Assembly Level Program (ALP) to find the length of null terminated string.
11	3	1,2, 3,4, 7	1. Exceptions Handling (Procedure). 2. ARM Processor Exceptions and Modes (all seven modes with purpose) 3. Vector Table (mode, offset, Branching) 4. Exception Priorities and Link Register Offsets.	1. Simulate Assembly Level Program (ALP) to find the smallest / largest number. 2. Simulate Assembly Level Program (ALP) to Convert Hexadecimal to ASCII and vice versa.
12	4	1,2, 3,4, 7	1. Interrupts (IRQ, FIQ, SWI) 2. Assigning Interrupts (Procedure) 3. Interrupt Latency (Nested, Prioritization) 4. IRQ and FIQ Exceptions, Flow Block Diagram Enabling and Disabling IRQ and FIQ Exceptions.	1. Interface a temperature sensor (e.g., LM35) with an ARM controller and display the temperature. **OR** 2. Write a program to capture sensor data from Temperature/ PIR/ ultrasonic and gas sensors and transfer to cloud using Embedded C programming

13	4	1,2, 3,4, 7	Emerging Trends in Embedded Systems 1. Edge Computing. 2. Artificial Intelligence (AI) 3. Machine Learning (ML) 4. IoT (Internet of Things)	Implement a traffic light system where different LEDs represent red, yellow, and green traffic lights. Implement time delays for each state. **OR** Implement any real time application using emerging technologies.

4. References.

- ARM System Developer's Guide by Andrew N. Sloss, Dominic Symes, Chris Wright
- Introduction to Embedded Systems by Shibhu K.V.
- Embedded Systems: A Contemporary Design Tool – James K. Peckol.
- AVR Microcontroller and Embedded Systems – Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi
- ARM Assembly Language –William Hohl, CRC Press
- ARM Programming Techniques –from ARM website
- Embedded Systems: A Contemporary Design Tool-James K.
- LPC 2148 USER MANUAL

5. CIE Assessment Methodologies:

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics.	1-13		50	
				Total	50 Marks

6. Practice Assessment Methodologies:

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper:

Program	Electronics and Communication Engg.			Semester -V	
Course Name	Embedded Technology			Test	I/III
Course Code	25EC51IC	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks

Section - 1				
1	a) Explain the key characteristics of an embedded system. b) Compare the embedded systems and general-purpose systems with suitable examples. c) Explain the block diagram of an embedded system with detailed descriptions of each component.	L2 L2 L2	1	7 8 10
2	a) Discuss the role of sensors and actuators in an embedded system, with examples of their applications. b) Explain the Little endian and Big endian concepts and their importance in embedded systems. c) Classify embedded systems and provide examples for each category.	L2 L2 L2	1	7 8 10
Section - 2				
3	a) Describe the differences between onboard communication interfaces such as I2C, SPI, and UART. b) Develop an embedded C program to blink 8 LEDS at a time in ARM. c) Illustrate the AMBA Bus Protocols (ASB, APB, AHB) and their significance in communication within embedded systems.	L3 L3 L3	1 2 2	7 8 10
4	a) Illustrate the role of watchdog timers in enhancing the reliability of embedded systems. b) Develop an embedded C program to blink alternate LEDS in ARM. c) Discuss the benefits of ARM processors in embedded systems, focusing on power consumption and code density.	L3 L3 L3	1 2 2	7 8 10
Note for the course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.				

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper:

Program	**Electronics and Communication Engg.**			**Semester**	**V**
Course Name	**Embedded Technology**			**Test**	**II/IV**
Course Code	**25EC51IC**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	CO	Marks
Writing two programs and execution of any one program.		50
Scheme of assessment		

a) Writing two programs .	**20**
b) Conduction of any one program.	**10**
d) Result	**10**
e) Viva	**10**
Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. Suggestive Activities:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose activities that are relevant to the topic.

Sl.No.	Suggested Activities
01	Use a keypad to enter a password for securing a system. If the correct password is entered, the system will activate (e.g., open a door or arm/disarm an alarm).
02	Use a soil moisture sensor to monitor the soil's moisture level and activate a water pump automatically when the moisture level is low.
03	Interface an IR sensor with LPC2148 to detect objects and activate devices like motors or alarms.
04	Generate basic tones (beeps or simple melodies) using LPC2148's DAC or PWM outputs to create sound.

10. Rubrics for Assessment of Activity (Qualitative Assessment):

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students:

Sl.No.	Particulars	Specifications	Quantity
01	Computers	i5/i7/i10 processor, 8/16 GB RAM , 512 GB SSD, 2 GB graphics card.	30
02	LPC2148 Development Board/Kit with RS232 / USB cable and adaptor.		30
03	Interfacing Modules	Buzzer, LED, DAC, Traffic Light, Stepper Motor, DC Motor and Temperature Sensor	5 Each
04	Integrated Development Environments (IDEs)	Keil µVision	
05	Digital multimeter		20
06	Dual trace oscilloscope	30MHz	20

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**V**
Course Name	**Sensors and Actuators**	**Type of Course**	**Integrated**
Course Code	**25EC52IA**	**Contact Hours**	**7 hours/week 91 hours/semester**
Teaching Scheme	**L:T:P :: 3:0:4**	**Credits**	**5**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

Sensors and Actuators are essential components in modern technology, bridging the gap between the physical world and digital systems. Sensors detect and measure physical phenomena like temperature, pressure, or motion, converting them into data, while actuators translate digital signals into physical actions, such as movement or light. Together, they enable the functionality of systems in robotics, healthcare, smart devices, and industrial automation, driving innovation and efficiency in diverse applications. Their role is pivotal in creating intelligent, responsive systems that improve productivity and enhance everyday life.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Explain the working principle, classification and industrial applications of sensors and actuators.
CO-02	Select a suitable sensor and actuator for specific applications.
CO-03	Interface sensors and actuators with microcontrollers for data acquisition and control in simple applications.
CO-04	Use the sensors and actuators in Artificial Intelligence (AI) and Internet of things (IoT) for a desired control system.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1,2,3	1, 4, 5	**Introduction to Sensors and Actuators** **1. Overview of Sensors and Actuators**: Definition and importance of sensors and actuators. Role in modern industrial automation, robotics, healthcare and automotive sectors. **2. Classification of Sensors**: Contact vs. Non-contact, Active vs. Passive, Analog vs. Digital sensors. **Industry Applications**: Sensors in automotive (ABS systems, airbag deployment), healthcare (vital sign monitoring), manufacturing.	**1. Arduino**: Interface an IR sensor with an Arduino and display the message on a serial monitor. Use an LED as an actuator to indicate when the object is detected.

			3. Types of Actuators: Electrical (motors), Mechanical (levers, gears), Hydraulic and Pneumatic actuators.	**2. Proteus Simulation**: Simulate the same circuit in Proteus, showing the IR sensor reading and activating an LED when the object is detected.
2	1,2, 3	2, 3	**Sensor Characteristics and Selection** **1. Key Sensor Characteristics**: Sensitivity, Range, Accuracy, Resolution, Precision, Linearity, Hysteresis and Response time. **2. Environmental Factors**: Impact of temperature, humidity and electromagnetic interference on sensor performance. **Selection Criteria**: Choosing appropriate sensors based on specific application requirements (cost, environmental factors, range, accuracy). **3. Case Studies**: Selection of sensors for different applications: Ex. Industrial robots, HVAC systems and Automotive etc.	**1. Arduino**: Use a potentiometer to vary the resistance and measure how the Arduino reads the changes in sensor output (**analogRead** function). Display the varying sensor values in real-time on the serial monitor. **2. Proteus Simulation**: Simulate a circuit with a potentiometer in Proteus and observe how sensor output (voltage) changes based on rotation. Use a virtual oscilloscope to display the output.
3	1, 2, 3	1, 2, 4	**Temperature Sensors:** 1. Working principle and types of Temperature Sensors: **Thermocouples**: Seebeck effect, advantages and common applications (industrial furnaces, gas turbines). **2. RTDs (Resistance Temperature Detectors)**: Working principle, advantages and applications. **3. Thermistors**: NTC and PTC types, Application in consumer electronics and household appliances. **Infrared Sensors**: Non-contact temperature sensing in medical thermometers and industrial monitoring.	**1. Arduino**: Interface three different temperature sensors (Thermistor, LM35, and DS18B20) with an Arduino. Compare their outputs in varying temperature conditions. **2. Proteus Simulation**: Simulate the same temperature sensors in Proteus. Use variable resistors in place of temperature sensors to simulate changing temperature conditions and observe the outputs.

4	1, 2, 3	1, 2, 3	**Pressure and Force Sensors** **1. Working principle and Applications of Pressure Sensors**: **Piezoelectric**: Based on electric charge generation in response to pressure; Study the application in airbag systems. **Capacitive**: Working Principle; Study the application in weather forecasting, automotive systems. **2. Resistive (Strain Gauge-based)**: Wheatstone bridge principle, Study the application in industrial load measurement. **3. Working principle and Applications of Force Sensors**: **Load Cells**: Strain gauge-based force sensors, Application in industrial weighing systems.	**1. Arduino**: Interface a piezoelectric pressure sensor with Arduino and display the pressure values on an LCD. Vary the pressure applied and observe how the readings change. **2. Proteus Simulation**: Simulate a strain gauge based pressure sensor in Proteus. Monitor the output voltage and connect the sensor to an Arduino for visualization in the simulation.
5	1, 2, 3	1, 3, 4	**Position and Displacement Sensors** **1. Working principle and Applications of Position Sensors**: **Potentiometers**: Rotary and linear types, Application in tracking the motion of mechanical parts. **2. LVDT (Linear Variable Differential Transformer)**: Working principle, Application in aircraft and industrial control systems. **3. Working principle and Applications of Displacement Sensors**: **Optical Encoders**: Working principle, Application in CNC machines and robotics for high-accuracy position tracking. **Capacitive Sensors**: Working principle, Application in precision manufacturing and semiconductor industry.	**1. Arduino**: Interface a rotary potentiometer with an Arduino to measure angular displacement. Display the position in degrees on the serial monitor. **2. Proteus Simulation**: Simulate an LVDT-based position sensor or potentiometer in Proteus and measure displacement using an Arduino circuit.
6	1, 2, 3	1, 3, 5	**Proximity and Distance Sensors:** **1. Inductive**: Working principle, Application in industrial automation, machine safety systems. **Capacitive**: Working principle, applications in liquid level detection, automation. **2. Ultrasonic**: Working principle, Application in object detection, parking assistance, and automation. **3. Laser Distance Sensors**: Working principle, Application in autonomous vehicles, industrial applications.	**1. Arduino**: Interface an ultrasonic sensor (HCSR04) with Arduino to measure distance. Display the distance on an LCD screen and trigger an LED when an object is closer than a certain distance. 2. **Proteus Simulation**: Simulate the HC-SR04 ultrasonic sensor in Proteus and visualize the distance measurement by connecting it to a virtual Arduino board.

7	1, 2, 3	1, 3, 4	**Light and Image Sensors:** **Photodiodes**: Working principle, its application in light meters, solar panels, optical communication systems. **Phototransistors**: Working principle, Application in industrial light detection systems. **2. CCD (Charge-Coupled Device) Sensors**: Working principle, Application in cameras, medical imaging, astronomy. **3. CMOS (Complementary Metal- Oxide Semiconductor) Sensors**: Working principle, Application in smartphones, surveillance systems.	**1. Arduino**: Interface a light sensor (LDR or photoresistor) with an Arduino to detect light intensity. Control an LED's brightness based on the ambient light levels. **2. Proteus Simulation**: Simulate the LDR sensor in Proteus. Connect it to an Arduino to demonstrate real-time light intensity measurements and LED brightness control.
8	1,2,3	1, 2, 3	**Motion and Vibration Sensors:** **1. Accelerometers**: Working principle of 2-axis and 3-axis accelerometers, Application in smartphones, vehicle stability systems, and robotics. **2. Gyroscopes**: Working principle, Application in navigation systems, drones, and autonomous vehicles. **3. Piezoelectric Vibration Sensors**: Working principle, Application in industrial machinery for monitoring vibrations and detecting faults in rotating equipment.	**1. Arduino**: Interface a 3 axis accelerometer (ADXL345) with Arduino and measure motion in three axes. Display the X, Y and Z data on the serial monitor or plot them using a software tool. **2. Proteus Simulation**: Simulate a basic accelerometer in Proteus and connect it to Arduino. Simulate tilt and observe how the X, Y and Z values change.
9	1,2,3	1, 4, 6	**Actuators:** **1. Mechanical Actuators**: Levers, gears, cams, and their applications in converting rotary motion to linear movement. **2. Electrical Actuators**: **Solenoids**: Working principle and its applications in locks, valves, and switches. **DC Motors, Stepper Motors, Servo Motors**: Basics of electric motors and its applications in precision control applications like robotics, drones. **3. Hydraulic and Pneumatic Actuators**: Working principle and its applications in heavy machinery, automotive braking systems, and industrial robots.	**1. Arduino**: Interface a DC motor with an Arduino and control its speed using a PWM signal. Implement a simple motor control based on sensor input (e.g., potentiometer). **2. Proteus Simulation**: Simulate a DC motor control circuit in Proteus with an Arduino. Use a virtual potentiometer to control the motor's speed in real-time.

10	1,2,3	3, 4	**Motor Control Techniques**: **1. DC Motor Drives**: Speed and torque control using PWM (Pulse Width Modulation). **2. Stepper Motors**: Precision control of rotational angle, applications in CNC machines and robotics. **Servo Motors**: Closed-loop position control, used in robotics, aerospace, and industrial automation. **3. Interfacing Actuators**: Practical methods of connecting actuators to control systems (e.g., microcontrollers, PLCs) with a focus on power requirements and driving circuits.	**1. Arduino**: Interface a stepper motor with an Arduino and demonstrate precision control of motor position using a sequence of control signals. Display motor rotation in steps. **2. Proteus Simulation**: Simulate a stepper motor in Proteus and interface it with an Arduino. Control the motor's position step by step based on user input.
11	1,2,3	3, 5	**Sensor and Actuator Integration in Systems:** **1. Interfacing Sensors and Actuators**: Techniques to interface sensors and actuators in both **open-loop** and **closed-loop** control systems. Introduction to feedback loops, PID control systems, and their applications. **2. Applications**: Building automated systems such as temperature control (thermostat), motor speed control, industrial robot arms or any other systems. 3. **Case Study**: Discussion on real-world integration of sensors and actuators in systems like smart home automation, autonomous vehicles, and industrial robots.	**1. Arduino**: Implement a simple PID controller with a DC motor using an encoder as feedback. Control the motor's speed and position in a closed loop system. **2. Proteus Simulation**: Simulate a PID control system using an Arduino in Proteus. Connect a motor and encoder to demonstrate real-time motor control with feedback.
12	4	4,6, 7	**Wireless Sensor and Actuator Networks:** **1. Wireless Communication Protocols**: Introduction to wireless communication technologies: Zigbee, LoRa, Bluetooth, Wi-Fi, and their application in sensor networks. **2. Wireless Sensor Network**: Applications in IoT : Smart cities, smart homes, industrial monitoring, and predictive maintenance. **3. Wireless Actuators Network**: Control of actuators over wireless networks, applications in smart homes, industrial automation, and remote monitoring.	**1. Arduino**: Set up wireless communication between two Arduinos using nRF24L01 modules. Send temperature data wirelessly from one Arduino to another and control an actuator (LED) based on the received data. **2. Proteus Simulation**: Simulate the nRF24L01 module in Proteus, showing wireless transmission of sensor data between two virtual Arduinos.

13	4	5, 6, 7	**Latest Trends and Technologies in Industries :** **1. MEMS and NEMS Sensors**: Overview of Micro and Nano-Electromechanical Systems (MEMS/NEMS), applications in automotive, aerospace, healthcare, and consumer electronics. **2. Smart Sensors, AI-Enabled Sensors** **3. IoT-Enabled Sensors and Actuators:** Autonomous Vehicles, Robotics and Automation	1. **Arduino**: Implement an IoT system using ESP8266 to send sensor data (temperature, humidity) to the cloud (ThingSpeak or Blynk) and control an actuator (motor or LED) remotely. 2. **Proteus Simulation**: Simulate an IoT system using Arduino and Wi-Fi modules in Proteus. Send sensor data to the cloud and simulate real-time remote control of actuators.

4. References:

1. D. Patrnabis, "Sensors and Actuators", 2nd edition PHI 2013.

2. Sensors And Actuators by Francisco Andre Correa Alegria.

3. Sergej Fatikow and Ulrich Rembold, "Microsystem Technology and Microbotics"

4. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application"

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 TheoryTest	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

(a) Any one suggested activity model with report and presentation evaluated for 50 Marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1) Written description of the experiment in the observation book.
2) Conducting the experiment and the associated learning outcomes.
3) The results obtained from the experiment.
4) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics And Communication Engineering			Semester - V	
Course Name	Sensors and Actuators			Test	I/III
Course Code	25EC52IA	Duration	90 min	Marks	50
Name of the Course Coordinator:					

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) With the definition of sensors and actuators describe the importance in industrial automation.	L2	1, 2	7
	b) Explain how sensors as contact vs. non-contact can be used in various applications, providing suitable examples for each type.	L2	1, 2	10
	c) Discuss the role of actuators in modern healthcare applications .	L3	1, 2	8
2	a) Describe the classification of sensors.	L2	1, 2	7
	b) Explain the working principles and application of electrical actuators DC motors.	L2	1, 2	10
	c) Analyze the role of sensors in manufacturing systems	L3	1, 2	8
	Section – 2			
3	a) Consider an application and explain how sensitivity, range, and accuracy of a sensor affect sensor selection.	L2	1, 2	10
	b) Demonstrate the working principle of thermocouples and their industrial applications.	L3	1, 2	10
	c) Explain the process of selecting sensors for an HVAC system.	L3	1, 2	5
4	a) Discuss how environmental factors like temperature and humidity influence sensor performance.	L2	1, 2	10
	b) Explain the function of Thermocouple in Industrial furnaces.	L3	1, 2	10
	c) Illustrate the role of Capacitive pressure sensors in weather forecasting.	L3	1, 2	5

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	Electronics and Communication Engineering			Semester	V
Course Name	Sensors and Actuators			Test	II/IV
Course Code	25EC52IA	Duration	180 min	Marks	50
Name of the Course Coordinator:					

Questions	CO	Marks
Writeup for two experiments and conduction of any one experiment.	CO 2, CO 3, CO 4	50
Scheme of assessment **a) Writeup of two experiments.** **b) Hardware Conduction & Simulation of anyone** **Hardware conduction & Output - 10 M** **Simulation & Output - 10 M** **c) Viva-voce**		**20** **20** **10**
Total		**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose any two activities that are relevant to the topic.

Sl.No.	Suggestive Activities for Tutorials
01	**Sensor Calibration**: Measure environmental parameters (e.g., temperature, light, or humidity) using different sensors and calibrate their readings against standard instruments.
02	**Design a Smart Light System**: Use light sensors (e.g., LDRs) and actuators to create an automatic lighting system that adjusts based on ambient light.
03	**Data Logging**: Use sensors to record real-time environmental data, such as air quality or temperature, and analyze trends.
04	**Actuator Demonstration**: Create a project using servo motors or stepper motors to demonstrate precise movement control.
05	**IoT Application**: Develop IoT based Student attendance system
06	**Create a Weather Station**: Combine sensors for temperature, humidity, and light to create a small-scale weather station
07	**Compare Sensor Performance**: Test different types of sensors for the same parameter (e.g., infrared vs. ultrasonic for distance measurement) and evaluate their accuracy and efficiency.

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. SEE- Model Practice Question Paper

Program	**Electronics and Communication Engineering**			**Semester**	**V**
Course Name	**Sensors and Actuators**			**Test**	**II/IV**
Course Code	**25EC52IA**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Writeup for two experiments and conduction of any one experiment.				CO 2, CO 3, CO 4	50
Scheme of assessment **a) Writeup of two experiments.** **b) Hardware Conduction & Simulation of anyone** **Hardware conduction & Output - 10 M** **Simulation & Output - 10 M** **c) Viva-voce**					**20 M** **20 M** **10 M**
				Total Marks	50

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	10
02	Arduino Uno (or equivalent)	At least 14 digital I/O pins, 6 analog inputs, USB interface	20
03	LM35 Temperature Sensor	Voltage output, 0 to 100°C range, 10mV/°C	10
04	Thermistor	NTC, 10kΩ resistance at 25°C, used for temperature sensing	10
05	LDR (Light Dependent Resistor)	5mm, working range 0-5V, resistance changes with light intensity	10
06	Rotary Potentiometer	10kΩ linear, for displacement or angle measurement	10
07	Ultrasonic Sensor (HCSR04)	Range: 2cm to 400cm, 5V, used for distance measurement	10
08	Servo Motor	5V DC, 180-degree rotation, used for positioning	10
09	Stepper Motor (NEMA 17)	12V, 1.8° step angle, used in precise control applications	10
10	DC Motor	5V, used for simple rotation and speed control	10
11	PIR Motion Sensor	5V, detects motion in range of 6 meters	10
12	Accelerometer (ADXL345)	3-axis, I2C interface, used for detecting movement/acceleration	10
13	LCD Display (16x2)	16x2 character LCD, used for output display	10
14	Proteus Software	Latest version, for simulation of circuits	10
15	Arduino IDE	Latest version, for programming Arduino boards	10
16	Jumper Wires	Assorted pack, male to male, male to female	200
17	Breadboard	Solderless breadboard, 400 points	10
18	Resistors	Assorted resistors, 10Ω to 10MΩ	100
19	Capacitors	Assorted capacitors, 1µF to 100µF	100
20	Transistors (BC547)	NPN transistors, used in switching and amplification	10
21	Power Supply	5V DC regulated power supply, 2A	10
22	Multimeter	Digital multimeter for measuring voltage, current, and resistance	10

Government of Karnataka

DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication Engineering**	**Semester**	**V**
Course Name	**Industrial Internet of Things [IIoT]**	**Type of Course**	**Integrated**
Course Code	**25EC52IB**	**Contact Hours**	**8 hours/week 104 hours/ semester**
Teaching Scheme	**L:T:P :: 3:0:4**	**Credits**	**6**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

Rapidly expanding IoT market is creating a significant demand for skilled professionals who can design, develop, and manage connected devices and systems. Holistic understanding of complex systems by acquiring knowledge of various technical disciplines like embedded systems, sensors, networking, cloud computing, and data analytics. Offers opportunities to work on practical projects with the real-world in diverse sectors like healthcare, manufacturing, smart homes, agriculture, and transportation, etc.

New and innovative products and services can be created by integrating physical devices with the internet, fostering creativity and problem-solving skills. Individuals with IoT expertise will be well-positioned for future career advancements in various technical fields as IoT technology continues to evolve.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Comprehend foundational knowledge of IoT technologies and components.
CO-02	Utilize IoT sensors and actuators to create practical applications for homes, cities, agriculture, environment, energy, and industry.
CO-03	Apply IoT protocols, networking, and security principles to design and analyze efficient, secure IoT systems for various applications.
CO-04	Create real-world IoT solutions for smart homes, industries, and other sectors.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1	1. Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies. 2. IoT Networking Components, Characteristics of IoT, Things in IoT, IoT Protocols. 3. Logical Design of IoT: Functional blocks Communication models, Communication APl's.	1. Videos on IoT applications and make a report on communication models used in IoT. 2. Videos on IoT applications and make a report on communication protocols used in IoT.
2	1	1,7	1. Industrial Revolutions: Background Industrial Revolution 1.0, 2.0, 3.0, 4.0,5.0.6.0,	1. Video demonstration of maintenance process / Industry

			concepts, applications. Industrial Internet of Things: Concept, definitions. 2. Difference between IoT and IIoT IIoT application in various sectors/industries: Healthcare, Manufacturing, Logistics. 3. Predictive and remote maintenance: concept, implementation use case.	visit for maintenance process.
3	1	1	1. IoT Enabling Technologies: Wireless sensor Networks, Cloud Computing, Big Data Analytics. 2. Introduction to NodeMCU ESP8266, Communication protocols, Embedded Systems. 3. IoT Levels & Deployment Templates: Level – 1 Level – 2 Level – 3 Level – 4 Level – 5 Level – 6	1. Demonstrate videos on IoT Levels 1,2,3. 2. Demonstrate videos on IoT Levels 4,5,6.
4	2	1,3,4	1. IIoT Sensing: Introduction, Sensors, Sensor Characteristics and Categories. 2. Sensorial Deviations, Sensing Considerations. 3. IoT Actuation: Actuators, Actuator Types, Actuator Characteristics.	1. Identification and prepare a report on data sheets about different types of sensors and actuators. 2. Connecting a temperature sensor to a NodeMCU ESP8266/ESP32 to read sensor data and control actuators such as LEDs, motors, and servos based on the sensor inputs.
5	2	2,3,4,5	Domain Specific IIoT's: 1. Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/ Gas detectors. 2. Smart Cities: Smart parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response. 3. Smart Agriculture: Smart irrigation, Greenhouse control.	1. Develop and demonstrate a Smoke detection system using IoT. 2. Develop and demonstrate a smart lighting system using IoT. 3. Develop and demonstrate a smart irrigation system using IoT.
6	2	2,3,4,5	1. Environment: Weather monitoring, Air Pollution monitoring, Noise Pollution monitoring, Forest fire detection, River Floods Detection.	1. Develop and demonstrate a Weather monitoring system using IoT.

			2. Energy: Smart Grids, Renewable Energy Systems, Prognostics. 3. Industry: Machine diagnosis and prognosis, Indoor air quality monitoring.	2. Develop and demonstrate a fire detection system using IoT. 3. Develop and demonstrate air quality monitoring systems using IoT.
7	3	1,3,4	1. IoT Protocols – need of protocols, types. 2. Network Protocols: HTTP, Bluetooth, ZigBee, LoRaWAN, RFID. 3. Data Protocols:MQTT, CoAP, AMQP.	1. Simulate or demonstrate a simple MQTT protocol-based system where a cloud application fetches data from a device using the MQTT protocol. 2. Demonstration of LoRAWAN communication.
8	3	1,2, 3,4	1. Machine to Machine (M2M) networks: SDN, NFV- examples. 2. M2M Value Chains, IoT Value Chains. Comparison between M2M & IoT. 3. Human Machine Interface (HMI) in an automation process – concept, implementation, examples.	1. Demonstrate videos on M2M Networks. 2. Demonstrate videos on HMI using any Wireless devices controlling any Actuator.
9	3	1,2,3 ,4	1. IoT Design Methodology: purpose and Requirements Specifications, Process Specifications, Domain model Specifications. 2. Information model Specifications, Service Specifications, IoT Level Specifications, Functional level Specifications. 3. Operational view Specifications, Divide and component Integration.	1. Case studies on Smart Appliances. 2. Case studies on surveillance systems. 3. Design a simple IoT-based temperature monitoring application using the Blynk IoT platform.
10	3	1,3,4 ,7	1. Cloud service models: Concept of Infrastructure as a service (IaaS) model, Software as a service (SaaS) model. Platform as a service (PaaS) model. 2. Comparison and applications of IaaS, SaaS, and PaaS. 3. Cloud – introduction, cloud computing: concept, benefits, types.	1. Design an IoT system using an ESP8266/ ESP32 and a light sensor to gather data, upload it to the ThingSpeak cloud, and perform data analysis. 2. Develop an IoT-based color sorting machine using ESP8266 and ThingSpeak cloud.

11	3	1,2,3,4,5	1. Cloud storage: working operation, benefits, challenges. 2. Deployment models – Features of private cloud storage, public cloud storage, hybrid cloud storage, Community cloud storage, Comparison, examples. 3. Cloud computing services: Concept, Types, Features of Amazon Web Services (AWS), Azure, Google Cloud Platform(GCP).	1. Develop an IoT-based Alexa Home Automation system/Alexa class room automation system using Arduino IoT Cloud & ESP8266/ ESP32 NodeMCU. 2. Demonstrate and explain AWS services related to IoT, highlighting their functionalities and applications.
12	3	1,3,5,7	1. Overview of Threats in IoT, Vulnerabilities: Device Vulnerabilities, Network Vulnerabilities, Data Vulnerabilities. 2. Encryption Techniques in IoT: Symmetric Encryption and Asymmetric Encryption, Authentication Mechanisms: User Authentication and Device Authentication. 3. Privacy Issues: Concerns related to the collection of personal and sensitive data, Privacy Regulations: GDPR (General Data Protect ion Regulation)	1. Demonstrate cybersecurity awareness in IoT devices through videos and showcase a Cyber-Physical System (CPS) application to highlight security measures. 2. Demonstrate a cyber-threat or hacking scenario in a specific sector or industry and present effective solutions to mitigate it.
13	4	1,2,3,4,5,6,7	Description of developing a home automation system using IoT through the following step-by-step process: 1. Identify the Components. 2. Assemble the Components and integrate them with the Software. 3. Testing and Troubleshooting.	1.Develop and Demonstrate IoT-based home automation system/ IoT-based smart water management system/smart garden system/IoT-based smart door lock system/ any real time application of IoT.

4. References:

1. Misra, Sudip, Mukherjee, Anandarup, Roy, Arijit. "Introduction to IoT." Cambridge University Press, 2021.
2. Bahga, Arshdeep, Madisetti, Vijay. "Internet of Things: A Hands-On Approach."
3. Gilchrist, Alasdair. "Industry 4.0: The Industrial Internet of Things."
4. URLs: https://circuitdigest.com/internet-of-things-iot-projects
5. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.)
6. Industry 4.0 The Industrial Internet of Things by Alasdair Gilchrist

7. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

8. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

9. CIE Theory Test model question paper

Program	Electronics & Communication Engineering			Semester - V	
Course Name	Industrial Internet of Things [IIoT]			Test	I/III
Course Code	25EC52IB	Duration	90 min	Marks	50
Name of the Course Coordinator:					

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Explain the concept of IoT and discuss its various applications across different industries.	L2	1	8
	b) Describe the role of the communication functional block in an IoT system.	L2		10
	c) Identify and analyze different IoT communication models, and provide a detailed explanation of two.	L3		7
2	a) List different types of protocols used in IoT and their applications.	L2	1	5
	b) Describe the features and differences between IoT Level 1 and IoT Level 2.	L2		10
	c) Compare the industrial revolutions from 1.0 to 6.0 and assess how IoT has influenced the 4th and 5th revolutions.	L3		10
	Section - 2			
3	a) List the different types of sensors used in IoT.	L2	2	5
	b) Explain the different types of sensor characteristics.	L2		10
	c) Design smoke detection system using IoT.	L3		10
4	a) List the different types of actuators used in IoT.	L2	2	5
	b) Explain the different types of actuator characteristics.	L2		10
	c) Design smart lighting systems using IoT.	L3		10

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

10.CIE Practice Test model question paper

Program	Electronics & Communication Engineering			Semester	V
Course Name	Industrial Internet of Things [IIoT]			Test	II/IV
Course Code	25EC52IB	Duration	180 min	Marks	50
Name of the Course Coordinator:					
Questions				CO	Marks
Problem statement: Design an IIoT system for a given application.					
Scheme of assessment: **a) Draw the circuit diagram and specify the required components.** **b) Programming and interfacing.** **c) Conduction and Results.** **d) Viva – voce.**					**10** **10** **20** **10**
				Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

11. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	Suggestive Activities for Tutorials
01	Develop an automatic plant watering system, that waters your plants at specific intervals, or if the soil is dry.
02	Design a system that monitors waste bin levels and sends alerts for collection.
03	Design an IoT-based health monitoring system that tracks vital signs such as heart rate, blood pressure, or temperature.
04	Design a system that detects gas leaks and sends an alert to the user.
05	Develop a system that controls the fan's operation based on humidity levels in a room.

12. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

13. SEE- Model Practice Question Paper:

Program	Electronics & Communication Engineering			Semester	V
Course Name	Industrial Internet of Things [IIoT]				
Course Code	25EC52IB	Duration	180 min	Marks	50

Name of the Course Coordinator:		
Questions	**CO**	**Marks**
Problem statement: Design an IIoT system for a given application.		
Scheme of assessment: a) Draw the circuit diagram and specify the required components. b) Programming and interfacing. c) Conduction and Results. d) Viva – voce.		 10 10 20 10
	Total Marks	**50**

1)Signature of the Examiner **2) Signature of the Examiner**

14. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Quantity
01	Bread Boards	30
02	NODEMCU ESP8266/ ESP32	30
03	Jumper Wires.	As per requirement
04	Related Sensors /components to Practice Exercises	As per requirement
05	Internet facility	As per requirement

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication Engineering**	**Semester**	**V**
Course Name	**Integrated Communication Technologies.**	**Type of Course**	**Integrated**
Course Code	**25EC52IC**	**Contact Hours**	**7 Hours/Week 91 Hours/Semester**
Teaching Scheme	**L:T:P :: 3:0:4**	**Credits**	**5**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** Integrated communication technologies is crucial in today's world because it provides ubiquitous connectivity, enabling people to access information and services from virtually anywhere using mobile devices, facilitating seamless communication, boosting productivity, and powering a wide range of applications like the Internet of Things (IoT) - all without the need for physical wires, making it a cornerstone of modern life and the digital economy.

   wireless technologies enable seamless global communication, which is critical in today's interconnected world. By studying wireless systems, students gain the skills to contribute to cross-border collaborations and global problem-solving initiatives.

   Industries worldwide demand professionals skilled in wireless technologies. Teaching wireless communication in undergraduate programs ensures students are workforce-ready and can meet the growing demand for expertise in telecommunications, IT, and network engineering.

2. **Course Outcomes: At** the end of the course, the student will be able to:

CO-01	Illustrate the concepts of drone communications for any applications using protocols & networks.
CO-02	Demonstrate the concepts of radar technology, its components and applications in real world.
CO-03	Identify the components of a given wireless communication system, explain the role of those components in the system and list their characteristics.
CO-04	Explain the working principle of Mobile communication and GSM Services.
CO-05	Demonstrate the working of a satellite communication system, its subsystems for a specific application.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,4,5	**Drone Communication Systems and Protocols:** 1. Fundamentals of frequency bands, bandwidth, and baud rate, and their applications in efficient communication systems. 2. Understanding techniques and protocols like PWM, PPM, SBUS, and MAVLink used for drone control and communication. 3. Protocols for connecting sensors in drones, such as UART, SPI, and I2C, for reliable data transfer and seamless integration.	1. Experiment: Generate and wirelessly receive PWM signals to control a motor's speed. 2. Case study: Evaluate the role of Controller Area Network [CAN] and Express Long Range System[ELRS] in enabling drone communication.
2	1, 3	1,4,5	**Wireless Communication Hardware.** 1. Fundamentals of antenna design, various types, and their critical applications in drone wireless communication systems. 2. Analysis of broadcast and unicast communication modes with applications in drone control systems, video transmission, and telemetry. 3. Effective management of the 3 key subsystems in drone communication systems for optimal performance and reliability.	1. Experiment: Construct a helical antenna and examine how signal strength changes with different orientations while transmitting LED control signals. 2. Experiment or Video documentation: Explore how frequency management and protocols improve reliability in drone communication systems.
3	1, 3	2,3,4	**Optimizing Communication Systems in Drones.** 1. Understanding the effects of transmitter power on range, interference, and communication efficiency in drone systems. 2. Exploring range limitations and their significant impact on latency and system performance in drone communication. 3. Implementing management techniques to ensure effective, reliable, and interference-free drone communication.	1. Video documentation: Understand the strategies on how power is managed in RF systems. 2. Experiment or Video Documentation: Simulate interference in video transmission systems and implement basic mitigation strategies.
4	2, 3	2,3,4	1. RADAR- principle of operation, Range equation (no derivation) and applications. 2. Instrument Landing System (ILS) – working principle & applications.	1. Conduct an experiment to use a smart phone as CCTV camera (or a CCTV camera) and connect it to another mobile to view the camera feed.

			3. Microwave signals, types of microwave devices. Magnetron applications.	2.video demonstration and documentation to understand radar scanning and tracking systems.
5	2, 3	3,4	1. Travelling Wave Tube (TWT) - working principle & applications. 2. Optical fiber -principle of operation, Numerical aperture, Angle of acceptance, Classification, fiber losses. 3. Basic components of Fiber optic system, splices, connecters, couplers and switches.	1. Demonstrate PC to PC communication using Fiber Optic Digital Link. 2. Demonstrate installation, testing, repair and power budgeting of fiber optic cable (using simulator/video)
6	3, 4	3,5,7	**Mobile communication**: 1. Features of 1G, 2G, 3G, 4G, 5G cellular networks. Terminologies used in mobile communication. 2. Cellular system – illustration with diagram. Cellular phone call – components & working principle. 3. Cellular & Frequency reuse concepts.	1. video demonstration and documentation to understand the working of a cellular phone call. 2. Conduct an experiment to connect PC to internet through Bluetooth access point of mobile and transfer a text file/image file/video file.
7	3, 4	3,5,7	1. Capacity expansion techniques- cell splitting– concept, key features & applications. 2. Capacity expansion techniques- cell sectoring – concept, key features & applications. 3. Handoff strategies – concept & types (any two).	Industry visit to BSNL telephone exchange/Mobile Service Providers to learn about Cellular networks, Public Switched Telephone Network (PSTN) & GSM implementation. Prepare a report with observations.
8	3, 4	1,4	1. GSM services and features. 2. GSM architecture, applications. 3. LTE services and features.	Video demonstration and documentation of, 1. Troubleshooting, testing and replacement of display, front camera. 2. Troubleshooting, testing and replacement of charging port, battery.
9	3,5	1,3,5	**Satellite Communication** 1. Satellite –concept, types. Orbits – concept & types. apogee and perigee, azimuth and elevation angles. 2. Sub satellite point, sub satellite paths, ascending and descending nodes. Posigrade and Retrograde orbits, Uplink	Industry Visit to All India Radio station/Akashvani to learn about Radio Transmission & Reception and prepare a report with observations.

			and downlink. 3. Orbital period and radius of geosynchronous satellite. Satellite eclipse – concept. Polar and Geostationary satellites - advantages and disadvantages.	
10	5	1,3,5	1. LEO, MEO & GEO satellites – features & applications. 2. Station keeping, Attitude control and thermal control – concept & working principle. 3. Satellite communication system block diagram, working principle.	1. Receive real weather satellite signals using a Software Defined Radio(SDR)and decode images using simulation software's. 2. Conduct a simulation experiment for satellite tracking and orbit prediction using open-source software & document the displayed parameters. (e.g., GPredict Open-source software)
11	3,5	2,3,4	1. Transponder single conversion, double conversion and regenerative transponder – concept & applications. 2. Increasing channel capacity - frequency reuse and spatial isolation – concept & advantages. 3. Communication satellite- satellite subsystems – components.	Industry Visit to local TV relay station to learn about transponders, its related operations and prepare a report with observations.
12	3,5	3,4,7	1. Earth station- block diagram, working principle, Applications payload – concept. 2. Satellite for TV applications - Direct-To-Home (DTH) and cable TV-concept. 3. Satellite for military applications, Very Small Aperture Terminal (VSAT) – features & applications.	1. Video demonstration and documentation on Working of Satellite TV. 2. Video demonstration and documentation on features & working of Global Positioning System (GPS) System.
13	3,5	3,4,7	1. Satellite for voice and data communication – concept, Earth observation - concept. 2. Set top box -concept, block diagram. 3. Set top box – working.	1. video demonstration and documentation of TV Set top box repair. 2. Test and troubleshoot Set top box.

3. References:

1. Documentation and Websites:
2. Betaflight Documentation: https://betaflight.com
3. PX4 Documentation: https://px4.io
4. Oscar Liang's Blog: https://oscarliang.com
5. GetFPV Learn Website: https://getfpv.com/learn
6. Joshua Bardwell YouTube Channel: https://youtube.com/joshuabardwell

Books:

1. Introduction to UAV Systems by Paul G. Fahlstrom.
2. Small Unmanned Aircraft: Theory and Practice by Beard and McLain.
3. Communication Protocol Engineering by Pallapa Venkataram and Sunilkumar S. Manvi.
4. Digital Communication Systems Engineering with Software-Defined Radio by Alexander M. Wyglinski, Di Pu, and Madihally Narasimha.
5. Wireless Communications and Networks by William Stallings.
6. Wireless communications by Theodore S.Rappaport. II Edition,PHI publications.
7. Satellite Communications, Fifth Edition" by Dennis Roddy.
8. Introduction to Radar Systems by Skolnic, TMH Publications.
9. Introduction to wireless telecommunications systems and networks by Mullett, CENGAGE Learning.
10. Mobile communications by Jochen Schiller.
11. Satellite Communication by Anil K Maini, Wiley India Publications.
12. Microwave Engineering, by Vasuki, Helena and Rajeswari, McGrawHill education.
13. Electronic communication system by George Kennedy and Davis Fourth Edition.

4. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

(a) Any one suggested activity model with report and presentation evaluated for 50 Marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1) Written description of the experiment in the observation book.
2) Conducting the experiment and the associated learning outcomes.
3) The results obtained from the experiment.
4) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

5. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

6. CIE Theory Test model question paper

Program	Electronics & Communication Engineering			Semester - V	
Course Name	Integrated Communication Technologies.			Test	I/III
Course Code	25EC52IC	Duration	90 min	Marks	50
Name of the Course Coordinator:					

Note: Answer any one full question from each section. Each full question carries equal marks.

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Illustrate the significance of frequency bands and bandwidth in drone communication systems. b). Compare PWM and SBUS protocols used for drone control. c) Sketch & explain the working of a UART-based sensor connection in drones.	L3/L4	1	08 07 10
2	a. Illustrate the impact of transmitter power on drone communication range. b) Suggest methods to mitigate interference in video transmission systems. c) Explain the management of drone communication subsystems for optimal performance.	L3/L4	1	08 07 10
	Section - 2			
3	a) During a satellite communication experiment, the received signal at the ground station is weaker than expected. The satellite uses a single conversion transponder. What factors might have caused the signal degradation? b) A disaster relief team in a remote area requires immediate satellite-based communication. Which satellite orbit (LEO, MEO, GEO) would be most	L3/L4	4,5	08 07

	suitable, and why? c) A satellite operator observes a drop in signal strength from one of their communication satellites. Identify potential causes and propose steps to troubleshoot and resolve the issue.			10
4	a) Make use of the block diagram of a satellite communication system with neat figure. b) Compare uplink and downlink frequencies with respect to a satellite communication system with earth station. c) Design a basic satellite communication system using single conversion transponders to connect two remote regions.	L3/L4	4,5	08 10 07
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.				

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

7. CIE Practice Test model question paper

Program	**Electronics & Communication Engineering**			**Semester**	**V**
Course Name	**Integrated Communication Technologies.**			**Test**	**II/IV**
Course Code	**25EC52IC**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					
Questions				**CO**	**Marks**
Conduct/simulate/demonstrate a wireless communication system /optical fiber communication/Bluetooth/Antenna/drone communication/satellite communication/mobile communication for a specific application.				**1,2,3,4,5**	**50**
Scheme of assessment **1. write up of circuit diagram, procedure for 2 experiments (any two communication systems)** **2. conduction/simulation of any 1 experiment.** **3. result /output evaluation.** **4. viva-voce**					**20** **10** **10** **10**
				Total Marks	**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic.

Sl.No.	Suggestive Activities for Tutorials
01	Build a simple system using an Arduino Uno and a radio transceiver to remotely control an LED. Include additional features like variable blinking patterns based on received commands.
02	Design and construct a simple dipole RF antenna using basic materials, such as copper wire and PVC pipes. Test the antenna's signal strength and compare the performance of different orientations.
03	Give a presentation about the usage of the radar technology in case of searching a crashed aircraft in the ocean.
04	Create a flowchart or infographic explaining the role of communication protocols (PWM, PPM, SBUS, and MAV Link) in drones, highlighting real-world examples of their applications.
05	Prepare a report on different types of launch vehicles used for launching a satellite in India and its significance.
06	Prepare a report on the different components of a CCTV Camera that requires it to be functional and demonstrate its usage.
07	Prepare a report on the various experimentation and findings being conducted on the surface of MARS by NASA's Perseverance Rover (include actual pictures released from NASA website).

9. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

10. SEE- Model Practice Question Paper

Program	**Electronics & Communication Engineering**		**Semester**	**V**
Course Name	**Integrated Communication Technologies**	**Course Code: 25EC52IC**	**Duration**	**180 min**
Questions			**CO**	**Marks**
Conduct/simulate/demonstrate a wireless communication system /optical fiber communication/Bluetooth/microwave communication/Antenna/drone communication/satellite communication/mobile communication for a specific application.			**1,2,3,4,5**	**50**

Scheme of assessment **1. write up of circuit diagram, procedure for 2 experiments (any two communication systems)** **2. conduction/simulation of any 1 experiment.** **3. result /output evaluation.** **4. viva-voce**	**20** **10** **10** **10**
Total Marks	**50**

Signature of the Examiner **Signature of the Examiner**

11. Equipment/software list with Specification for a batch of 30 students.

Sl.No.	Particulars	Specification	Quantity
1	Arduino-based DIY RF Testing Kit	Arduino Uno dual kits, radio transceiver modules, brushed motor pair with propellers and stand, antenna holder, copper wire antenna material, LED modules	15
2	Drone Communication Simulation Kit	ELRS communication system, CAN-enabled sensor with appropriate microcontroller or processor, 2.4 GHz control link with receiver, 915 MHz telemetry module	5
3	Open-Source Video Transmission Kit	RF power meter, 5.8 GHz video transmission system, dipole antenna, directional antenna	5
4	Computers	Computers Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication Engineering**	**Semester**	**V**
Course Name	**Automation & Robotics**	**Type of Course**	**Integrated**
Course Code	**25EC53IA**	**Contact Hours**	**7 Hours/week 91 hours/Semester**
Teaching Scheme	**L:T:P :: 3:0:4**	**Credits**	**5**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

The growth of automation & robotics has been tremendously high in recent years and the next few years are to witness great advancement in automation & robotic technology. The Robotics and Automation course focuses on the construction and operation, design automation of robotic devices, computer systems for necessary control action, feedback devices and information processing. Through project-based learning, design thinking, and inquiry learning, students will explore the technical skills needed to design and fabricate physical devices. Robotics and Automation is an interdisciplinary branch of Engineering that includes Mechanical, Electrical, Electronics, Computer Science, Sensors and Instrumentation, Industrial Automation, Artificial Intelligence and Machine learning, Nanotechnology and Machine Vision. The course provides knowledge and exposure in the field of Automation and Robotics and other related areas of automated production systems.

2. Course Outcomes: At the end of the Course, the student will be able to

CO-01	Explain and demonstrate the concept, components of Automation and its applications in Industries.
CO-02	Use Sensors, Actuators, VFD and PLC for specific applications in the automation.
CO-03	Apply the knowledge of robotic structure and its working to design and construct/simulate Robots for different applications.
CO-04	Identify the role of the sensors, actuators, AI, ROS and use it in robotic applications.

3. Course Content

WEEK	CO	PO	Theory	Practice
1	**1**	**1,2, 3,7**	➢ Automation in Production Systems, Reasons for Automating. ➢ Automation Principles and strategies. ➢ Components of Production System: Facilities and Manufacturing Support System. Case study on Benefits of converting a manual production system to Automated	Develop a Conveyor to automate parts movement. Interface Conveyor to PLC and control movement of parts. When the START button is pressed, the conveyor has to start rotating until the STOP button is pressed. Prepare a report on

			Production system.	a) Step by step procedure to develop a conveyor. b) Specifications of the actuator used. c) Selection of conveyors for different industrial applications.
2	**1**	**1,2, 3,7**	➢ Basic Elements of an Automated System: Power to accomplish the automated Process, Program of instructions, Control System ➢ Levels of Automation. ➢ Consider a use case to Demonstrate and analyze the following in the Medical Electronics /equipment manufacturing Industry. a) Improving Manufacturing Plant Efficiency b) Wastage of material c) Adapting to Technological Change	Interface Conveyor to PLC and control movement parts: Use Proximity sensor to be placed on the conveyor to detect the presence of the work piece. The conveyor has to rotate only when a work piece is available. Prepare a report on benefits if the conveyor speed can be controlled automatically.
3	**2**	**1,2, 3,7**	➢ Need for Controllers in automation: Microprocessor-based system, The Programmable Logic Controller Internal Architecture, Sourcing and sinking. ➢ PLC systems: Typical arrangement of PLC rack system, The IEC standard for PLC, Programming PLC. ➢ Use case on PLC Installation practices in a Manufacturing plant/Pharmaceutical industry/Defense and prepare a report.	Develop a PLC trainer kit and Interface toggle switches, Output LEDs to PLC. Check the working of PLC by programming it for automatic metal counting on the conveyor. Prepare a report on a) The Specifications of the PLC used. b) PIN functions of the PLC used. c) The range of industrial applications that the used PLC supports. d) List of various PLC vendors.
4	**2**	**1,2, 3,7**	➢ Role of sensors in Industrial automation, Common Measuring Devices Used in Automation. ➢ Desirable Features for Selecting Sensors Used in Automated Systems. Selection of sensors in industrial automation systems based on the given applications. ➢ Case study on application of sensors in any automated manufacturing industry.	Interface Liquid level sensor to PLC for detecting the level of liquid in a container and control the valve accordingly. Prepare a report on a) Different types of sensors used for liquid level sensing. b) Selection of liquid level sensors for different industrial applications. c) Working of the liquid level sensor used in the experiment.
5	**2**	**1,2, 3,7**	➢ Role of Actuators in industrial automation. Working and industrial applications of: Contactors and Relays, Solenoids, directional control valve. ➢ Working and industrial applications of: DC motors, AC, servo and stepper motors. ➢ Case study on the role of Actuators in	Interface Color detection sensor to PLC and separate the work pieces on the conveyor based on the color. (any two colors). (Use electric/Hydraulic/ Pneumatic actuator for parts separation) Prepare a presentation on a) The specification of the actuator

			- Automation packaging - Label scanning and - Printing	used. b) The advantages of it compared to other actuators c) The industry applications of it.
6	**2**	**1,2, 3,7**	➢ Introduction to Variable Frequency Drive (VFD), Building blocks of VFDs ➢ Specifications, types and working principles, Industrial applications of VFD ➢ Case study on application of VFD drives on speed control in the Automation Industry.	Interface PLC and VFD to change the speed of the induction Motor so that the programmable automation system is able to handle different product varieties in production: Example filling of Kissan Jam in Both Bottle (1 ltr) and sachets(100ml). Prepare a presentation on the a) Specifications of the VFD b) Induction motor used c) The types of load it supports. d) Benefits using VFD for automatic speed control e) Industry applications of it. Present the same in the class.
7	**3**	**1,2, 3,7**	➢ Introduction to Robotics: Definition of Industrial Robot, Generations of Robots. ➢ Robot Anatomy: Base, arm, wrist, end-effector. Links, joints. Joint Notation & Type of joints in robot- Linear Joint (L Joint), Orthogonal Joint (O Joint), Rotational Joint (R Joint), Twisting Joint (T Joint), Revolving Joint (V Joint) ➢ Degree of Freedom- Forward and Back, Up and Down, Left and Right, Pitch, Yaw, Roll (video demonstration of different types of Robots)	Visit nearby ITI/GTTC college and make a report on a) Types of robots. b) Work Volume c) Degree of Freedom- Forward and Back, Up and Down, Left and Right, Pitch, Yaw, Roll d) Joint Notation & Type of joints in robot- Linear Joint (L Joint), Orthogonal Joint (O Joint), Rotational Joint (R Joint), Twisting Joint (T Joint), Revolving Joint (V Joint)
8	**3**	**1,2, 3,7**	➢ Discuss Robotic Coordinate system of robots. ● Joint co-ordinate system ● Rectangular co-ordinate system ● User or object coordinate system ● Tool coordinate system. Work Volume ➢ Discuss End Effectors- Grippers, Tools Types of grippers Factors to be considered for Selecting a Gripper. ➢ Robot movement and Precision.	➢ Video demonstration on the role of Robots in automatic car assembly plants. Prepare a report on the type of robots used in the plant. ➢ Video demonstration on how the Robot pharmacist works. Prepare a report on types of sensors and actuators used in the robot.
9			➢ The need for Robotics in Automation industries. ➢ Discuss the different types of sensors used in industrial robots & their	➢ Video demonstration on the working of Driverless cars. Prepare a report on different types of sensors in it. ➢ Implement Automatic Car

	4	**1,2, 3,7**	application. ➢ Explain different Types of Actuators used in Industrial Robots.	Reverse parking alarm system by using Ultrasonic sensor and Arduino. When there is an object/obstacle, indicate it by beep sound. Beeping Interval should depend on the distance between the car and obstacle.
10	**3,4**	**1,2, 3,7**	➢ Types of Industrial Robots and their applications. ➢ Working of AGV and AMR. ➢ Case study Applications of AGVs in Unmanned systems: Defense, Medical and other Industries for material Handling.	Develop Obstacle Avoidance Robot/Line following robot using Arduino board.
11	**3,4**	**1,2, 3,7**	➢ Introduction to camera, Camera calibration. ➢ Vision Guided Robots (automated navigation guidance by vision system) ➢ Working of Turtlebot Robot.	1. Using simulation software Simulate an industry application of picking and placing an object from one place to another/ Simulate an industry application of picking the objects from the main conveyor and placing them on different conveyors based on colors using a vision sensor. 2. Make a report on the different Robotic applications using Vision Sensor.
12	**3,4**	**1,2, 3,7**	➢ Discuss and make a report on the use of Artificial Intelligence in robotics. ➢ Introduction and overview of robotic systems and their dynamics (Forward and inverse dynamics. Properties of the dynamic model. ➢ Joint space and task space control schemes (Position control, velocity control, trajectory control and force control).	1. Program a ROBO to trace a circular path, Rectangular path using any simulation software (Robo Analyser Software/ROBO studio/Gazebo / Robosoft) 2. Program a ROBO to trace elliptical and conical using any simulation software.
13	**3,4**	**1,2, 3,7**	➢ Introduction to ROS, Installation and Packages. ➢ Need for ROS. Its packages, ROS communication Tools (Topic, Services, Action) ➢ Case study on Development of various robots using ROS.	Build a Maze solving robot using real-time/ simulation software.

4. References:

Sl.No	Description
1	Automation, Production Systems, and Computer-Aided Manufacturing- Mikell P Grover, Prentice-Hall International publication.
2	Automating Manufacturing Systems with PLC by Hugh Jack.
3	Hand book of Modern Sensors" Physics, Designs and Applications- JACOB FRADEN-Springer Publications.

4	Springer Handbook of Automation by Shimon Y. Nof
5	Robotics technology and flexible automation – S.R. DEB and S.DEB.
6	R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
7	John J.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education
8	M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.
9	B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max Marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

(a) Any one suggested activity model with report and presentation evaluated for 50 Marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1) Written description of the experiment in the observation book.
2) Conducting the experiment and the associated learning outcomes.
3) The results obtained from the experiment.
4) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max Marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics And Communication Engineering			Semester - V	
Course Name	Automation & Robotics			Test	I
Course Code	25EC53IA	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Discuss the different components of the Production System.	L2	1	10
	b) Describe the different levels of Automation.	L2	1	10
	c)Discuss the benefits of Programmable automation in any production industry.	L3	2	5
2	a) Summarize the Basic elements of an Automated system.	L2	1	10
	b) Use the automation principle strategies and explain the benefits of converting a manual system to an automated production system.	L2	1	10
	c) Discuss the different types of automated manufacturing system relative to production quantity and product variety.	L3	2	5
	Section – 2			
3	a) Demonstrate the desirable features of sensors used in the Automation industry.	L3	2	10
	b) Explain the working of different sensors used in potato chips production plant.	L3	2	10
	c) PLC is preferred over microcontrollers in an automation industry. Justify.	L3	2	5
4	a) Identify the need for controllers in automation and explain.	L3	2	10
	b) Demonstrate the PLC arrangement of the Rack system to be used in the milk production industry.	L3	2	10
	c) Implement the PLC installation practices in any manufacturing plant.	L3	2	5

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	**V**
Course Name	Automation & Robotics			**Test**	**II/IV**
Course Code	**25EC53IA**	**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	Marks
Writing two programs and execution of any one program.	1,2,3,4	50
Scheme Of Assessment:		
Writing of Two experiment (Hardware/simulation) **Conduction/simulation of any 1** **Troubleshooting** **Result** **Viva**		**20** **10** **05** **05** **10**
Total Marks		**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose any ONE activity that is relevant to the topic.

Sl.No.	**Suggestive Activities**
1	Design an Automatic liquid filling system.
2	Develop an automation system on Sensors and actuators.
3	Develop a Robot to separate parts moving on the conveyor based on the colour.
4	Use a color sensor to separate the parts moving on the conveyor based on the colour.
5	Use VFD for direction control of the Induction motor.
6	Integrate IOT and Automation for data monitoring.
7	Develop prototype of Self Driving Car

10. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		0-10	11-20	21-30	31-40	41-50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
	Average Marks=(40+30+40+30)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. SEE- Model Practice Question Paper

Program	**Electronics and Communication Engineering**		**Semester**	**V**
Course Name	**Automation & Robotics**	**Course Code 25EC53IA**	**Duration**	**180 min**
Questions			**CO**	**Marks**
Writing two programs and execution of any one program.			1,2,3.4	50
Scheme Of Assessment:				
Writing of Two experiments (Hardware/simulation) **Conduction / simulation of any 1** **Troubleshooting** **Result** **Viva**				**20** **10** **05** **05** **10**
			Total	50

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	PLC Kits	14-20 I/O ports , 24V	15
02	PLC with Power Supply	14-20 I/O ports , 20V	15
03	Toggle Switches , Output LEDs	—----------	100 each

03	Arduino Uno (or equivalent)	At least 14 digital I/O pins, 6 analog inputs, USB interface	30
04	Ultrasonic Sensor (HCSR04)	Range: 2cm to 400cm, 5V, used for distance measurement	30
05	DC Motors	5V, used for simple rotation and speed control	30
06	Arduino IDE	Latest version, for programming Arduino boards	30
07	Computer (for Simulation and Coding)	Minimum 4GB RAM, 500GB HDD, Windows/Linux OS, with Arduino IDE and Proteus installed	30
08	Robo Analyser Software /ROBO studio/Gazebo/ Robosoft	—----------	For 30 PCs
07	VFD drive	0.5HP/1HP/2HP	5
08	Induction Motor	0.5HP/1HP/2HP	5

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication**	**Semester**	**V Sem**
Course Name	**Agritech**	**Type of Course**	**Integrated**
Course Code	**25EC53IB**	**Contact Hours**	**7 hours/week 91 hours/semester**
Teaching Scheme	**L: T:P :: 3:0:4**	**Credits**	**5**
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. **Rationale:** Agricultural technology abbreviated Agritech is the use of technology in agriculture with the aim of improving yield, efficiency and profitability. Agritech boosts crop yields by optimizing crop output via using precision agriculture methods, such as data analytics and remote sensing, modern agriculture, GPS and GIS in Agriculture, IoT in agriculture and dairy, Drones Application, Mobile Apps in Agriculture, e-kiosks etc.

2. **Course Outcomes:** At the end of the Course, the student will be able to

CO-01	**Understand agriculture in Indian economy and use various technological approaches to enhance agriculture and its sub sectors.**
CO-02	**Understand Agritech in today's agriculture sector and use Modern agricultural technologies and equipment to Develop skills in Agritech.**
CO-03	**Use ICT, IoT, Precision Farming and AI in Agritech and Analyze Remote sensing of farming using GPS and GIS in Modern Agriculture.**
CO-04	**Apply Robotics ,DRONES and latest technology for efficient modern agricultural practice.**

3. Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,7	**Importance of Agriculture** • Agriculture-Definition, Brief analysis of the various crops grown in India. Understanding the imports and exports of agricultural products /crops • Evolution of Agriculture from post-independence to the present time. Analyze the reasons for the decline in agricultural economy though with large surge in population, agricultural industries and export. • Challenges faced by farmer in agriculture. Discuss the need for technology to become part of agriculture.	• Give a presentation on the ➢ varieties of crops grown in India. ➢ India pioneer in space technology in the world but remained behind in agricultural field • Discuss/Video demonstration on why Sri M S Swaminathan is known as "Father of the Green Revolution" in India
2	1	1,2,7	**Introduction to Agritech** • Introduction to Agritech- need for technological revolution replacing men, importance of agriculture in Indian economy • Video demonstration on the role of Agritech in enhancement of agricultural production and productivity. • Challenges faced by farmers in production and marketing	• Give a presentation on ➢ Rice varieties which reap better yield with less water. ➢ Role of electronics in the technology used in Rice Analyzers/Sortex machines. • Introduction of the progressive farmers of India and Success stories of Agripreneurs. (Video Demonstration/Direct visit through KVK)

3	**1,2**	**3,4,6**	**Technology in agriculture** • Technological methods of using Pesticides and insecticides for better production of crop. • List of the companies in the production and service providers to technological products used in agriculture. • Scope of Entrepreneurship as service provider in Agriculture technology. Name some of the well-known Agritech startups in India.	• Give a presentation on e-commerce (software handling) in food supply chain (like Amazon/Big Basket/Swiggy/Zomato/Blinkit/ Zepto) And Submit a Report on E-trading/e-NAM/spot Exchange/ commodity exchanges. • Give a presentation on the role of Incubation for the development of agriculture (Ex: start up India, Stand up India, etc.)
4	**1,2**	**1,4,7**	• Introduction to subsectors in Agriculture-Horticulture, Fishery, Diary, poultry, sericulture. • Justification of how Technology plays critical role in Horticulture. • Benefits of animal husbandry in Modern agriculture.	• (a)Introduction to apps and platforms to monitor crop health. Ex: crop doctor, mkissan, EOSDA crop monitoring, Krishi DSS platform etc. (b) Discuss the electronic gadgets used in food supply chain and value chain. • Local Visit to krishi vignana Kendra(KVK) and submit a report on it.
5	**2**	**3,4,5**	• Technology used for ✓ Efficient water management in agricultural land. ✓ Energy management in agricultural land ✓ Agri waste management and water treatment technology • Equipment/Software and the Technology used in	• Expert talk on Briquetting technology from Agri-waste and Demo on Production of briquets from different agri wastes OR • Visit a local warehouse. (i)Identify the role of electronics in its maintenance(ii)collect stock management software used to manage

			✓ weather forecasting/ Disaster management/ Price forecasting ✓ Quality management in fssai ✓ Packaging Management for export of local fruit/vegetable/crop (ex. Bettle nut, turmeric, paddy, sugarcane etc.)	depositors(iii)List out the problems of the stakeholders • Prepare a report on the efficient water management of a 2-acre land (factors to be considered- types of water sources, excess water management, Groundwater recharge)
6	**3**	**3,4,7**	**ICT in agriculture** • ICT in agriculture: Aims and Objectives • Impact of ICT on Agriculture and its subsectors like Horticulture/Sericulture/fishery/poultry • Role of sensors in agriculture • Different types of sensors used in agriculture • Taking up Entrepreneurship in supplying sensors for agriculture purpose/Livestock surveillance.	• **(a)Mobile Apps** in agriculture: IFFCO Kisan Agriculture, Meghdoot Pusa Krishi, Agri App, Crop Insurance, Kheti-Badi, Agri-Market, Shetkari, Kisan Suvidha (b)Navigate e-SAP, Dhartimitra Apps Software Application for Information Kiosk: FARM CALCULATORS, AGRO CHEMICALS. • Visit a KSAMB /COFFEE BOARD and collect (i) information on role of electronic gadgets in their market expansion (ii) Market Data (iii) information on sourcing the raw materials from different companies and its management .
7	**3**	**3,4,5**	**IoT in the agriculture** • Role of **IoT** in agriculture and its subsectors, list its applications • Use case of IoT to Monitor ✓ Soil conditions ✓ Weather conditions ✓ Water conditions • Use case of **IoT** to Monitor ✓ Crop health,	• Use IoT devices to monitor soil moisture, pH, temperature, and humidity levels. • Demonstrate case studies on international best practices in Agritech. • Video demonstration on Automated seed sorting /

			✓ Livestock health ✓ Pest control	frequency based pest detection/control system.
8	**3**	**3,4,5**	• Role of **IoT** in transforming Indian dairy industry to smart dairy farming, Health Tracking Devices for Cattle. • Introduction to Robotics- classification with respect to geometrical configuration(anatomy), selection based on the agriculture application. • Hydroponics – concept, principle, advantages, applications. Discuss any case study.	• Robotic Milking Machines (Visit/Video Demonstration) Or Visit a local APMC and collect the data on software used for the following -arrival date of products-collection-its analysis- its decimation (also interact with the farmers for other information) • Cultivate any crop using hydroponics in college premises and monitor it using IoT devices.

9	**3,4**	**3,4,5**	**Precision/Smart Farming** • Precision Farming-Introduction, its importance, list the types • Introduction to vertical farming – importance, features, applications • principles of precision farming (4R's of precision farming) and Real-world applications of precision agricultural technology	Visit a nearby precision farming unit and Identify (i) various sensors used in precision farming (ii) The technical snags in precision farming and discuss its solution in the class. Submit a report on the above. OR Visit any KMF and submit a report on automation adopted in package of milk and milk products. (expiryTime, quality check, preservatives used, quantity)
10	**3**	**3,4,5**	**Remote sensing in Agriculture** • Remote sensing in Agriculture, GPS and GIS in Agriculture. • Smart irrigation OR GSM/mobile based irrigation system • With suitable GIS , analyze the greenery in your college campus.	• Introduction to QGIS (Quantum Geographic Information System) open source GIS software and its installation and **Demo** on using GPS and GIS free tools. • Collect and analyse the soil/ crop /weather/water data using QGIS software on taking decisions for optimal cropping practices (to predict optimal time for fertilizer and pesticide applications).
11	**3**	**3,4,5, 7**	**AI in Agriculture and Livestock** • Introduction to artificial intelligence, its applications to analyze crop patterns • Use of AI in agriculture for	• Video demonstration on use of AI in agriculture, Livestock. Submit a detailed report on it. • Discussion to Emphasize Data Science & AI in Agri-business-

			autonomous crop management and health, livestock health • Use of AI in monitoring, intelligent pesticide application, automatic weeding and harvesting, sorting of produce.	Incorporate detailed modules on AI-driven data analytics, machine learning, and predictive models that are transforming the agri-business sector. OR • Study a Use case and do analysis on Drone captured image processing with respect to crop patterns etc.
12	**4**	**3,4,5**	• **Drones –** Introduction, its applications in agriculture industry. Benefits of Agri-drones. • Discuss the need and use of Drones in Livestock surveillance. • Drone SOPs for particular crops, safety issues, DGCA guidelines for Agriculture.	• Workshop on uses of Drones in agriculture (any one application such as Drone irrigation/spraying/seed and fertilizer broadcasting) OR • Workshop on implementation of Drone and its components. • Simulate drone path planning for crop spraying(using DroneKit /python)
13	**4**	**3,4,6, 7**	**Modernisation in Agriculture** • Discuss the Benefits of Computerising Farmers Producer Organisations (FPO), co-operative societies in India. • Cold storage – necessity, advantages disadvantages. • **Emerging Technologies** Discuss newer advancements like ➢ Blockchain in agriculture, ➢ Gene editing technologies ➢ Electronic land survey.	• VISIT to a nearby FPO and submit report on Governmentt schemes for Farmers, Agripreneurs. • (i)Video demonstration on automated grain storage management system**.** (ii)Submit a report on food export quality inspection and certification procedures • Discuss Technology used for testing Food safety and standards, its certification procedure. List the equipment used for it.

4. References:

- Online Website: https://agritech.tnau.ac.in/org_farm/orgfarm_index.html
- Principles of Agronomy: S R Reddy
- Principles of Agronomy: T. Yellamanda Reddy and G. H. Sankara Reddy
- Fundamentals of Soil Science: Indian Society of Soil Science
- Fundamentals of Remote Sensing: George Joseph and C Jaganathan
- A Competitive Book of Agriculture: Nem Raj Sunda
- Agronomy facts for Competitions: Ram Swaroop Meena and Sandeep Kumar Sihag
- "The Digital Agricultural Revolution: Innovations and Challenges in Agriculture through Technology Disruptions" by K. R. Gupta
- "Technology in Agriculture" by Muhammad Sultan
- "Weather Forecasting Handbook (5th Edition)" by Tim Vasquez
- "Emergency and Disaster Management" by Michael J. K. Thomas
- "Forecasting Financial Markets: Technical Analysis and the Dynamics of Price" by J. Murphy
- "Water Management in Agriculture" by R.K. Sharma
- "Principles of Irrigation Engineering" by S.K. Gupta
- "Soil Water Management: Principles and Practices" by C. D. S. Reddy
- "Agro-Waste Management" by S. K. Singh
- "ICT in Agriculture: Perspectives and Policy Issues" by R. K. Sharma
- "Precision Agriculture Technology for Crop Farming" by Qin Zhang
- "Remote Sensing and GIS for Environmental Monitoring" by M. S. Swaminathan
- Smart Farming Technologies" by D. L. Miller
- "Internet of Things (IoT) in Agriculture" by P. R. Sharma
- "IoT for Smart Agriculture" by S. M. R. L. Y. R. Singh
- "Artificial Intelligence in Agriculture" by R. K. Sharma

Refer the following Websites-

1. IGNOU
2. Manage Hydrebad
3. MSME- Food processing
4. CFTRI
5. IIHR
6. IIIT
7. NIFT

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1TheoryTest	4	90	50	Average of all CIE=50 Marks
2.	CIE-2Practice Test	7	180	50	
3	CIE-3TheoryTest	10	90	50	
4.	CIE-4Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

6. SEE – Practice Assessment Methodologies

Sl. No	SEE – Practice Assessment	Duration (minutes)	Max marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics and Communication			Semester - V	
Course Name	Agritech			Test	I/III
Course Code		Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section .Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	1. Describe importance of agriculture in Indian economy 2. Explain the equipment and technology in i. weather forecasting ii. Disaster management 3. Explain the technology used for i. water management in agriculture. ii. Moisture conservation	L2 L2 L2	1 2 2	5M 10M 10M
2	1. Describe the impact of ICT on Agriculture and Information Technology 2. Discuss a Use case each of IoT to Monitor i. Soil conditions ii. Weather conditions 3. Discuss a Use case each of IoT to Monitor i. Crop health, ii. Livestock health	L2 L2 L2	2,3 2 2	5M 10M 10M
	Section - 2			
3	1. Explain the Role of IoT in transforming Indian dairy industry to smart dairy farming using Robotic Milking Machines 2. Analyze the use of GPS and GIS in Agriculture	L2 L4	3,4 1,3	10M 15M
4	1. List the benefits of Agri-Drones. 2. Analyze the implementation of smart irrigation OR GSM/mobile based irrigation	L2 L4	4	10M 15M
Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks ,cognitive level and course outcomes.				

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

6. CIE Practice Test model question paper

Program	**Electronics and Communication**			**Semester**	
Course Name	**Agritech**			**Test**	**II/IV**
Course Code		**Duration**	**180 min**	**Marks**	**50**
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
Demonstrate the Use IoT devices to monitor soil pH, light intensity, and humidity/Use IoT devices for pest control (Camera/Gas Sensors/Electronic Nose) OR Demonstrate any Agricultural mobile app and document its uses.	**L3**	**50**
Scheme of assessment **a) Write up** **b) Setting up** **c) Demonstration** **d) Result**		**10** **10** **20** **10**
	Total Marks	**50**

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

7. Suggestive Activities for Tutorials:

The List is an Example and not inclusive of all possible activities of the course. Student and Faculty are encouraged to choose activities that are relevant to the topic

Sl.No.	**Suggestive Activities for Tutorials**
01	RFID-Based Livestock Tracking System
02	IoT-Based Livestock Feeding Schedule Management
03	Automated Biosecurity System for Farms
04	Smart Irrigation System with Soil Moisture Sensors
05	Smart Fencing System for Livestock Protection
06	Remote Sensing for Crop Health Monitoring
07	Hydroponic plantation

8. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		10	20	30	40	50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	50
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	20
	Average Marks=(40+30+50+20)/4=35						**35**

Note: DimensionandDescriptorshallbedefinedbytherespectivecoursecoordinatoraspertheactivities

9. SEE- Model Practice Question Paper

Program	**EC**			**Semester**	
CourseName	**AgriTech**	**CourseCode**	**20EC53IB**	**Duration**	**180 min**
Questions				**CO**	**Marks**
Implement any one case study expert system					**50**
Scheme of assessment **a) Write up** **b) Demonstration** **c) Result** **d) VIVA VOCE**					**10** **20** **10** **10**
				Total Marks	**50**

1) Signature of the Examiner **2) Signature of the Examiner**

10. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	IoT Sensors for Soil moisture, pH, temperature, Humidity levels etc.		30
02	Precision farming sensors		30
03	Robotic Milking Machines	1000 litre	02
04	Drone Kit		02
05	Agri Apps, QGIS, GPS and GIS free tools		

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics & Communication Engineering**	**Semester**	**V**
Course Name	**E- Vehicles & Drone Technologies.**	**Type of Course**	Integrated
Course Code	**25EC53IC**	**Contact Hours**	**7 hours/week 91 hours/semester**
Teaching Scheme	**L:T:P :: 3:0:4**	**Credits**	5
CIE Marks	**50**	**SEE Marks**	**50 (Practice)**

1. Rationale:

EVs are at the forefront of technological innovation, involving fields like battery technology, electric motors, smart systems, and autonomous driving. This offers the chance to work with the latest technology and develop hands-on skills that are highly valuable in the future. By entering the EV industry, students can gain experience in emerging tech areas that can also be applied to other industries, ensuring long-term career growth and adaptability. With the diversity of roles in the EV space, students can develop a broad skill set. They can also transition into other engineering or technology-related industries over time, as the skills they acquire in EVs—such as working with electronics, automation, or renewable energy systems—are transferable.

This course introduces students to the interdisciplinary integration of drones and EV systems. It provides comprehensive knowledge of drone subsystems, navigation systems, energy efficiency, and regulatory compliance. The curriculum prepares students for real-world applications and industry readiness.

2. Course outcomes: On successful completion of the course, the students will be able to,

CO1	Illustrate the E-vehicle technology fundamentals including components, systems, regulations and its significance in real-world applications.
CO2	Analyze the communication protocols, battery management systems, charging systems and demonstrate them.
CO3	Explain drone technology fundamentals, including its components, systems, navigation, regulations, and real-world applications.
CO4	Gain hands-on skills in drone assembly, flight, and integration, focusing on safety and exploring careers in drone and EV industries.

3. Course Contents

WEEK	CO	PO	Theory	Practice
1	1	3,5,7	**Introduction to EV.** 1. Introduction to Electric Vehicles - Myths, Success factors & Challenges. 2. Types of different pollutants produced due to IC engine vehicle (ICEV) and their effect on human health. 3. Policy measures in EV. ➢ Incentives and Concessions ➢ Battery swapping. Special initiatives for EV manufacturing.	1. Find out the following parameters through the following online links. ✓ Co2 emission calculator (Should I shift to Electric Vehicle) ✓ Crude Oil Saving Calculator 2. Prepare a report on different types of EV in India by EV Manufacturers. (TATA, Maruthi Suzuki, KIA, TESLA, HYUNDAI, etc.)
2	1	1,4	**Types of Electric Vehicles** Block diagram and working principle of – 1. Battery Electric Vehicle (BEV). 2. Hybrid Electric vehicle (HEV). 3. Plug in Hybrid Electric Vehicle (PHEV).	1. Identify commercially available battery & hybrid electric vehicles and prepare a list of electric vehicles with its battery capacity, Motor and range. 2. Identify commercially available plugin hybrid electric & available fuel cell electric vehicles and prepare a list of electric vehicles with its battery capacity, Motor and range
3	1,2	2,3,4	**Energy sources / BATTERY in EV.** **1.** Energy sources used in EVs and HEVs – concept & applications of • Batteries • Ultra-Capacitors • Ultra-Flywheels • Fuel cells. 2 Battery Management Systems – components & working. 3. Importance of thermal management system with examples.	1. Design a battery pack rated capacity 25Ah in a simulation software with C rate calculation. 2. Test and compare different batteries for overcharging, short circuit, and mechanical damage and ignition conditions.

4	1,2	2,3,4	**Sensors, power electronics in EV** **1.** Importance of Power electronics in E - Vehicles – Rectifiers (AC-DC) & Inverters (DC-AC), switch controller, Solid State controllers (DC-DC), electronic controllers –working principle & applications 2. Switching devices– diodes/IGBT's/MOSFETs, Onboard chargers/off board chargers – working principle & applications. 3. Battery Monitoring Sensors, State of the Charge Sensing, MEMS Sensors for Engine Management, Hall effect sensors.	1. Construct and simulate the charging circuit of a battery using any simulation software. 2.Construct a circuit to monitor the voltage and the state of charge of the battery.

5	2	3,4	**Communication Protocols -** significance**.** 1. Automotive bus system - CAN (Control Area Network) - Features & applications. 2. Automotive bus system -LIN (Local Interconnect Network) - - Features & applications. 3.Automotive bus system FlexRay™ and MOST (Media Oriented Systems Transport) - Features & applications.	1.Demonstration of CANalyser/CANoe software (CAN related software), application areas – analysis, diagnostics, logging, etc. 2.Video demonstration of any two communication protocols used in EV's.
6	2	3,5,7	**STM32 Programming** 1. Role of an ECU, ECU software, types of MCUs: NXP, TI, Infineon – features. 2.STM32 microcontroller – importance and its applications. 3.STM32 Microcontroller – basic programming examples.	1. Demonstration of STM32CUBE IDE software with simple application programs. 2.Conduction of STM32CUBE IDE software with simple application programs.

7	1,2	3,5,7	**EV Charger.** **1.** Battery charging technologies – features. • Normal charging • Opportunity charging • Fast charging • Battery swapping. 2. EV charger – components, charging standards. 3. Advanced Driver Assistance System (ADAS) - concept, features, demonstration	1. Construct and Simulate EV Charger using any open-source software. 2. Visit a nearby EV charging station and note down the specifications
8	3,4	1,4	**Introduction to Drones and Applications** 1. History and evolution of drones, emphasizing their technological milestones and industrial adoption. 2. Applications of drones in agriculture, logistics, construction, and environmental monitoring. 3. Overview of trends and advancements in drone technology, including automation and integration with other emerging technologies.	1. Video demonstration: Watch case studies showcasing drones used for environmental monitoring and precision agriculture. 2. Case study: Analyze the role of drones in improving operational efficiency in logistics or construction projects.

9	3,4	1,3,5	**Drone System and Components** 1. Structural components: Frames, landing gear, and arms, with a focus on lightweight material innovations. 2. Electronic components: Motors, ESCs, flight controllers, and propellers, and their contribution to drone performance. 3. Wiring schematics: Overview of wiring diagrams and connections involved in assembling a functional drone.	1. Video demonstration: Observe the assembly process of a drone and explore how materials affect stability and performance. 2. Experiment or Video Demonstration: Understand how all the subsystems of a drone are electronically connected using wires and connectors.

10	3,4	1,3,5	**Power Systems and Energy Efficiency** 1. Types of batteries used in drones, including LiPo, Li-ion, and their respective energy densities. 2. Importance of battery management systems for charging safety and long-term performance. 3. Comparison of power systems in drones and EVs for optimizing energy consumption.	1. Video documentation or Experiment: Watch a demonstration of charging cycles and safety precautions for LiPo and Li-ion batteries. 2. Experiment or case study: Analyse how the power consumption of a propulsion system affects under varying throttle values
11	3,4	2,3,4	**Navigation Systems and Sensor Integration** 1. Navigation systems used in drones, such as GPS, barometers, and Inertial Measurement Units(IMU), with a focus on their accuracy and reliability. 2. Sensor integration and fusion techniques for autonomous navigation and enhanced obstacle avoidance. 3. Real-world applications of navigation systems in mapping and surveying.	1. Video demonstration: Observe how drones use navigation and sensor fusion for precise mapping in surveying projects. 2. Experiment or Case study: Analyze the key differences between an accelerometer and a gyroscope in an IMU .
12	3,4	3,4,7	**Basic Flight Maneuvers** 1. Drone flight controls including throttle, pitch, yaw, and roll, and their role in flight stability. 2. Basic flight maneuvers such as takeoff, hovering, and landing. 3. Advanced maneuvers like turns, figure-eight, and other directional changes.	1. Video demonstration: Observe different types of flight modes based on the type of drone used as per their application. 2. Experiment: Practice basic flight maneuvers using a drone Flying kit/ simulator.

13	3,4	3,4,7	**Drone Regulations, safety protocols and career opportunities** 1. Importance of failsafe systems like return-to-home and emergency landing protocols, and strategies for ensuring operational safety and reliability in emergencies. 2. Overview of DGCA guidelines, operational compliance, and ethical considerations, including privacy and data security in drone operations. 3. Emerging roles and certifications in the drone and EV industries, emphasizing interdisciplinary career paths and advancements.	1. Video documentation: Observe drones in action under DGCA guidelines to understand operational compliance. 2. Assignment: Prepare a report on emerging career opportunities at the intersection of drones and EV technologies.

4. References:

Documentation and Websites:

- PX4 Documentation: https://px4.io
- Betaflight Documentation: https://betaflight.com
- Oscar Liang's Blog: https://oscarliang.com
- GetFPV Learn Website: https://getfpv.com/learn
- Joshua Bardwell YouTube Channel: https://youtube.com/joshuabardwell

Books:

- Introduction to UAV Systems by Paul G. Fahlstrom.
- Small Unmanned Aircraft: Theory and Practice by Beard and McLain.
- Drones for Dummies by Mark LaFay and Kyle Snyder.
- Fundamentals of Navigation and Inertial Sensors by Amitava Bose.
- Power Electronics for Renewable Energy Systems, Transportation, and Industrial Applications by Haitham Abu-Rub, Mariusz Malinowski, and Kamal Al-Haddad.
- Battery Management Systems for Large Lithium-Ion Battery Packs by Davide Andrea.
- Mechatronics: Principles and Applications by Godfrey C. Onwubolu.
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- Electric and Hybrid Vehicles by Tom Denton. (Institute of the Motor Industry)
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- Modern electric, hybrid electric, and fuel cell vehicles: fundamentals, theory, and design, by Sebastian, Yimin Gao , CRC Press publications.
- Advanced Electric Drive Vehicles by Ali Emadi , CRC Press publications.
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- Fundamentals and Application of Lithium-ion Batteries in Electric Drive Vehicles by Jiuchun Jiang & Caiping Zhang , Wiley Publications.
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- K. T. Chau, "Energy Systems for Electric and Hybrid Vehicles", The Institution of Engineering and Technology, 2016

- B. Scrosati, J. Garche and W. Tillmetz, "Advances in Battery Technologies for Electric Vehicle", Woodhead, 1st edition, 2015.

5. CIE Assessment Methodologies

Sl. No	CIE Assessment	Test Week	Duration (minutes)	Max marks	
1.	CIE-1 Theory Test	4	90	50	Average of all CIE=50 Marks
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all the activities through Rubrics	1-13		50	
				Total	**50 Marks**

Note: Portfolio evaluation includes average of (a) and (b)

(a) Any one suggested activity model with report and presentation evaluated for 50 Marks.

(b) Each laboratory exercise will be evaluated for a total of 50 marks. The evaluation will include the following components:

1) Written description of the experiment in the observation book.
2) Conducting the experiment and the associated learning outcomes.
3) The results obtained from the experiment.
4) Corrections and evaluations of the experiment completed in the previous class, documented in the record book.

6. SEE – Practice Assessment Methodologies.

Sl.No	SEE – Practice Assessment	Duration (minutes)	Max Marks	Min marks to pass
1.	Semester End Examination-Practice	180	50	20

7. CIE Theory Test model question paper

Program	Electronics And Communication Engineering			Semester - V	
Course Name	E- Vehicles & Drone Technologies.			Test	I
Course Code	25EC53IC	Duration	90 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					

Q.No	Questions	Cognitive Level	Course Outcome	Marks
	Section - 1			
1	a) Analyse the economic and environmental impacts of using E – Vehicles in the modern-day society. Explain the role of EV's in reducing Greenhouse effect.	L2	1	10
	b) A person sees a car which is being driven without a driver. Can this be possible? what is the technology involved. Explain in detail.	L2	1	10
	c) An EV owner while driving the vehicle observes that suddenly the steering system has lost its power feature and is very hard to operate. Explain the causes for the failure of the system and its solution.	L3	2	5
2	a) Power electronics plays a very important role in EV. Do you agree? If yes list all the components and technologies involved. justify your answer.	L2	1	10
	b). Why aren't the Metal air batteries are not used widely in spite of having many benefits. Analyze the possible causes.	L3	1	10
	c) The range of an EV Vehicle is about 250km. The owner wants to increase the range as he is going on a family trip. How the range can be extended in an E- vehicle, explain the concept involved.	L3	2	5
	SECTION- 2			
3	Briefly describe the evolution of drones and their industrial applications.	L3	3	5
	Analyze the role of drones in improving operational efficiency in logistics.	L3	3	10
	Prepare & explain a flowchart of the main components in a drone system.	L3	3	10
4	Discuss how GPS and IMUs are integrated into drones for autonomous navigation	L3	4	10
	Illustrate the safety protocols to be followed during drone operations as per DGCA guidelines?	L3	4	10
	Compare LiPo and Li-ion batteries in terms of energy density and safety	L3	4	5

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

8. CIE Practice Test model question paper

Program	Electronics and Communication Engineering			Semester	V
Course Name	E- Vehicles & Drone Technologies.			Test	II/IV
Course Code	25EC53IC	Duration	180 min	Marks	50
Name of the Course Coordinator:					

Questions	CO	Marks
1 Practice question on E- Vehicles/Drone Technologies.	1,2,3,4.	50
Scheme Of Assessment:		
Write up for two experiments and conduction of any one experiment: **1. write up of procedure & system design for 2 experiments.** **2. conduction/Simulation of any one experiment.** **3. result/output evaluation.** **4. viva-voce**		 20 10 10 10
Total		50

Signature of the Course Coordinator | **Signature of the HOD** | **Signature of the IQAC Chairman**

9. Suggestive Activities

The List is an Example and not inclusive of all possible activities of the course. Students and Faculty are encouraged to choose any ONE activity that is relevant to the topic.

Sl.No.	Suggestive Activities
1	Using the Drone Model Assembly Kit, create a wiring schematic for a drone. Simulate common wiring faults (e.g., loose connections or reversed polarity) and practice troubleshooting these issues.
2	Analyse the energy consumption of a few propulsion systems using the Propulsion System Testing Kit. Experiment with different propellers and figure out the best system for a drone with an all up weight of 300 grams
3	Use the Drone Sensor Kit to calibrate accelerometers and gyroscopes. Demonstrate how these sensors can stabilize a drone during simulated motion
4	Research the safety systems used in drones, such as return-to-home (RTH) and geofencing. Write a report explaining their importance in commercial applications and how they enhance operational safety.
5	Design and build a model of an electric vehicle using basic materials like motors, batteries, and sensors.

6	Simulate/ build and program a simple Battery Management System (BMS).
7	Conduct research into the current state of the EV market understanding the market dynamics, the economic impact of EV adoption, and potential business opportunities in the EV industry.

10. . Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		0-10	11-20	21-30	31-40	41-50	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	40
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	30
	Average Marks=(40+30+40+30)/4=35						**35**

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities.

11. SEE- Model Practice Question Paper

Program	**Electronics and Communication Engineering**		**Semester**	**V**
Course Name	**E- Vehicles & Drone Technologies.**	**Course Code 25EC53IC**	**Duration**	**180 min**
Questions			**CO**	**Marks**
1 practice experiment each on E Vehicles & Drone technologies.			1,2,3,4	50 M
Scheme of Assessment:				
1.write up of procedure & system design for 2 experiments (1 Drone & 1 EV experiment) **2.conduction / simulation of any 1 experiment.** **3.result/output evaluation** **4.viva-voce**				20 10 10 10
			Total	50

1) Signature of the Examiner **2) Signature of the Examiner**

12. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	MAT LAB Simulink Software	As per industry standards.	1
02	Diagnostic Software for EV's	As per industry standards	1
03	Drone Model Assembly and Wiring Kit	Model assembly drone with individual components in plug-and-play format, with wiring connection features	5
03	Propulsion System Testing Kit	Thrust stand with modular motor assembly, data feedback for power and thrust, Li-ion and LiPo battery with charger and parallel boards	4 3
04	Open Source Drone Sensor Kit	Accelerometer and gyroscope testing kit with microcontroller.	8
05	Drone Communication Simulation Kit	ELRS communication system, CAN-enabled sensor with appropriate microcontroller or processor, 915 MHz telemetry module, RF power meter, 5.8 GHz video transmission system, dipole antenna, directional antenna	3
06	Drone Model Assembly and Wiring Kit	Model assembly drone with individual components in plug-and-play format, with wiring connection features	2

Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	**Electronics and Communication Engineering**	**Semester**	**5**
Course Name	**Project Management and Entrepreneurship**	**Type of Course**	**Integrated**
Course Code	**25EC54I**	**Contact Hours**	**8 Hrs/Week 104 Hrs/Week**
Teaching Scheme	**L: T:P:: 4:0:4**	**Credits**	**6**
CIE Marks	**50**	**SEE Marks**	**50 (Theory)**

1. Rationale:

Project Management skills provides a comprehensive understanding of the methodologies, tools, and practices that drive the success of projects. It develops critical competencies in planning, executing, controlling, and closing projects, making it a vital skill set for anyone aiming for leadership roles in their career. These competencies help both individuals and organizations achieve their strategic goals, optimize resources, and deliver successful outcomes, thus contributing to long-term success and career advancement.

Entrepreneurship provides individuals with the knowledge, and mindset needed to identify opportunities, take risks, and create meaningful impact through business ventures. It fosters innovation, personal growth, and critical business skills, while also contributing to economic development and job creation. Whether aiming to start a business or work in innovative companies, entrepreneurship education prepares individuals to navigate the challenges of the modern business world and create value in dynamic environments.

The course is designed to equip diploma students with essential knowledge, practical skills, and a mindset to excel in managing projects and pursuing entrepreneurial ventures.

2. Course Outcomes: At the end of the Course project, the student will be able to:

CO-01	Develop comprehensive plans, including defining objectives, scope, creating Work Breakdown Structures (WBS), and estimating resources..
CO-02	Use project tools such as Gantt charts, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT) to manage project timelines and budgets.
CO-03	Demonstrate leadership and team management skills, and Apply project monitoring techniques to track project progress and performance.
CO-04	Identify the viable business opportunities through entrepreneur skills.
CO-05	Create comprehensive business plans, including marketing, operations, and financial strategies.

3. Course Content

WEEK	CO	PO	Lecture (4 Hours per Week)	Practical (4 Hours per Week)
1	1	1,2,6,7	**Introduction to Project Management** ● Importance of project management. ● Key concepts: scope, time, cost, quality, risk, and stakeholders. ● Project lifecycle: Initiation, planning, execution, monitoring, and closure. ● Icebreaker exercise: Identifying roles in a project.	**Case Studies and Analysis** **Objectives:** Critical thinking, problem-solving, risk assessment. ● **Activity**: Provide students with case studies of successful and failed projects. Ask them to analyze what worked, what didn't, and suggest improvements.
2	1	1,2,3,6,7	**Project Initiation and Planning** ● Defining project goals and objectives. ● Stakeholder analysis and management. ● Developing a project charter. ● Creating a Work Breakdown Structure (WBS).	**Team Project Planning** **Objectives:** Planning, task delegation, goal setting. ● **Activity:** Divide students into small groups and assign them a project (e.g., organizing an event or developing a small product or similar event familiar to the students). Each group creates a project plan, including objectives, scope, WBS, timelines, and deliverable.
3	2	1,2,3,6,7	**Scheduling and Resource Management** ● Project scheduling and timelines. ● Tools: Gantt charts, Critical Path Method (CPM), and PERT. ● Resource allocation and management. ● Case study: Resolving resource conflicts in a project	**Gantt chart Creation** **Objectives:** Scheduling, prioritization, use of project management tools. ● **Activity:** Students design a Gantt chart for a mock or real project, outlining tasks, timelines, and dependencies.
4	2	1,2,3,6,7	**Risk Management and Communication** ● Identifying and analyzing project risks. ● Risk mitigation strategies. ● Developing a communication plan.	**Risk Management Workshop** **Objectives:** Risk assessment, contingency planning ● **Activity:** Present a project scenario with potential risks. Students identify risks, assess their impact, and create mitigation strategies.
5	2	1,2,3,6,7	**Monitoring, Control and Quality Management** ● Project monitoring tools and techniques.	**Time Management Challenge** **Objectives:** Time management, multitasking

			• Change management in projects. • Quality assurance and control	• **Activity:** Students Conduct a root cause analysis and manage their schedules to complete a project with multiple overlapping deadlines.
6	3	1,2,3, 6,7	**Leadership and Team Management** • Leadership styles in project management. • Building and managing high-performing teams. • Conflict resolution techniques • Importance of emotional intelligence.	**Role-Playing Scenarios** **Objectives:** Communication, conflict resolution, leadership • **Activity:** Students take on specific project roles (e.g., project manager, team member, client) and simulate project scenarios such as resolving conflicts, managing deadlines, or dealing with scope changes.
7	3	1,2,3, 6,7	**Closing a Project and Review** • Closing phase: Documentation, handover, and lessons learned. • Conducting project reviews and retrospectives.	**Presentation and Reporting** **Objectives:** Reporting, presentation skills • Activity: Students present project updates or final outcomes to a client, simulating stakeholder meetings. and After completing a project, students conduct a retrospective to reflect on what went well, what didn't, and how to improve in the future
8	4,5	1,2,3, 6,7	**Introduction to Entrepreneurship** • What is entrepreneurship? • Characteristics of successful entrepreneurs. • Types of entrepreneurs • Importance of entrepreneurship in economic development • Case studies of successful entrepreneurs	**SWOT Analysis** **Objective**: To introduce students to the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis tool and how it helps assess business viability. **Activity:** • Ask students to choose a business idea (either their own or one you provide) and conduct a SWOT analysis. • In small groups, they will identify and discuss the strengths, weaknesses, opportunities, and threats associated with the idea. • Each group should present their findings, and afterward, you can facilitate a discussion on how to address weaknesses or leverage strengths to increase the chances of success. • Submit a detailed report on various state and central government schemes on supporting the start-ups.

9	4,5	1,2,3, 6,7	**Idea Generation and Validation** ● Identifying Opportunities ● Analyzing market trends ● Recognizing problems as opportunities. ● Brainstorming innovative ideas	**Business Idea Generation** **Objective**: To encourage students to think creatively and develop a viable business idea. **Activity:** ● Break students into small groups and ask them to come up with 3-5 unique business ideas based on different industries (e.g., technology, sustainability, healthcare etc). ● Encourage them to think about solving problems, identifying gaps in the market, or improving existing products or services. ● Each group should present their ideas, explaining how they would execute them, potential challenges, and target customers. ● Afterward, allow other groups to provide feedback and suggestions on the ideas.
10	4,5	1,2,3, 6,7	**Business Planning and Strategy** ● Understanding Business Models ➢ Types of business models ➢ Lean canvas model ➢ Key resources, activities, and partnerships ● **Crafting a Business Plan** ➢ Components of a business plan ➢ Setting clear objectives ➢ Understanding target audiences and market segmentation ➢ Writing a simple business plan	**Business Plan Development** **Objective:** To provide students with hands-on experience in creating a business plan. **Activity:** ● Identify the resources required, activities involved, partnership criteria, understanding target audiences and market survey for your business model. ● Develop business model consisting of sections like market analysis, financial projections, marketing strategy, and operational plan) for your business idea. Give a presentation on your business plan to the class. ● Students can either work individually or in teams to create a business plan for a hypothetical business (could be based on a previously developed idea or a new one). ● Take feedback and discuss the strengths and weaknesses of each business plan.
11	4,5	1,2,3, 6,7	**Marketing and Sales** ● **Market Research:** ➢ Understanding the target audience ➢ Competitor analysis ➢ Developing a marketing strategy ● **Branding and Marketing:** ➢ Building the brand identity ➢ Digital marketing basics ➢ Social media strategies ➢ Developing a Unique Selling Proposition (USP) ➢ Creating a simple marketing plan	**Market Research Simulation** Objective: To replicate the process of conducting market research and identifying customer needs by considering the students as customers. **Activity:** ● Conduct market research by interviewing "customers" (other students in the class) regarding the product from their business plan ● Have them prepare a questionnaire or survey to gather feedback on potential customer interest, price sensitivity, and purchasing habits? ● After collecting data, students will analyze it and use the insights to refine their product.

12	4,5	1,2,3, 6,7	**Financial Planning and Management** ● Basics of Business Finance ➢ Understanding startup costs ➢ Revenue streams and pricing ➢ Profit margins and break-even analysis ➢ Financial statements: Income Statement, Balance Sheet, Cash Flow. ● Funding Your Business: ➢ Sources of funding: loans, investors, grants ● Case study: Analyze a startup's financials	**Financial Planning Exercise** **Objective:** To help students to understand the financial aspects of starting and running a business. **Activity:** ● Conduct financial analysis such as financial data, including startup costs, monthly expenses, and expected revenue for your business plan. ● Ask them to create a basic budget or financial projection for the business over the first year. ● Discuss key financial concepts such as cash flow, break-even point, and profit margins. ● At the end of the exercise, review the financial projections of your project team and analyze the sustainability of the business.
13	4,5	1,2,3, 6,7	**Scaling and Sustaining the Business** ● Growth strategies. ● Managing risks and pivoting. ● Exit strategies: mergers, acquisitions, or IPOs. ● Case studies: Stories of scaling from small businesses to global brands. ● Intellectual property rights	**Elevator Pitch Competition** Objective: To practice delivering a concise and persuasive business pitch. **Activity:** ● Ask students to prepare a 30-60 second "elevator pitch" for their business idea. ● The pitch should include the problem they are solving, their solution, target market, and how their business is unique. ● Organize a competition where participants present their pitches to the class or a panel of judges. ● Judges can provide feedback on the clarity, creativity, and persuasiveness of the pitch and a winner can be selected.

Suggested projects for the weekly activities from week 2 to week 7.

Note: Students should execute a simple real-time project in teams and then carry-out all the activities related to the respective project in each week.

1) IoT-Based Home/class room Automation System.
2) Automatic Water level controller for the institution
3) Autonomous Mobile Robot.
4) Smart Parking System in your college premises.
5) Smart Irrigation System with Soil Moisture Sensors
6) Smart Fire Alarm System
7) Smart Door Lock System for class room/Lab

4. References:

Sl. No.	Author	Title of Book
1	Donald F. Kuratko	Entrepreneurship: Theory, Process, and Practice"
2	Eric Ries	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses
3	Stanley E. Portny	"Project Management for Dummies"
4	Steve Blank and Bob Dorf	The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company
5	Bruce R. Barringer and R. Duane Ireland	Entrepreneurship: Successfully Launching New Ventures
6	Guy Kawasaki	The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything
7	Michael E. Gerber	The E-Myth Revisited: Why Most Small Businesses Don't Work and What to Do About It
8	Alexander Osterwalder and Yves Pigneur	Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers.
9	Clayton Christensen	The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail
10	Simon Sinek	Start with Why: How Great Leaders Inspire Everyone to Take Action
11	Jessica Livingston	Founders at Work: Stories of Startups' Early Days
12	Jeffrey K. Pinto	Project Management: Achieving Competitive Advantage
13	Scott Berkun	The Art of Project Management
14	Jack R. Meredith and Samuel J. Mantel Jr.	Project Management: A Managerial Approach
15	Brant Cooper and Patrick Vlaskovits	The Lean Entrepreneur: How to Accomplish More by Doing Less
16	Harold Kerzner	Project Management: A Systems Approach to Planning, Scheduling, and Controlling
17	Scott Berkun	Making Things Happ
18	Adam Josephs and Brad Rubenstein	Risk Up Front
19	Patrick Lencioni.	The Five Dysfunctions of a Team
20	by Jonah Berger.	"Contagious: How to Build Word of Mouth in the Digital Age"
21	Karen Berman and Joe Knight	"Financial Intelligence for Entrepreneurs"

22	Eric Ries	"The Lean Startup"
23	Peter Thiel.	"Zero to One"
24	Eric Ries,	*"The Lean Startup"*
25	Peter Thiel.	*"Zero to One"*
26	Simon Sinek	*"Leaders Eat Last"*
27	Templates: Project Charter and WBS (see PMI.org or MS Office templates). Templates: Risk Register and Communication Plan. Templates: Project Closure Checklist. Templates for business plans (e.g., from SCORE or SBA). Tools: Google Trends, SEMrush (for market analysis). Tools: Excel templates for financial planning. Tools: Business Model Canvas, Value Proposition Canvas	
28	Video: "How to Write a Project Charter" (YouTube or similar). Video: "Introduction to Gantt Charts." Video: "Managing Project Risks" (LinkedIn Learning or YouTube). Video: "Project Monitoring Techniques." Video: "How to Lead Teams Effectively." Video: "Project Monitoring Techniques." Video: "How to Lead Teams Effectively Video: "How to Close a Project Effectively." Videos: Simon Sinek's TED Talk *"Start With Why."* Videos: TED Talks like "How to Build Your Creative Confidence" by David Kelley. Videos: TED Talks like "How to Build Your Creative Confidence" by David Kelley.	

5. CIE Assessment Methodologies

Sl. No.	CIE Assessment	Test Week	Duration (minutes)	Max Marks	
1.	CIE-1 Theory Test	4	90	50	
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	Average of all CIE=50 Marks
4.	CIE-4 Practice Test	13	180	50	

5	CIE-5 Portfolio evaluation of all the weekly activities through Rubrics	1-13		50	
Total					**50 Marks**

6. SEE – Theory Assessment Methodologies

Sl. No	SEE – Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE-1 Theory Test Model Question Paper

Program	**Electronics and Communication Engineering**			**Semester 5**	
Course Name	**Project Management and Entrepreneurship**			**Test**	**I**
Course Code	**25EC54I**	**Duration**	**90min**	**Marks**	**50**
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					
Q. No	**Questions**		**Cognitive Level**	**Course Outcome**	**Marks**
Section-1					
1	a) Define project management and explain its importance in modern organizations. – 8 marks b) Describe the components of the project management triangle and their correlation between them. - 9 marks c) Explain the importance of stakeholder management in a project.- 8 marks		L3	1	25
2	a) What is a Work Breakdown Structure (WBS), and how does it aid in project planning? – 8 marks b) What is risk management in project management? Describe the steps involved- 9 marks c) Using examples, discuss techniques to prevent and manage scope creep in projects – 8marks		L3	1	
Section-2					
3	a) Discuss the role of communication in project management. How can poor communication impact a project? – 12 marks b) Describe the different tools used in project management for planning and scheduling- 13 marks		L3	2	25

4	a) Prepare a Gantt chart for implementing smart irrigation system in your college garden. b) Provide an example of a project risk scenario and suggest how it could be mitigated - 13 marks .	L3	2	

Note for the Course coordinator: Each question may have one, two or three subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

8. CIE-2 Practice Test model question paper

Program	**Electronics and Communication Engineering**			**Semester**	5
Course Name	**Project Management and Entrepreneurship**			**Test**	II
Course Code	**25EC54I**	**Duration**	180 min	**Marks**	50
Name of the Course Coordinator:					

Questions	**CO**	**Marks**
You are managing the setup of a new production line in a manufacturing unit for a consumer goods company. The project involves the following tasks: 1. **Procurement of Equipment**: 4 weeks 2. **Installation of Equipment**: 3 weeks 3. **Recruitment and Training of Staff**: 5 weeks 4. **Trial Production Run**: 2 weeks 5. **Quality Assurance Testing**: 1 week 6. **Full-Scale Production Launch**: 1 week The tasks have the following dependencies: 1. **Installation of Equipment** can begin only after the Procurement of Equipment is completed. 2. **Recruitment and Training of Staff** can run in parallel with Procurement of Equipment but must be completed before the Trial Production Run**.** 3. **Trial Production Run** depends on the completion of both Installation of Equipment and Recruitment and Training of Staff**.** 4. **Quality Assurance Testing** follows the Trial Production Run. 5. **Full-Scale Production Launch** depends on the successful completion **of** Quality Assurance Testing**.** The deadline for completing the project is 12 weeks.	2	50
Scheme of assessment 1. Develop a Gantt chart to represent the timeline and dependencies of the tasks in this project. – **30 marks** 2.If the Procurement of Equipment is delayed by 2 weeks due to supply chain issues, how will it impact the overall timeline and Prepare a revised plan to mitigate this delay.- **20marks**		
Total Marks		**50**

Signature of the Course Coordinator **Signature of the HOD** **Signature of the IQAC Chairman**

9. Rubrics for Assessment of activities (Qualitative Assessment)

Sl. No.	Dimension	Un satisfactory	Need Improvement	Satisfactory	Good	Excellent	Students Score
		(0-10)	(11-20)	(21-30)	(31-40)	(41-50)	
1	Technical Accuracy	Significant errors make the drawing unusable.	Multiple inaccuracies	Some errors affecting understanding but correctable.	Minor errors in interpretation or calculations	All details are accurate	40
2	Line Quality	Lines are messy and confusing.	Lines are uneven	Inconsistent line quality	Clear lines with minor inconsistencies.	Clean and consistent lines	40
3	Dimension	Dimensions are missing or incorrect.	Many errors; hard to interpret	Some dimension errors affecting interpretation.	Mostly accurate; minor issues	Dimensions are precise, clear, and correctly positioned, following standards.	45
4	Presentation on & Neatness	Very untidy;Very poor presentation	Messy;Presentation hinders clarity	Somewhat neat;Some layout issues	Generally neat with minimal flaws; minor improvement in Presentation	Extremely neat and organized; all details easy to read	40
5	Adherence to Standards	Does not follow any drawing standards.	Limited adherence to standards	Lacks consistency.	Minor deviations from standards.	Aadheres to relevant drawing standards (ISO, ANSI, etc.).	35
	Average Marks = (40+40+45+40+35)/5 =						**40/50**

Note: *Dimension and Descriptor shall be defined by the respective course coordinator as per the activities*

10. Equipment/software list with Specification for a batch of 30 students

Sl.No.	Particulars	Specification	Quantity
01	Computers	Latest configuration	30

Government of Karnataka
Department of Technical Education

C-25 Diploma Curriculum

INTERNSHIP

AND

CAPSTONE PROJECT

GUIDELINES

FOR

FACULTY, STUDENTS AND EXAMINERS

INTERNSHIP

Introduction

The students of Polytechnic Programs will have an opportunity to be part of one of the most challenging educational experiences in the year-3, The students will be trained in the specialization pathways of their interest in fifth semester, followed by 13-week internship or a Capstone Project work in sixth semester.

An internship is a professional learning experience which offers meaningful, practical work relevant to a student's field of study or career interest. It gives the students an opportunity for exploring the various career choices and acquire varied skills. It also offers an opportunity to bring out the innovative, creative ideas and energy into the workplace. This effectively aims at developing talent and potentially builds a pipeline for future Job prospects that may be ready for challenging roles in future. Internship has become very crucial for students to gain on-field experience which acts as an advantage for the students who do not have corporate experience.

Internships allow students to examine new situations, work techniques, problem-solving tactics, interpersonal skills, understanding of timelines and targets which would otherwise not be possible unless they were on board. Companies which plan to offer job placements to students also prefer hiring the interns for a short period as a trial wherein they have an opportunity to assess their ability and select them based on their observations over a considerable amount of time. This alternative gives the recruiter a better understanding of the candidate's worth in comparison to the assessment made in couple of interview sessions. Even for the interns it is a win-win situation as they get an opportunity to learn the corporate work culture in advance and later demonstrate their skills at their workplace

Outcomes

After completing Internship, Interns will be able to,

- Apply the theoretical knowledge and skill during performance of the tasks assigned in internship
- Demonstrate soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship
- Document the Use case on the assigned Task

Facilitating the Interns by an Internship Provider

- Orient intern in the new workplace. Give interns an overview of the organization, Explain the intern's duties and introduce him or her to co-workers
- Develop an internship job description with clear deliverables and timeline
- Allow the interns in meetings and provide information, resources, and opportunities for professional development
- The interns have never done this kind of work before, they want to know that their work is measuring up to organizational expectations, hence provide professional guidance and mentoring to the intern

- Daily progress report of Intern is to be evaluated by industry supervisor. examine what the intern has produced and make suggestions. Weekly supervision meetings can help to monitor the intern's work.

Duties & Responsibilities of the Faculty (Cohort Owner):

- To facilitate the placement of students for the internship
- To liaison between the college and the internship provider
- To assist the Industrial Training Supervisor during assessment

Instructions to the Interns(Students):

- Students shall report to the internship provider on the 1st day as per the internship schedule
- Intern is expected to learn about the organization, its structure, product range, market performance, working philosophy etc
- The interns shall work on live (On Job) projects assigned by the internship provider.
- The Intern shall record all the activities in the daily log book and get the signature of the concerned training supervisor
- Intern shall have 100% attendance during internship programme. In case of un-avoidable circumstances students may avail leave with prior permission from the concerned training supervisor of the respective internship provider. However, the maximum leave permitted during internship shall be as per company norms where they are working and intern shall report the leave sanctioned details to their college cohort owner
- The interns shall abide all the Rules and Regulations of internship provider
- Intern shall follow all the safety Regulations of internship provider.
- On completion of the internship, intern shall report to the college and submit the internship certificate mentioning duration of internship, evaluation of interns by internship provider, Student's Diary, report to the cohort owner.

Assessment

The Internship will be assessed for 100 marks through formative and summative assessment tools, in formative assessment the internship will be evaluated for 50 marks and in summative assessment internship will be evaluated for 50 marks

The Formative Assessment- (Continuous Internal Evaluation- CIE)

The Formative Assessment is conducted for 50 marks throughout the course in three developmental phases as CIE-I, CIE II and CIE-III. Students shall complete CIE-I before taking CIE-II and complete CIE-II before taking CIE-III, otherwise will not be eligible to take Semester End Examination.

Continuous Internal Evaluation- CIE - I conducted at the end of 4th week		
Sl No	**Assessment parameter**	**Marks**
1	Submit a report to the training supervisor and copy to the cohort owner focusing on: • Overview of the organization • Vision and mission of the organization • Organization structure • Roles and Responsibilities of personnel in the organization • Products and market performance	30
2	Give a presentation on the above	20
	Total	**50**

Note: CIE-1 shall be assessed by the Faculty (Cohort owner) for 50 marks using appropriate Rubrics.

Continuous Internal Evaluation- CIE - II conducted at the end of 8th week		
Sl No	**Assessment of On Job Training (OJT)**	**Marks**
1	On select job role of his/her interest in an organization or role assigned by the training supervisor for next Four weeks and submit a report to the training supervisor and copy to cohort owner focusing on: 1. Intern's ability to apply the skill and technical knowledge on OJT 2. Intern's performance on assigned tasks and project 3. Extent of Intern's ability to add value to the organization through internship	30
2	Document a Use case on a task where he is working as intern	20
	Total	**50**

Note:

1. CIE-II shall be assessed by the Industrial Training Supervisor using companies' assessment Tools/Rubrics.

2. Faculty (Cohort owner) shall assist the Industrial Training Supervisor during assessment of CIE-II.

Continuous Internal Evaluation- CIE -III conducted at the end of 13th week		
Sl No	**Assessment of On Job Training (OJT)**	**Marks**
1	On select job role of his/her interest in an organization or role assigned by the training supervisor for next Five weeks and submit a report to the training supervisor and copy to cohort owner focusing on: 1. Intern's ability to apply the skill and technical knowledge on OJT 2. Intern's performance on assigned tasks and project 3. Extent of Intern's ability to add value to the organization through internship	30
2	Documenting of another Use case on a task where he is working as intern	20
	Total	**50**

Note:

1. CIE-III shall be assessed by the Industrial Training Supervisor using companies' assessment Tools/Rubrics
2. Faculty (Cohort owner) shall assist the Industrial Training Supervisor during assessment of CIE-III
3. **Average Marks obtained in the above Three CIE's (CIE-I, CIE-II & CIE-III) shall be recorded as Formative assessment for 50 Marks.**

The Summative assessment- Semester End Examination (SEE)

During the semester end examination, students shall demonstrate the outcomes of their Internship to the Panel of Examiners comprises of a Cohort owner and an external Subject Expert The evaluation criteria are as follows

Sl No	**SEE Evaluation Criteria**	**Marks**
1	**Presentation shall include**: 1. Overview of the organization, vision, mission, structure, roles and responsibilities of personnel's, products, market Performance etc. - (10marks) 2. The role performed in the organization during OJT and Intern's ability to apply the skill and technical knowledge – (20 marks)	30
2	Evaluation of comprehensive Internship Report with special focus on organization profile, OJT and contribution made to the organization	20
	Total	**50**

Note: Cohort owner and External subject expert shall assess the intern separately using an appropriate rubrics and average marks to be tabulated

FORMATS

Department of Technical Education

FORMAT - 1

Student Internship Application

(Complete and submit to the Training and Placement Officer)

Student Name			
Student e-mail Id			
Mobile			
Name of the Institute			
Name of the Program			
Specify the Specialization Pathway			
Overall CGPA			
Internship Preferences	Location	Core area	Organization
Preferance-1			
Preferance-2			
Preferance-3			
Cohort owner Signature: Date			
Student Signature: Date			

Department of Technical Education

FORMAT - 2

Request Letter from Institute to Internship Provider

(To be forwarded by the Training and Placement Officer/Student)

Date:

To,

.....

.....

Subject: Request for 13 weeks Semester long internship training of Diploma in ---------- engineering Program

Dear Sir/ Madam,

This is to certify your good office to allow Mr/ Ms----------student of our polytechnic perusing sixth semester diploma in ---------- engineering and trained in ---------- specialization pathway in boot camp mode to render on-the-job internship training in your prestigious company

As per the requirement of Diploma in ---------- engineering program, he/she is required to complete 520 hours of internship related to his/her specialization

Your support in this regard is highly appreciated

With warm regards,

Signature of Training and Placement Officer

Department of Technical Education

FORMAT - 3

Agreement

This Agreement is between the student, cohort owner and internship provider. It shall serve to clarify the educational purpose of the internship and to ensure an understanding of the total learning experience among the student, cohort owner and Industrial training supervisor

Part I: Contact Information

Student

Name: _____ Student ID_____Class Year: _____

College Address: _____City, State: _____

Phone: _____ Email: _____

Industrial Supervisor

Name: _____ Designation: _____

Company/Organization: _____

Address: _____City, State----------Pin: _____

Phone: _____ Email: _____

Cohort owner

Name: _____ Designation: _____

Phone: _____ Email: _____

College Address: _____

Academic Credit Information

Program: _____

Pathway: ---------- Credits: 16

Beginning Date: _____ Ending Date: _____

Hours per Week: 40

Part II: The Internship

Internship Objectives:
Describe What do the interns intend to learn, acquire skill through this internship? Try to use concrete, measurable terms in listing the learning objectives under each of the following categories:

- Knowledge
- Skills

Job Description:

Describe in as much detail as possible intern's role and responsibilities while on internship. List duties, project to be completed, deadlines, etc. Describe How interns' technical knowledge can be applied at the site of the internship and how they can create value to the organization through internship

Supervision: Describe in as much detail as possible the supervision to be provided/needed at the work site. List what kind of instruction, assistance, consultation interns will receive from whom, etc

Evaluation: Describe How will interns work performance be evaluated? By whom? When?

Part III: Agreement

This Agreement may be terminated or amended by student, cohort owner or industry training supervisor at any time upon 7days written notice, which is received and agreed to by the other parties.

Student _____ Date _____

Cohort owner _____ Date _____

Industry Training Supervisor _____ Date _____

Department of Technical Education

FORMAT 4

Student's Daily Log Book

Day-1	Date:
Time of Arrival	Time of Departure
Dept/Division	Nature of work
Name of the Supervisor With designation and email ID	
Remarks of the Training supervisor:	
Record Main actives of the day (including observation, sketches, discussions, etc) **Signature of Industry Supervisor**	

Note: Prepare a A4 size hard bound Intern work book using this format with college and student details

Department of Technical Education

FORMAT 4

Internship Report template

The student, after the completion of internship should submit a comprehensive Internship report, the contents of the report shall be arranged in the following order:

1. Cover Page
2. Inside Title Page
3. Internship Certificate issued by the organization
4. Acknowledgements
5. Executive Summary
6. Table of Contents
7. List of Figures
8. List of Tables
9. Abbreviations/ Notations/ Nomenclature
10. Text of the Report
    - **Chapter 1:** Company Profile
    - **Chapter 2**: Describe in as much detail as possible intern's role and responsibilities while on OJT. List duties, project completed, etc. Describe How interns' technical knowledge can be applied at the site of the internship and how they can create value to the organization through internship
11. Student Profile/Resume
12. Photo Gallery
13. Appendices

General Guidelines

Report Size - Report may contain maximum of about 50 pages including Proto gallery and appendices.

Paper Size - Use A4 size paper

Paper Quality - White bond paper weighing 85 g/m2 or more should be used. Photographs or images with dense colors may be printed in single side on glossy paper.

Margins - A margin of 40 mm is to be provided on left and 30 mm on right sides, whereas top and bottom margins should be 30 mm. No print matter should appear in the margin except the page numbers. All page numbers should be centered inside the bottom margin, 20mm from the bottom edge of the paper.

Font - Times New Roman (TNR) 12-point font has to be used throughout the running text. The captions for tables and figures should have font size of 11 and foot notes should be set at font size
10. Font sizes for various levels of headings are given in the table below

CHAPTER 3

TITLE PAGE-CENTERED TNR 17-POINT BOLD ALL CAPS

3.1. Section Heading
Left aligned with number, TNR 17 points, bold and leading caps
3.1.1. Second level section heading
Left aligned with number, TNR 14 points, bold and sentence case**.**
3.1.1.1 Third level section heading
Left aligned with number, TNR 12 points, bold and sentence case.
Fourth-level section heading
Numbered subsections beyond third level are not recommended. However, fourth-level subsection headings may be included without numbering, TNR 12-point font, left aligned and italicized
Running text should be set in 12-point TNR and fully justified. First line of paragraph should have indentation of 15 mm**.**

Line Spacing - The line spacing in the main text should be 1.5, for quotations, figure captions, table captions, figure legends, footnotes, equations, tables, figures, and quotations Single line spacing should be given.

Table / Figure/equation Format-

Tables and figures shall be numbered chapter-wise. For example, second figure in Chapter 3 will be numbered Figure 3.2. The figure can be cited in the text as Figure 3.2, Tables shall be numbered similarly (Table 2 in Chapter 3 will be numbered Table 3.2) and shall be cited in the text as Table 3.2. Figure caption shall be located below the figure. Table number and caption shall be located above the table.

Appendices

Include data tables, drawings, background calculations, specification lists for equipment used, details of experimental configuration, and other information needed for completeness,

Page Numbering

Page numbers for the prefacing materials (Inside title page, certificate, acknowledgements, executive summary, table of contents, etc.) of the report shall be in small Roman numerals and should be centered at the bottom of the pages.

The numbering of the prefacing material starts from the Inside Title Page. However, the number is not printed on the Inside Title Page. Each new item of the prefacing materials listed above should start on a fresh paper on right page. If the content of the prefacing material exceeds one page, it has to be printed on both sides of the paper by starting from the right-side page. For example, if the item „Table of Contents" extends for 5 pages, it should be printed in fresh paper on right side page with second page of the „Table of Contents" on the back of the paper and then continued. The page numbers of the prefacing material will be printed in small Roman numerals continuously counting blank pages also. However, the numbers are not printed on the blank pages

The body of the report starting from Chapter 1 should be paginated in Arabic numerals and should be centered at the bottom of the pages. The pagination should start with the first page of Chapter 1 and should continue throughout rest of the report. Each side of a sheet of paper should be counted as a separate page, even if the back side of a sheet of paper is blank. The odd numbered pages are always on the right and even-numbered pages are always on the left. If the end of a chapter is in odd page (right side page) the next chapter should start on odd page i.e., on a fresh paper, and should be numbered as odd only by counting the blank even page also. However, the page number is not printed on the blank pages.

Each of the items - Inside cover page, Certificate, Acknowledgements, executive summary, Table of Contents, List of Figures, List of Tables, Abbreviations, Notations, Nomenclature, each new Chapter, References, and each new Appendix should start on an odd page i.e., on the right side

Non-Paper Material

A report may contain non-paper material, such as specimen, CDs and DVDs, Pen drive if necessary. They have to be accommodated in a closed pocket in the back cover page of the report. The inclusion of non-paper materials must be indicated in the Table of Contents. All non-paper materials must have a label each clearly indicating the name of the candidate, student Register number and the date of submission**.**

Binding

Two hard bounded copies of the project Report shall be submitted for evaluation; the cover page should be printed on sky blue card of 300 g/m2 or above**.** One copy is used for Semester End Examination and after the exam it should be maintained in the concerned Head of the department and another copy is maintained at cohort owner

Electronic Copy

An electronic version (PDF) of the project report should be submitted to the cohort owner and Head of the department. The file name should contain, student name, Register number and date of submission.

CAPSTONE PROJECT

GUIDELINES
FOR
FACULTY (COHORT OWNER), STUDENTS AND EXAMINERS

CAPSTONE PROJECT

How to design and deliver

The students of Polytechnic Programs will have an opportunity to be part of one of the most challenging educational experiences in the year-3. The students will be trained in the specialization pathways of their interest in fifth semester followed by an internship or a capstone project work in sixth semester. Those students who want to do a capstone project, requires to do developmental work on real-world problems which would motivate them to produce practical solutions. It is an opportunity for the students to use the problem-solving tools and techniques to solve the problems while doing the capstone project. With this approach, the learning process is gained through 'by-doing' experience and the students are expected to apply both the Capstone Project Management Skills and Technical Skills gained in previous years of polytechnic courses, which will enable them to participate and prepare for future employment.

Working under the guidance of a Cohort owner, students may shape the direction of what they want to be, as well as gain better understanding of the responsibilities they need to shoulder when they undertake a capstone project. Teamwork will be inculcated with the development of good and professional relationships with their cohort owner and team members. The undertaken capstone project can also be used as a basis for employment or Startup by fully exploiting the learning process they have gone through, the skills they have gathered and the experience they have gained from the capstone project.

The guidelines are prepared for Cohort owner, students and examiners enabling them to execute their respective roles and responsibilities in an effective manner.

Aims of Capstone

1. Promote integration and synthesis within the program of study.
2. Promote meaningful connections between the program of study and career experiences.
3. Improve learner's career preparation and pre professional developments.
4. Demonstrate professional identity as learner's transition from academic to professional World.

Job Alignment and Professional Scenario

While developing a capstone the goal should always to;

1. Use a real world professional scenario- built out with employer engagement where ever possible.
2. Align skills to be assessed to a job.
3. Explicitly and intentionally developed important learner's skills, competencies and perspectives that are tacitly developed in the curriculum and required in the workplace.
4. Give learner's the freedom to showcase their learning though a demonstrable artifact or output e.g. Technical Product, System, Service that resolves a real world problem.

Employer Engagement

Support in capstone development:

- Provide a problem statement
- Provide a case study background
- Review and feedback on case studies/scenarios developed

Support in class

- Mentor learner's during the capstone
- Support cohort owners during class-workshop seminars

Presentation of Capstone

- Sit on presentation panel for learners to give feedback.

Outcomes

On successful completion of the capstone project, students will be able to:

- Write Capstone project scope document
- Prepare a capstone project execution plan
- Manage the capstone project from start to finish meeting stated milestones and timelines
- Test and validate the findings
- Demonstrate interpersonal skills, teamwork, and effective use of appropriate technology required for the capstone project

Responsibilities of the Head of the Department

The Head of the Department shall coordinate in Executing the Capstone projects, their responsibilities can be summarized as follows:

- To ensure that the Capstone project scope document is relevant to the specialization pathway opted by the students in Fifth semester
- To assign Cohort owner to the students
- To maintain a centralized capstone project hub repository to facilitate capstone project management and keeping track of all capstone projects and design changes

Responsibilities of the Faculty (Cohort owner):

Students will be supervised by Cohort owner; their responsibilities can be summarized as follows:

- To guide the students in writing the Capstone project scope document
- To guide the students in preparing capstone project execution plan
- To interact with the students once in a week to review the progress of the capstone project work, these sessions shall reinforce/review the concepts, findings and focus on addressing

issues relevant to weekly meetings.

- To guide the students in managing the capstone project from start to finish, meeting the stated milestones and timelines
- To guide the students in preparing the capstone project report
- Develop appropriate Rubrics and evaluate the capstone project work as per assessment criteria
- To oversee the capstone project work until the submission of the final report, and Semester End Examination
- Maintain all the documents related to the capstone project work

Responsibilities of the Students

Students are also required to exercise self-discipline, self-management, job co-ordination, teamwork, and trustworthiness to ensure the success of the capstone project.

The expected responsibilities are:

- To write the Capstone project scope document
- To prepare a capstone project execution plan
- To adhere to the weekly meeting schedule with the cohort owner for the purpose of updating their progress and seeking advice on capstone project matters (Attendance is compulsory as per regulation) and submit weekly report
- To Manage the capstone project from start to finish meeting stated milestones and timelines
- To report immediately to the cohort owner any difficulties encountered that would interrupt the work.
- To submit all reports on time

Group Member Roles and Contributions

The Capstone project groups often function more effectively when group members have designated roles. Each capstone project group shall consist of not more than **four students**. The Three core roles and responsibilities are:

- **Capstone project Lead**: One student in the group shall act as a capstone project lead, who is responsible for keeping the group on task, distributing the workload, meeting deadlines, and ensuring smooth group communication and coordination as well as accountability with the cohort owner and capstone project requirements
- **Documenter Lead**: One student in the group shall act as a documenter lead, who is responsible for recording group discussions and decisions, documenting various aspects of the capstone project's progress, and ensuring well-formed reports and capstone project documents are produced.
- **Development Lead**: Two students in the group shall act as a Development lead, who are responsible for overseeing the collaborative aspects of the capstone project, troubleshooting major technical problems.

The entire capstone project team should be engaged in discussions, documentation, and development of the capstone project. All members are expected to contribute towards the capstone project.
Groups will a have to rotate the roles among members for different stages of the capstone project. This will allow members to gain experience through being responsible in different areas of capstone project management.

Assessment of the capstone project work

This section is addressed to the Faculty (Cohort owner) and examiners. It provides information on assessment criteria for the capstone project work. It also provides guidance to students about what examiners will be looking for in evaluating the capstone projects. The Capstone project work will be assessed for 100 marks through formative and summative assessment tools, in formative assessment the capstone project will be evaluated for 50 marks and in summative assessment capstone project will be evaluated for 50 marks

The Formative Assessment- (Continuous Internal Evaluation- CIE)

The Formative Assessment is conducted for 50 marks throughout the course in three developmental phases as CIE-I, CIE II and CIE-III. Students shall complete CIE-I before taking CIE-II and complete CIE-II before taking CIE-III, otherwise they will not be eligible to take Semester End Examination

Continuous Internal Evaluation- CIE - I conducted at the end of 4th week		
Sl No	**Assessment of parameter**	**Marks**
1	Writing the Capstone project scope document	10
2	**Capstone project Planning**: • Work Breakdown Structure (WBS) - 05 marks • Time-line Schedule - 10 marks • Cost Breakdown Structure (CBS) - 10 marks • Risk Analysis - 10 marks	35
3	Identification of Methodology (Including Literature survey)	05
	Total	**50**

Continuous Internal Evaluation- CIE - II conducted at the end of 8th week		
Sl No	**Assessment of parameter**	**Marks**
1	**Capstone project Details:** • Description of Technology Used • Details of Hardware devices • Details of software products • Programming languages • Descriptions of the components in the system • Component diagrams and required design if any • Construction or Fabrication details • Any other information needed to execute the capstone project	50
	Total	**50**

Continuous Internal Evaluation- CIE - III conducted at the end of 13th week		
Sl No	**Assessment of Parameter**	**Marks**
1	**Testing and validation**: Details of laboratory experiments/programming/modelling/simulations/ analysis/fabrication/construction etc.,	30
2	Results and inference	20
	Total	**50**

Note: Average Marks obtained in the above Three CIE's (CIE-I,CIE-II & CIE-III) shall be recorded as Formative assessment for 50 Marks.

The Summative assessment- Semester End Examination (SEE)

During the Summative assessment, students shall demonstrate the outcomes of their Capstone project work to the Panel of Examiners comprising a cohort owner and an external Subject expert

The evaluation criteria are as follows:

Sl No	Parameters	Marks
1	Power point presentation on outcomes of the Capstone project work	20
2	Demonstration the Capstone project work	20
3	Capstone project Report -Format and Technical writing skill	10
	Total	**50**

Plagiarism

Plagiarism is the act of obtaining or attempting to obtain credit for academic work by representing the work of another as one's own without the necessary and appropriate acknowledgment. If a student is in doubt of the nature of plagiarism, he/she should discuss the matter with the supervisor. If a student is caught committing plagiarism, disciplinary action will be taken against the student

Keeping in view the policy of plagiarism, and avoid piracy of intellectual property, the student needs to follow the citation policy:

- When 10 words are taken together from some established core work, citation becomes essential.
- When the copied content reaches 40 words in accumulation, the fragment needs to be kept under inverted comma (“_”) in italic.
- It is necessarily required to cite reference in case of any content adopted from anywhere other than internet open sites. It is also that, even in case of open site internet source or any other source the copied contents if found more than 35 percent in aggregate during plagiarism detection, the work shall not be considered for further process and asked to resubmit the report again for the evaluation

Copyright

The Polytechnic institutions shall be the owner for all findings, designs, patents, and other intellectual property rights.

FORMATS

Department of Technical Education

Capstone project

Format- 1

Capstone project Scope Document

Capstone project Scope Document

The capstone project scope clearly describes what the capstone project will deliver and outlines all the work required for completing the capstone project.

Capstone project Title:

Group Members:

Problem Statement:

Objectives:

Capstone project description:

Capstone project Deliverables:

Key milestones:

Constraints:

Estimated Capstone project Duration:

Estimated Capstone project cost:

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education

Capstone project

Format- 2

Work Breakdown Structure

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Capstone project Objective(s): < statements describing the capstone project's objective(s)>

Work Breakdown Structure - Deliverables

1. Identify the deliverables (in the scope statement) to be produced in the capstone project.
   This highlights the work to be done.
2. Decompose each large deliverable into a hierarchy of smaller deliverables. This involves taking a deliverable and breaking it down into lower and lower levels of detail.
3. The lowest level of detail is called a 'work package' which consists of activities and tasks.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education

Capstone project

Format- 3
Time - line Schedule

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

1. Identify the activities and tasks needed to produce each work package.
2. Identify resources for each task (e.g., time, knowledge, monetary costs etc.)
3. Estimate how long it will take to complete each task. Consider constraints - resources, time, knowledge
4. Determine which tasks are dependent on other tasks and develop a critical path.
5. Develop a schedule of all activities and tasks - weekly and monthly. Work out when eachtask is scheduled to begin and end. Use a Gantt chart.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education

Capstone project

Format- 4
Cost Breakdown Structure

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

A cost breakdown structure (CBS) breaks down cost data into different categories, and helps you manage costs efficiently. It is a crucial part of the capstone project planning and management process, as it allows you to gain better insight into how much you spend and what you spend your capstone project budget on. When you have a solid structure in place, you can have better control of your capstone project costs to avoid going over budget.

1. Analyze your Work Breakdown Structure

- Before you can identify your costs, you must first determine what your capstone project entails.
- You can do this by looking at your work breakdown structure in detail, and work out the components that will contribute to the capstone project costs.

2. Estimate the labor cost of work

- The next step is to estimate the labor cost of work for each task or activity you have identified in your WBS.
- The time it takes for your team members to finish each work package in the WBS contribute to your labor costs.
- Once you have estimated the labor costs of work for all the tasks, you can use them to work out the final cost of labor for your capstone project.

3. Estimate the cost of materials

The next step is to look at the cost of the materials needed to complete each task you identified in your WBS. These costs include

- Raw material costs
- Equipment and parts purchased for this capstone project
- Anything rented for the purpose of the capstone project

4. Overhead costs.

- Ensure your CBS also includes an appropriate allocation to overhead costs.
- Overhead include various costs that aren't related to specific tasks, but are necessary for the capstone project to take place.

5. Build contingency into your CBS

- No matter how accurate your estimates are, you should still allow for some contingency in your cost breakdown structure in the CBS

6. Final-check

- The last step in creating a cost breakdown structure is to check your estimates against your available budget.
- If it your estimate is within the available budget, then you can be confident that the financial aspect of your capstone project will be smooth sailing
- If your CBS comes in higher than the available budget, you can look at ways to control costs.

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education

Capstone project

Format- 5
Capstone project Execution Document

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

- Main Deliverables -

1) **Design:** descriptions of the components in the system, Component diagrams, and required design if any.
2) **Description of Technology Used:** provide details of Hardware devices, software products, programming languages etc.
3) **Fabrication**: fabrication or construction details
4) **Testing and validation**: provide the details of Methodologies/ laboratory experiments/ computer programming/ modelling/ simulations/ analysis/ findings etc
5) **Results and inference**

Date

Signature of the student

Signature of the cohort owner

Department of Technical Education
Capstone project

Format- 6
Weekly Meeting Record

<For Cohort Owner Use>

Capstone project Title:		
Group Members	1) 2) 3) 4)	□Present □Present □Present □Present
Date		
Meeting venue		□On Time
Documents Submitted	□ Status Report	□On Time
Issues Group Working on		
Assessment of Progress	□Excellent □Good □Satisfactory □Fair □Poor	
Notes/ Concerns/ Comments		

Signature of the Cohort owner

Department of Technical Education

Capstone project

Format- 7
Weekly Status Report

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Status:

Briefly describe and illustrate the progress.

Highlights

List any items of note. Breakthroughs, accomplishments, major decisions, or changes in the capstone project plan Are you on schedule, ahead of schedule or behind schedule?

Risks or Issues List

In the following table, list any risk or issue that is critical for the success of the capstone project. This could be anything from "*we need to get data*" to "*how do we ensure that the system is usable*" to "*performance is unacceptable*". This should be a complete historical list that is kept from the beginning of the capstone project until the end.
Status should be one of *New*, *ongoing*, *Closed*.
The resolution column should be filled in if the issue or risk has been taken care of.

A capstone project may be expected to have around 1-3 active issues or risks that are being managed (new or ongoing) at any given time. If you have more than three, then either you have a capstone project in serious trouble or your criteria for what is "critical to success" is too loose.

Date	Risk or Issue	Description	Resolution	Status

Contd..

Tasks in Progress or Completed:

List the tasks that each member of the capstone project worked on up to the present time.

Task Name	Description	Team Member Responsible	Percentage Complete

Upcoming Tasks:

List the tasks that each capstone project member is planning to work on in the upcoming Task.

Task Name	Description	Team Member Responsible

Date:

Signature of the students

Department of Technical Education

Capstone project

Format- 8
Student's Daily Log Book

Capstone project Name: <State the Title of the capstone project >

Capstone project Members: <List of group members>

Day-1	Date:
Capstone project Name:	
Name of the student	
Name of the Cohort owner:	
Remarks of the Cohort owner:	
Record Main actives of the day (including observation, sketches, discussions, etc): Signature of the Cohort owner	

Note: Prepare a A4 size hard bound Student's Diary/ Daily Log book using this format with college and student details

Department of Technical Education

Capstone project

Format- 9

Capstone project Report Template

The contents of the capstone project report shall be arranged in the following order:

1. Cover Page
2. Inside Title Page
3. Certificate signed by the Cohort owner and HOD
4. Declaration signed by the Candidate
5. Acknowledgements
6. Executive Summary
7. Table of Contents
8. List of Figures
9. List of Tables
10. Abbreviations/ Notations/ Nomenclature
11. Text of the Report
    Chapter 1
    Chapter 2
    --
    --
    Chapter... n
12. References
13. Appendices
14. non-paper materials (if any)

The different Chapters in the capstone project report shall have the following content,

Chapter 1

- Introduction
- Scope of the capstone project

Chapter 2

Capstone project planning

- Work breakdown structure (WBS)
- Timeline Development – Schedule
- Cost Breakdown Structure (CBS)
- Capstone project Risks assessment

Requirements Specification

- Functional
- Non-functional (Quality attributes)

- User input
- Technical constraints

Design Specification

- Chosen System Design
- Discussion of Alternative Designs
- Detailed Description of Components/Subsystems
- Component 1- n

Chapter 3

Approach and Methodology

Discuss the Technology/Methodologies/use cases/ programming/ modelling/ simulations/ analysis/ process design/product design/ fabrication/etc used in the capstone project

Chapter 4

Test and validation

i. Test Plan
ii. Test Approach
iii. Features Tested
iv. Features not Tested
v. Findings
vi. inference

Describe what constitute capstone project success and why? Discuss the product/service tests that will confirm the capstone project succeeds in doing what it intended to do.

Chapter 5

Business Aspects

Discuss the novel aspects of this service or product. Address why a company or investors should invest money in this product or service**.**

- Briefly describe the market and economic outlook of the capstone project for the industry
- Highlight the novel features of the product/service.
- How does the product/service fit into the competitive landscape?
- Describe IP or Patent issues, if any?
- Who are the possible capstone projected clients/customers?

Financial Considerations

- Capstone project budget
- Cost capstone projections needed for either for profit/nonprofit options.

Conclusions and Recommendations

- Describe state of completion of capstone project.
- Future Work
- Outline how the capstone project may be extended

General Guidelines

Report Size - Report may contain maximum of about 100 pages including references and appendices.

Paper Size - Use A4 size paper

Paper Quality - White bond paper weighing 85 g/m2 or more should be used. Photographs or images with dense colors may be printed in single side on glossy paper.

Margins - A margin of 40 mm is to be provided on left and 30 mm on right sides, whereas top and bottom margins should be 30 mm. No print matter should appear in the margin except the page numbers. All page numbers should be centered inside the bottom margin, 20mm from the bottom edge of the paper.

Font - Times New Roman (TNR) 12-point font has to be used throughout the running text. The captions for tables and figures should have font size of 11 and foot notes should be set at font size 10. Font sizes for various levels of headings are given in the table below

CHAPTER 3

TITLE PAGE-CENTERED TNR 17-POINT BOLD ALL CAPS

3.1. Section Heading
Left aligned with number, TNR 17 points, bold and leading caps
3.1.1. Second level section heading
Left aligned with number, TNR 14 points, bold and sentence case**.**
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Left aligned with number, TNR 12 points, bold and sentence case.
Fourth-level section heading
Numbered subsections beyond third level are not recommended. However, fourth-level subsection headings may be included without numbering, TNR 12-point font, left aligned and italicized
Running text should be set in 12-point TNR and fully justified. First line of paragraph should have indentation of 15 mm**.**

Line Spacing - The line spacing in the main text should be 1.5, for quotations, figure captions, table captions, figure legends, footnotes, and references. The equations, tables, figures, and quotations Single line spacing should be given.

Table / Figure/equation Format-

Tables, figures, and equations shall be numbered chapter-wise. For example, second figure in Chapter 3 will be numbered Figure 3.2. The figure can be cited in the text as Figure 3.2, Tables shall be numbered similarly (Table 2 in Chapter 3 will be numbered Table 3.2) and shall be cited in the text as Table 3.2. Figure caption shall be located below the figure. Table number and caption shall be located above the table.

Listing of the References:

Referencing is a way to give credit to the writers from whom you have borrowed words and ideas. By citing the work of a particular scholar, you acknowledge and respect the intellectual property

rights of that researcher. As a student or academic, you can draw on any of the millions of ideas, insights and arguments published by other writers, many of whom have spent years researching and writing. All you need to do is acknowledge their contribution to your assignment. References are to be listed after last chapter. They are to be listed in alphabetical order and numbered. Within a reference the line spacing should be single. Each reference should be separated by one blank line. The reference number should be left aligned. The text of the reference should have an indentation of 10 mm. The reference format to be followed for journal articles, text books, conference proceedings etc. are given below.

Journals

1. Parkas, K. (2011). Feedback and optimal sensitivity: Model reference transformations, multiplicative semi norms, and approximate inverses. IEEE Transactions on Automatic Control, 26(2): 301–320.

Text books

1. Myers, D. G. (2007). Psychology (1st Canadian ed.). Worth: New York.

Conference proceedings

1. Payne, D.B. and Gunhold, H.G. (1986). Digital sundials and broadband technology, In Proc. IOOC-ECOC, 1986, pp. 557-998.

Reports

1. Milton, M and Robert, L. (2004). Atmospheric carbon emission through genetic algorithm, Environment and Technical Report No.3., Indian Meteorological Department., New Delhi

Online journals with a DOI (Digital Object Identifier)

1. Krebs, D.L. and Denton, K. (2006). Explanatory limitations of cognitive developmental approaches to morality. Psychological Review, 113(3): 672- 675. doi: 10.1037/0033-295X.113.3.672

Online journals without a DOI

1. Vicki, G.T., Thomae, M., Cullen, A. and Fernandez, H. (2007). Modeling the hydrological impact on Tropical Forests. Forest Ecology, 13(10): 122-132. Retrieved from http://www.uiowa.edu/~grpproc/crisp/crisp.html

Online books

1. Perfect, T.J. and Schwartz, B. L. (Eds.) (2002). Applied metacognition. Retrieved from http://www.questia.com/read/107598848 (--If DOI is available, use the DOI instead of a URL

Chapters from a book

1. Krebs, D.L. and Denton, K. (1997). Social illusions and self-deception: The evolution of biases in person perception. In J. A. Simpson & D. T. Kenrick (Eds.), Evolutionary social psychology (pp.21-48). Hillsdale, NJ: Erlbaum

Appendices

Include data tables, drawings, background calculations, specification lists for equipment used, details of experimental configuration, and other information needed for completeness,

Page Numbering

Page numbers for the prefacing materials (Inside title page, dedication, certificate, declaration,

acknowledgements, executive summary, table of contents, etc.) of the report shall be in small Roman numerals and should be centered at the bottom of the pages.

The numbering of the prefacing material starts from the Inside Title Page. However, the number is not printed on the Inside Title Page. Each new item of the prefacing materials listed above should start on a fresh paper on right page. If the content of the prefacing material exceeds one page, it has to be printed on both sides of the paper by starting from the right- side page. For example, if the item „Table of Contents" extends for 5 pages, it should be printed in fresh paper on right side page with second page of the „Table of Contents" on the back of the paper and then continued. The page numbers of the prefacing material will be printed in small Roman numerals continuously counting blank pages also. However, the numbers are not printed on the blank pages

The body of the report starting from Chapter 1 should be paginated in Arabic numerals and should be centered at the bottom of the pages. The pagination should start with the first page of Chapter 1 and should continue throughout rest of the report. Each side of a sheet of paper should be counted as a separate page, even if the back side of a sheet of paper is blank. The odd numbered pages are always on the right and even-numbered pages are always on the left. If the end of a chapter is in odd page (right side page) the next chapter should start on odd page i.e., on a fresh paper, and should be numbered as odd only by counting the blank even page also. However, the page number is not printed on the blank pages.

Each of the items - Inside cover page, Certificate, Acknowledgements, executive summary, Table of Contents, List of Figures, List of Tables, Abbreviations, Notations, Nomenclature, each new Chapter, References, and each new Appendix should start on an odd page i.e., on the right side

Non-Paper Material

A report may contain non-paper material, such as specimen, CDs and DVDs, Pen drive if necessary. They have to be accommodated in a closed pocket in the back cover page of the report. The inclusion of non-paper materials must be indicated in the Table of Contents. All non-paper materials must have a label each clearly indicating the name of the candidate, student Register number and the date of submission**.**

Binding

Two hard bounded copies of the capstone project Report shall be submitted for evaluation; the cover page should be printed on sky blue card of 300 g/m2 or above**.** One copy is used for Semester End Examination and after the exam it should be maintained in the concerned Head of the department and another copy is maintained at cohort owner

Electronic Copy

An electronic version (PDF) of the capstone project report should be submitted to the cohort owner and Head of the department. The file name should contain title of the capstone project, student Register number and date of submission.

Government of Karnataka
Department of Technical Education
Board of Technical Examinations

C-25 SEE Theory Question Paper Pattern

Course Name: Course Code:
Time: 3 Hours Max. Marks :100

Instructions:

For Part-A questions, only the first written answers will be considered for evaluation.

PART A

I. Select the correct answer from the choices given: 15X1 = 15 Marks

1. Multiple Choice Question-1
   A.
   B.
   C.
   D.
2. Multiple Choice Question-2
   A.
   B.
   C.
   D.
3. Multiple Choice Question-3
   A.
   B.
   C.
   D.
4. Multiple Choice Question-4
   A.
   B.
   C.
   D.
5. 5. Multiple Choice Question-5

   A.

   B.

   C.

   D.

6. Multiple Choice Question-6

   A.

   B.

   C.

   D.

7. Multiple Choice Question-7
    A.
    B.
    C.
    D.
8. Multiple Choice Question-8
    A.
    B.
    C.
    D.
9. Multiple Choice Question-9
    A.
    B.
    C.
    D.
10. Multiple Choice Question-10
    A.
    B.
    C.
    D.
11. Multiple Choice Question-11
    A.
    B.
    C.
    D.
12. Multiple Choice Question-12
    A.
    B.
    C.
    D.
13. Multiple Choice Question-13
    A.
    B.
    C.
    D.

14. Multiple Choice Question-14

    A.

    B.

    C.

    D.

15. Multiple Choice Question-15

    A.

    B.

    C.

    D.

II. Fill in the blanks by choosing appropriate answer from those given in the bracket: (Answer-1, Answer-2, Answer-3, Answer-4, Answer-5) 5X1 = 05 Marks

1. Question-1
2. Question-2
3. Question-3
4. Question-4
5. Question-5

PART B

III. Answer any FIVE questions: 5X2 = 10 Marks

1. Question-1
2. Question-2
3. Question-3
4. Question-4
5. Question-5
6. Question-6.
7. Question-7
8. Question-8

PART C

IV. Answer any FIVE questions: 5X3 = 15 Marks

1. Question-1
2. Question-2
3. Question-3
4. Question-4

5. Question-5
6. Question-6
7. Question-7
8. Question-8

PART D (Section I)

V. Answer any FIVE questions: 5X5 = 25 Marks

1. Question-1
2. Question-2
3. Question-3
4. Question-4
5. Question-5
6. Question-6
7. Question-7
8. Question-8

PART D (Section II)

VI. Answer any THREE questions: 10X3 = 30 Marks

1. Question-1
2. Question-2
3. Question-3
4. Question-4
5. Question-5