



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**  
**Curriculum Structure**

**IV Semester Scheme of Studies- Diploma in Electronics and Communications Engineering**

Sl. No.	Course Category / Teaching Department	Course Code	Course Name	Hours per week			Total contact hrs /week	Credits	CIE Marks		SEE Marks		Total Marks	Min Marks for Passing (including CIE marks)	Assigned Grade	Grade Point	SGPA and CGPA
				L	T	P			Max	Min	Max	Min					
<b>Integrated Courses</b>																	
1	PC/EC	20EC41P	PCB Design & Fabrication	3	1	4	8	6	60	24	40	16	100	40			<b>Both SGPA &amp; CGPA</b>
2	PC/EC	20EC42P	Wireless Communication	3	1	4	8	6	60	24	40	16	100	40			
3	PC/EC	20EC43P	Embedded C Programming	3	1	4	8	6	60	24	40	16	100	40			
4	PC/EC	20EC44P	Industrial Automation	3	1	4	8	6	60	24	40	16	100	40			
<b>Audit Course</b>																	
5	AU/EC	20EC45T	Indian Constitution	2	0	0	2	2	50	20	-	-	50	20			
<b>Total</b>				<b>14</b>	<b>4</b>	<b>16</b>	<b>34</b>	<b>26</b>	<b>290</b>	<b>116</b>	<b>160</b>	<b>64</b>	<b>450</b>	<b>180</b>			

**\*PC: Programme Core:: AU-Audit Course:: L: Lecture:: T: Tutorial:: P: Practice**



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<b>Programme</b>	Electronics & Communication	<b>Semester</b>	IV
<b>Course Code</b>	20EC41P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	PCB Design & Fabrication	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 3:1:4	<b>Credits</b>	6
<b>CIE Marks</b>	60	<b>SEE Marks</b>	40

### 1. Rationale

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. Apart from electrically connecting, it also gives mechanical support to the electrical components. Using PCBs, a highly complicated circuit can be designed in a very small package which helps in reducing the size of electronic devices.

PCB design can be done either manually or using software. Electronic design automation tools are software tools used for designing the schematic and layout of PCB. Large number of PCBs can be fabricated at the same time after the layout is designed once. With consumers pushing for slimmer and faster devices, and with industries seeking improved functionality, the PCB will continue to develop in the future.

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

CO-1	Identify different types of Printed Circuit Board (PCB), list the differences between them and its adequacy for specific application.
CO -2	Draw the schematic and PCB layout for an analog circuit to be used for a given application.
CO-3	Select the right components for a designed circuit, build the circuit and fabricate it using the appropriate tools following all necessary safety protocols.
CO-4	Test the fabricated circuit, identify the problem and troubleshoot to ensure the circuit provides the desired output.

### 3. Course Content

Week	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	1	<p>1. Introduction to PCB, need and evolution of PCBs.</p> <p>2. Classes of PCB – First Class (RF, microwave, and analog PCB) &amp; Second Class (digital based PCB) – characteristics.</p> <p>3. Types of PCB - Single sided, double sided and multilayer PCBs, rigid and flexible PCBs.</p>	Refer Table 1	<p>1. Familiarization of any Electronic design automation (EDA) software -Open source EDA Tool KiCad.</p> <p>2. Practice the PCB design steps for a simple analog circuit: Schematic design- Familiarization of schematic editor, schematic creation, annotation, electrical rule check, mapping of components, netlist generation.</p>
2	1,2	1	<p>1. Comparison between single layer, double layer and multilayer PCBs.</p> <p>2. Importance of grounding in PCBs, impedance matching, reflection, ground bounce, SSN.</p> <p>3. Materials used for multilayer PCBs, PCB thickness, aspect ratio.</p>	Refer Table 1	<p>1. Practice placement of components.</p> <p>2. Practice the routing (normal tracks -10 mils and power tracks-50 mils).</p>
3	1,2	1,2	<p>1. Component package types - Through-Hole, Surface-Mount, Fine Pitch, FPGA, QFT, TFP, BGA, Press Fit.</p> <p>2. Calculation of track width required for different types of packages.</p> <p>3. Types of Planes in PCB.</p>	Refer Table 1	<p>1. Learn how to create symbols for diodes, transistors, connectors, ICs.</p> <p>2. Create the footprint for diodes, transistors, connectors, ICs.</p>
4	2	2,3,4	<p>1. Design for manufacturability (DFM).</p> <p>2. Electromagnetic Interference (EMI), Electromagnetic Compatibility (EMC).</p> <p>3. Thermal issues in PCB</p>	Refer Table 1	<p>1. Design Schematic for Regulated Power supply.</p> <p>2. Design PCB layout for Regulated Power supply.</p>

5	2	2,3,4	<p>1. Conduction, convection, radiation in thermal issues.</p> <p>2. Heat Dissipation in PCB, Heat sinks.</p> <p>3. RF PCB-introduction.</p>	Refer Table 1	<p>1. Design Schematic for inverting /summing amplifier using op-amp.</p> <p>2. Design PCB layout for inverting /summing amplifier using op-amp.</p>
6	2	2,3,4	<p>1. High-speed digital basics.</p> <p>2. General design factor for digital and analog PCBs.</p> <p>3. Voltage and current considerations in PCBs.</p>	Refer Table 1	<p>1. Design Schematic for astable multivibrator using IC 555.</p> <p>2. Design PCB layout for astable multivibrator using IC 555.</p>
7	2	2,3,4	<p>1. Transmission lines, significance of transmission line and its effects.</p> <p>2. Types of Transmission lines.</p> <p>3. Different types of termination techniques, simple problems.</p>	Refer Table 1	<p>1. Design Schematic for RC coupled amplifier.</p> <p>2. Design PCB layout for RC coupled amplifier.</p>
8	2	2,3,4	<p>1. Crosstalk in transmission lines, minimization of crosstalk.</p> <p>2. ENIG and ENEPIG.</p> <p>3. Noise budget.</p>	Refer Table 1	<p>1. Design Schematic for a given circuit ( Ex: proximity sensor/ LED blinking/+ or -12v power supply using 7812 IC and 7912 IC)</p> <p>2. Design PCB layout for a given ckt (Ex:proximity sensor/LED blinking circuit/+or - 12v power supply using 7812 and 7912 IC)</p>
9	2,3	3,4,,5	<p>1. Preparation of Manufacturing Drawing (MD).</p> <p>2. Importance of Solder mask, assembly drawing, silkscreen, Gerber file.</p> <p>3. Board origin, component origin, importance of origin.</p>	Refer Table 1	<p>1. Familiarisation of copper clad sheet, drilling machine, drill bits, required chemicals .(links)</p> <p>2. Generate the Gerber file of works done in weeks 4 - 8 and take printouts on glossy paper.</p>

10	2,3,4	4,5	<p>1. Importance of CNC machines. CNC machines for component pick and place, drill file.</p> <p>2. Design for Testing(DFT)</p> <p>3. Design specification standards.</p>	Refer Table 1	Fabrication process.
11	2,3,4	7	<p>1. Steps involved in fabrication of single side PCB.</p> <p>2. Steps involved in fabrication of double sided PCB.</p> <p>3. Steps involved in fabrication of multilayer PCB.</p>	Refer Table 1	Fabrication process.
12	2,3,4	7	<p>1. Steps involved in fabrication of multilayer PCB- continued.</p> <p>2. Soldering techniques.</p> <p>3. Testing of PCB.</p>	Refer Table 1	Fabrication process.
13	2,3,4	7	<p>1. Importance of RoHS (Restriction of use of Hazardous Substances).</p> <p>2. Waste management of hazardous materials in PCB.</p> <p>3. Environment Management Standards (EMS).</p>	Refer Table 1	Fabrication process.
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**TABLE 1: Suggested activities for tutorials.**

The list is shared as an example and not inclusive of all possible activities of the course.

The list of activities for one week can be shared among teams in a batch of students.

<b>Week no.</b>	<b>Suggested activities for tutorials</b>
<b>01</b>	<p>1. Prepare a report on reference designators for components used in PCB.</p> <p>2. Give a presentation on general guidelines for designing the PCB.</p> <p>3. Prepare a report on comparison of different types of PCBs.</p>

02	<ol style="list-style-type: none"> <li>1. Collect information on different electronic design automation (EDA) tools and their comparison (Cadstar, Orcad, Pads).</li> <li>2. Collect the information on materials used for multilayer PCB, drill holes, vias, aspect ratio and present it.</li> </ol>
03	<ol style="list-style-type: none"> <li>1. Collect the datasheets of electronic components such as diode, regulator IC, DIP IC and study their mechanical dimension and their projection (first angle/ third angle projection, top view, front view).</li> <li>2. Give a presentation on through-hole and surface-mount technology.</li> </ol>
04	<ol style="list-style-type: none"> <li>1. Collect a case study on DFM issues and present it.</li> <li>2. Give a presentation on Electromagnetic Interference in real life and provide solution to solve the problem.</li> </ol>
05	<ol style="list-style-type: none"> <li>1. Collect details of different types of heat sinks used in PCBs.</li> <li>2. Collect any frequency synthesizer circuit and explain it.</li> </ol>
06	<ol style="list-style-type: none"> <li>1. Prepare a report on comparison of analog and digital PCBs and present it.</li> <li>2. Give a presentation on the importance of spacing and thickness of the tracks in PCB's.</li> </ol>
07	<ol style="list-style-type: none"> <li>1. Give a presentation on the importance of transmission lines.</li> <li>2. Discuss selection of transmission lines for optimum design.</li> </ol>
08	<ol style="list-style-type: none"> <li>1. Write a report on how to analyse the presence of crosstalk in signals.</li> <li>2. Give a presentation on advantages and disadvantages of ENIG and ENEPIG.</li> </ol>
09	<ol style="list-style-type: none"> <li>1. Collect information on different types of solder paste.</li> <li>2. Collect any completed PCB file and explain it.</li> </ol>
10	<ol style="list-style-type: none"> <li>1. Prepare a report on comparison of manual soldering and machine soldering and present it.</li> <li>2. Collect information on design standards used in India for designing PCBs.</li> </ol>
11	<ol style="list-style-type: none"> <li>1. Collect different types of manufacturing techniques and explain them.</li> <li>2. What are the different parameters to be considered to decide the cost of manufactured PCB?</li> </ol>
12	<ol style="list-style-type: none"> <li>1. Give a presentation on the failures of PCB due to improper soldering.</li> <li>2. Write a report on testing of PCB.</li> </ol>

<b>13</b>	<p>1. Study the latest technological changes in this course and present the impact of these changes on industry.</p> <p>2. Give a presentation on the role of students for protecting environment from hazardous materials.</p> <p>3. Find different methods for disposing of PCB lab wastes and dispose it.</p>
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#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
<b>Total Marks</b>					<b>100</b>

#### 5. Format for CIE (1, 2, 3) Written Test

Course Name	<b>PCB Design &amp; Fabrication</b>	Test	I/II/III	Sem	III/IV
Course Code	<b>20EC41P</b>	Duration	80 Min	Marks	30
<b>Note:</b> Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1				
	2				
II	3				
	4				
III	5				
	6				
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.					

#### 5. (a) Format for CIE-4 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identification of different types of PCB.	10
2	2	Schematic Design of the given Analog Circuit using EDA tool(KiCad)	40
3	2	Layout Design of the given Analog Circuit using EDA tool (KiCad)	40
4	1,2	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 5. (b) Format for CIE-5 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	2	<u>Design of the given Analog Circuit</u> Schematic Design -5 Marks Layout Design -5 Marks	10
2	3	<u>Fabrication of the given Analog Circuit</u> Fabrication -30 Marks Component mounting & soldering -20 Marks	50
3	4	<u>Testing &amp; Troubleshooting of a given PCB.</u> Testing - 10 Marks Troubleshooting - 20 Marks	30
4	2,3,4	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							<b>5</b>

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

### 7. Reference:

Sl. No.	Description
1	Printed Circuits Handbook - 6th edition Clyde F. Coombs,Jr.
2	PCB Design & Technology - Walter C. Bosshart
3	Printed Circuit Board by RS Khandpur, Tata McGraw Hill Education Pvt Ltd., New Delhi
4	Electronic Product Design Volume-I by S D Mehta, S Chand Publications
5.	Open source EDA Tool KiCad Tutorial: <a href="http://kicad-pcb.org/help/tutorials/">http://kicad-pcb.org/help/tutorials/</a>
6	PCB Fabrication user guide page: <a href="http://www.wikihow.com/Create-Printed-Circuit-Boards">http://www.wikihow.com/Create-Printed-Circuit-Boards</a> <a href="http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication">http://www.siongboon.com/projects/2005-09-07_home_pcb_fabrication</a> <a href="http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself">http://reprap.org/wiki/MakePCBInstructions#Making_PCBs_yourself</a>



## 8. SEE Scheme of Evaluation

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identification of Types of PCB.	10
2	2	<u>Design of the given Analog Circuit</u> Schematic Design -15 Marks Layout Design -15 Marks Routing -10 Marks	40
3	3	<u>Fabrication of the given Analog Circuit</u> Fabrication -10 Marks Component mounting & soldering -10 Marks	20
4	4	Testing & Troubleshooting of PCB.	10
5	1,2,3,4	Viva Voce	20
<b>Total Marks</b>			<b>100</b>

## 9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	Open source EDA Tool KiCad.		20
3	Single-sided copper clad sheet.		100
4	Diluted Acidic solution for copper etching purpose with plastic tray.		5
5	Tapes and pads for layout design of different dimensions.		
6	Glossy paper		60
7	Hand drilling/Power drilling machine.		10
8	Tool kit (Tray, Brush, PCB Laminate, tong, hand gloves etc.)		20



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<b>Programme</b>	Electronics & Communication	<b>Semester</b>	IV
<b>Course Code</b>	20EC42P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	Wireless Communication	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 3:1:4	<b>Credits</b>	6
<b>CIE Marks</b>	60	<b>SEE Marks</b>	40

### 1. Rationale

The purpose of wireless communication is to communicate messages over distances without the use of wires. It includes an exposure to microwave engineering, radar systems, cellular and satellite communication. In the microwave industry, job opportunities are available in assembly, production, installation, repair and maintenance of microwave transmitters and receivers. The knowledge of radar systems allows opportunities with civil and defence organizations dealing with aircraft and shipping. Satellite communication is used to relay signals around the curvature of Earth allowing communication between widely separated points. Mobile communication is a fast changing technology which offers voice and data connectivity between individuals.

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

CO-1	Identify the types of wireless communications, list differences and its applications.
CO-2	Identify the components of a given wireless communication system, explain the role of those components in the system and list their characteristics.
CO-3	Build a working model of a wireless communication system to be used for a specific application.
CO-4	Test a given set top Box / mobile phone, identify the problem and troubleshoot to ensure the device is fully functional.

### 3. Course Content

We ek	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1,2, 3	1	1. Wireless communication – Concept, block diagram, types, frequency spectrum used in different wireless communication systems.  2. Wireless metropolitan area network(WMANs), Wireless local area networks(WLANs), Wireless personal area network – (WPANs)  3. Wi-Fi- Features and applications, significance of hotspot.	Refer Table 1	1. Implement WLAN in your computer lab.

2	1,2,3	1,3	<p>1. RFID- concept &amp; applications.</p> <p>2 Bluetooth – components, connections, networking &amp; applications.</p> <p>3. Waveguides- Need, types, applications.</p>	Refer Table 1	<p>1. Conduct an experiment to connect PC to internet through bluetooth access point of mobile and transfer a text file/image file/video file.</p> <p>2. Interface RFID reader for any application using Arduino controller.</p>
3	1,2,3	1,5	<p>1. Microwave signals, microwave devices –Two cavity klystron, Reflex klystron.</p> <p>2. Magnetron and Travelling Wave Tube (TWT) and their applications.</p> <p>3. RADAR- principle of operation and applications.</p>	Refer Table 1	<p>1. Video demonstration &amp; documentation on working of</p> <p>a. Two cavity klystron.</p> <p>b. Reflex klystron.</p> <p>2. Video demonstration &amp; documentation on working of</p> <p>a.Magnetron.</p> <p>b.TWT.</p>
4	1,2,3	1,2	<p>1. Radar range equation (no derivation) and factors influencing the radar range.</p> <p>2. Pulsed radar system- principle and block diagram, Duplexer.</p> <p>3. Antenna scanning and tracking.</p>	Refer Table 1	<p>1. Study and measure the characteristics of pulse from signal generator using a CRO.</p> <p>2. 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.</p>
5	1,2,3	1,5	<p>1. Special purpose Radars- doppler radar, MTI radar-block diagram and their applications.</p> <p>2. Secondary surveillance radar &amp; ILS.</p> <p>3. ZigBee –architecture, network topologies, applications.</p>	Refer Table 1	<p>1a.Video demonstration and documentation to understand radar scanning and tracking systems.</p> <p>b. Video demonstration and documentation to understand the working of secondary surveillance radar.</p> <p>2. Interface Zigbee module for any application using Arduino controller.</p>
6	1	1,5	<p>Satellite Communication</p> <p>1. Satellite - Types, orbits. apogee and perigee, azimuth and elevation angles, sub satellite point, sub satellite paths, ascending and descending nodes.</p> <p>2. Posigrade and Retrograde orbits, Uplink and downlink, orbital period and radius of geosynchronous satellite, satellite eclipse. Polar and Geostationary satellites - advantages and disadvantages.</p> <p>3. LEO, MEO &amp; GEO satellites, Station keeping, Attitude control and thermal control</p>	Refer Table 1	<p>1. Study the features and working of different sections in a satellite communication trainer kit.</p> <p>2. Conduct an experiment to Transmit &amp; Receive three separate Signals (Audio, Video, and Tone/ Voice) simultaneously through satellite link and perform Link Fail Operations using satellite communication trainer kit.</p>

7	1,2	1,5	<p>1. Satellite communication system- block diagram. Transponder- single conversion, double conversion and regenerative transponder.</p> <p>2. Increasing channel capacity- frequency reuse and spatial isolation. Communication satellite- satellite subsystems.</p> <p>3. Earth station- block diagram, Applications payload.</p>	Refer Table 1	<p>1. Find the delay between Uplink transmitter and Downlink receiver during data transmission using satellite communication trainer kit.</p> <p>2. Demonstrate working of satellite transponders using satellite communication trainer kit.</p>
8	1,2, 3	1,5	<p>1. Global Positioning System (GPS) –features, working.</p> <p>2. Satellite for TV applications - Direct-To-Home (DTH) and cable TV.</p> <p>3. Satellite for military applications, VSAT – features &amp; applications.</p>	Refer Table 1	<p>1. Video demonstration and documentation on a.Working of GPS System b.Working of Satellite TV.</p> <p>2. Conduct an experiment to tabulate latitude, longitude, Plus codes of different locations using a GPS receiver in mobile phone and learn sharing of live locations.</p>
9	1,2, 4	1,5,7	<p>1. Satellite for voice and data communication, Earth observation.</p> <p>2. Set top box -concept, block diagram.</p> <p>3. Set top box - working.</p>	Refer Table 1	<p>1. Video demonstration and documentation of TV Set top box repair.</p> <p>2. Test and troubleshoot Set top box.</p>
10	1,2	1,5	<p>1. Cellular networks, cellular concept, frequency reuse.</p> <p>2. Terminologies used in mobile communication. capacity expansion techniques-cell splitting and cell sectoring.</p> <p>3. Handoff strategies. working of a typical cellular system.</p>	Refer Table 1	<p>1. Conduct an experiment to understand the working of different sections in a mobile phone using a mobile phone trainer kit.</p> <p>2. Conduct an experiment to analyze MIC &amp; Speaker section, Buzzer section using a mobile phone trainer kit.</p>
11	3	7	<p>1. GSM services and features.</p> <p>2. GSM architecture, working.</p> <p>3. LTE architecture and working.</p>	Refer Table 1	<p>1. Conduct an experiment to analyse vibrator section, LED control section using a mobile phone trainer kit.</p> <p>2. Conduct an experiment to analyse the active mode/sleep mode/Partially ON mode while charging of a mobile phone using a mobile phone trainer kit.</p>
12	1,2, 4	7	<p>Mobile servicing</p> <p>1. Mobile displays – working principle.</p>		Video demonstration and documentation of

			2. Mobile camera – working principle. 3. Charging ports & battery - concept	Refer Table 1	1. Troubleshooting, testing and replacement of display, front camera.  2. Troubleshooting, testing and replacement of charging port, battery.
13	1,2, 3	7	1. IoT – introduction, characteristics of IoT, internet of things.  2. IoT protocols-MQTT, IoT-functional blocks.  3. IoT communication models, IoT enabling technologies.	Refer Table 1	1. Build an IoT based simple real time application using Arduino controller and prepare a report.
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**Note: 1) In Practice sessions Video demonstration should be followed by MCQs/Quiz/Subjective questions and the evaluation has to be documented.**

**2) In Practice sessions, all circuits should be simulated using suitable software before its construction and verification.**

**TABLE 1: Suggested activities for tutorials**

**The list is shared as an example and not inclusive of all possible activities of the course.**

**The list of activities for one week can be shared among teams in a batch of students.**

<b>Week no.</b>	<b>Suggested activities for tutorials</b>
<b>01</b>	1. Give a presentation on differences between wired and wireless communication. 2. Demonstrate the implementation of Wi-Fi hotspot. 3, Video demonstration & documentation of working of industrial wireless communication.
<b>02</b>	1. Give a presentation on Bluetooth specification Standards (IEEE 802.15.1). 2. Build a simple application using RFID. 3. Analyse the CCTV setup in your department/college and troubleshoot the CCTV application if required and submit the report.
<b>03</b>	1. Prepare a report on microwave devices- IMPATT & TRAPATT. 2. Give a presentation on the working of any one type of waveguide.

04	<ol style="list-style-type: none"> <li>1. Give a presentation on any one application of a Radar system in daily life.</li> <li>2. Give a presentation about the usage of the Radar technology in case of searching a crashed aircraft in the ocean.</li> <li>3. Solve problems on radar range equation.</li> </ol>
05	<ol style="list-style-type: none"> <li>1. Prepare and present a report on radar displays.</li> <li>2. Give a presentation on aircraft landing systems (ILS).</li> <li>3. Give a presentation on the design &amp; performance analysis of the doppler radar system.</li> </ol>
06	<ol style="list-style-type: none"> <li>1. Give a presentation on applications of LEO &amp; MEO satellites.</li> <li>2. Prepare a report on satellites launched by ISRO.</li> <li>3. Give a presentation on differences between geostationary and geosynchronous satellite. List some examples of geostationary satellites.</li> </ol>
07	<ol style="list-style-type: none"> <li>1. Present a report on satellite frequency allocation and satellite bandwidth.</li> <li>2. Give a presentation on station keeping.</li> <li>3. Give a presentation on the different types of antennas used in earth station.</li> </ol>
08	<ol style="list-style-type: none"> <li>1. Prepare &amp; present a report on GPS applications.</li> <li>2. Prepare a report on DRONE, its working and various uses.</li> <li>3. Prepare a report on different types of launch vehicles used for launching a satellite in India and its significance.</li> </ol>
09	<ol style="list-style-type: none"> <li>1. Differences between cable box &amp; set top box.</li> <li>2. Compare the different set up boxes available in the market.</li> <li>3. 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).</li> </ol>
10	<ol style="list-style-type: none"> <li>1. Prepare a report on different generations of cellular networks.</li> <li>2. Give a presentation on different mobile operating systems.</li> </ol>
11	<ol style="list-style-type: none"> <li>1. Study of SIM card and its detection, SIM reset, SIM clock, SIM data, and SIM supply.</li> <li>2. Give a presentation on CDMA system-services and features.</li> <li>3. Give a presentation on LTE system services and features.</li> </ol>
12	<ol style="list-style-type: none"> <li>1. Prepare a report on compatibility of mobile phone battery size and its heat dissipation.</li> <li>2. Discuss the types and characteristics of antennas used in mobile phones.</li> </ol>

<b>13</b>	<p>1. Study the latest technological changes in this course and present the impact of these changes on industry.</p> <p>2. Demonstrate the importance of IoT based health monitoring system.</p>
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#### LINKS

1. <https://youtu.be/Q97bVxd2r10>
2. <https://youtu.be/Fvud81pYGOg>
3. <https://youtu.be/bUsS5KUMlvw>
4. [https://youtu.be/4-wp\\_M1z4ls](https://youtu.be/4-wp_M1z4ls)
5. <https://youtu.be/qzBPSG1b5uo>
6. [https://youtu.be/H00\\_PVX2bRw](https://youtu.be/H00_PVX2bRw)
7. [https://youtu.be/wCcARVbL\\_Dk](https://youtu.be/wCcARVbL_Dk)
8. <https://youtu.be/OpkatIqkLO8>
9. <https://youtu.be/AiT36qdoSCc>
10. <https://youtu.be/oEa0Pfxl4C8>
11. [https://youtu.be/1JZG9x\\_VOwA](https://youtu.be/1JZG9x_VOwA)
12. <https://youtu.be/iS8jmhVAfoQ>
13. [https://youtu.be/2UujN\\_pOcYI](https://youtu.be/2UujN_pOcYI)
14. <https://youtu.be/iQeaK0NGMnA>
15. [www.ifixit.com](http://www.ifixit.com)-> Repair guides->select the particular model for ref.

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
<b>Total Marks</b>					<b>100</b>

#### 5. Format for CIE (1, 2, 3) Written Test

Course Name	Wireless Communication	Test	I/II/III	Sem	III/IV
Course Code	<b>20EC42P</b>	Duration	80 Min	Marks	30
<b>Note:</b> Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions		Cognitive Levels	Course Outcome	Marks
I	1				
	2				
II	3				

	4			
III	5			
	6			

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.

### 5.(a) Format for CIE-4 Skill Test - Practice

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identification of types of wireless communications & its applications.	10
2	2	Identify the various components of a given wireless communication system & their role in the system.	10
3	3	Build and demonstrate a WLAN/ RFID/ZIGBEE communication for a specific application. Construction / Setting up - 40 Marks. Result /Output - 30 Marks.	70
4	1,2,3	Portfolio evaluation of Practice sessions through Rubrics.	10
<b>Total Marks</b>			<b>100</b>

### 5.(b) Format for CIE-5 Skill Test - Practice

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identification of types of wireless communications & its applications.	10
2	2	Identify the various components of a given wireless communication system & their role in the system.	10
3	3	Demonstrate a wireless communication system for a specific application Construction - 10 Marks Output - 10 Marks	20
4	4	Test a given Set Top Box/Mobile Phone. Testing Steps -25 Marks Troubleshooting Steps -25 Marks	50
5	1,2,3, 4	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							<b>5</b>

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



## 7. Reference:

Sl. No.	Description
1	Microwave Devices and Components by Sylio, Prentice Hall of India, New Delhi
2	Wireless Communications (Principles and Practice), by Theodore Rappaport
3	Wireless Communications and Networking, by William Stallings
4	Mobile Communication by John Schiller, Prentice Hall of India, New Delhi

## 8. SEE Scheme of Evaluation

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identify the types of wireless communications and its uses/applications	10
2	2	Identify the various components of a given wireless communication system & their role in the system.	10
3	3	Demonstrate a wireless communication system for a specific application Construction - 15 Marks Output - 15 Marks	30
4	4	Test a given Set Top Box/Mobile Phone Testing Steps -15 Marks Troubleshooting Steps -15 Marks	30
5	1,2,3,4	Viva- Voce	20
<b>Total Marks</b>			<b>100</b>

## 9. Equipment/software list with Specification for a batch of 20 students

SI No	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	MATLAB Software		
3	Dual trace oscilloscope	Up to 20-30MHz	10
4	CAT5 cable		100m
5	RJ 45 connectors		100
6	Arduino microcontroller board		10
7	RFID Reader , Tag		5, 20
8	ZigBee Module		10
9	Satellite Communication trainer kit	Uplink Transmitter, Inbuilt tone generator Satellite Link, Downlink receiver.	5
10	TV Set up box		10
11	Mobile phone trainer kit	Onboard Section: Keypad, Dual SIM, Charging Circuit, User interface: Buzzer, Vibrator, Mic, Speaker, Hands free port and display LEDs	5
12	Not- working mobile phones		5



**Government of Karnataka**  
**DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION**

Programme	Electronics and Communication	Semester	IV
Course Code	20EC43P	Type of Course	Programme Core
Course Name	Embedded C Programming	Contact Hours	8 hours/week 104 hours/semester
Teaching Scheme	L:T:P :: 3:1:4	Credits	6
CIE Marks	60	SEE Marks	40

**1. Rationale**

C is a general purpose programming language which is robust and highly portable used for scripting system applications which form a major part of all operating systems. C language is available on a very wide range of platforms, from embedded microcontrollers to supercomputers. Microcontroller is a compressed microcomputer manufactured to control the functions of embedded systems in various fields such as automobile, aeronautics, robotics, mobile communication, electronic appliances, industrial processing, defense, space, medical applications etc. The future of the micro controller depends on machine learning in embedded systems.

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

CO1	Write the code using C constructs for a given requirement, execute the program, debug and to demonstrate that the program produces the required result/output.
CO2	List the various components and the characteristics of each component in a 8051 Microcontroller.
CO3	Write an embedded program for a given requirement, test and troubleshoot to obtain the desired output.
CO4	Identify the right microcontroller/peripheral device using data sheets / specification sheets for a given application.

**3. Course Content**

Week	C O	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	1,2,3	1. Introduction to C - features, compilation process. 2. C tokens, variables and identifiers, constants. 3. Data types - classification, memory requirement, range of values, usage.	Refer Table 1	1. Familiarisation of TURBO C. 2. Programs to illustrate the use of different data types and verify their memory size.

2	1	1,2,3	<p>1. Operators and Operands- Arithmetic, logical, relational operators.</p> <p>2. Unary, conditional, assignment and special operators, precedence and associativity.</p> <p>3. Basic input and output functions, format specifiers, preprocessor directive &amp; library functions</p>	Refer Table 1	<p>1a. Compute simple interest given the principal, interest rate and duration.</p> <p>b. Compute compound interest given P,t,r,n.</p> <p>2a. Compute the area of a circle, square, rectangle and triangle.</p> <p>b. Swap contents of two variables without using intermediate variables.</p>
3	1	1,2,3	<p>1. Flowchart and Algorithm, Structure of a C program, simple C programs.</p> <p>2. Branching- conditional -if, if-else, example programs.</p> <p>3. Nested if-else, switch, example programs.</p>	Refer Table 1	<p>1a. Compute the largest of three numbers using if-else and ternary operators.</p> <p>b. Compute the result of a student using nested if.</p> <p>2. Given the resistance and tolerance, generate the color bands of the resistor using a switch statement.</p>
4	1	1,2,3	<p>1. Looping- for, while, do-while loops.</p> <p>2. Example programs on looping.</p> <p>3. Arrays- definition, declaration, initializing single dimensional arrays. Examples.</p>	Refer Table 1	<p>1a. Compute factorial of a single digit number.</p> <p>b. Compute the sum of digits of a given 3 digit number reducing it to a single digit.</p> <p>2. Sort an array of numbers in ascending order and descending order.</p>
5	1	1,2,3	<p>1. Strings- declaration, initialization with an example. Two dimensional arrays- declaration, initialization with an example.</p> <p>2. Functions- elements of user defined functions, example.</p> <p>3. Pointers- introduction with example. Structures- introduction with example.</p>	Refer Table 1	<p>1a. Compute the length of a string and reverse the string using string functions.</p> <p>1b. Compute the sum of two matrices.</p> <p>2a. Compute cube of a number using a function.</p> <p>2b. Store the details of an employee using a structure and print the details</p>
6	2	1	<p>1. Introduction to the concepts of embedded systems, microprocessors, microcontrollers.</p> <p>2. Selection of 8 bit, 16 bit, 32 bit, 64 bit microcontrollers. Introduction to 8051 microcontroller.</p> <p>3. Architecture of 8051 microcontroller, PSW and special function registers.</p>	Refer Table 1	<p>1. Identification of program development tools.</p> <p>2. Familiarization of program development using Keil.</p>
7	2	1,2,3	<p>1. Memory organization, general purpose RAM, bit addressable RAM.</p> <p>2. Register banks, Pin details of 8051.</p>	Refer Table 1	<p>1. Familiarize with the structure of the 8051 assembly program and executing it.</p>

			3. Interfacing external data and code memory.		2. Write and execute simple ALP to understand different addressing modes.
8	3	1,2,3	<p>1.8051 Addressing modes.</p> <p>2. Instruction set- classification, syntax and function of data transfer instructions,</p> <p>3. Arithmetic instructions, Logical instructions.</p>	Refer Table 1	<p>1. Write and execute an ALP to</p> <p>(a) Move a block of data within internal RAM</p> <p>(b) Exchange a block of data between internal RAM and external memory.</p> <p>2. Write an ALP to</p> <p>(a) evaluate simple arithmetic expression such as <math>y = (((5*2)-(4+1))/3) \% 2</math>.</p> <p>(b) Perform addition of three 8-bit BCD numbers to result in BCD form.</p>
9	3	1,2,3	<p>1. Bit level instructions, jump instructions.</p> <p>2. Introduction to Embedded C and its applicability to 8051.</p> <p>3. General structure of embedded C program, data types.</p>	Refer Table 1	<p>1. Write an ALP to</p> <p>(a) Rotate or shift 16-bit data.</p> <p>(b) Evaluate simple logical expression such as <math>Y = a \&amp; b    c \wedge !d</math> where a, b, c and d are 8-bit data.</p> <p>2. Write and execute an assembly and embedded C program to convert</p> <p>(a) Packed BCD to unpacked BCD</p> <p>(b) Unpacked BCD to packed BCD.</p>
10	3	1,2,3	<p>1. Memory types and models, pointers, pointer's memory type.</p> <p>2. Time-delay generation using loops, example program.</p> <p>3. Arithmetic and logical operators, example programs.</p>	Refer Table 1	<p>1. Write and execute a program to search a given 8-bit number in an array of N numbers using embedded C.</p> <p>2. Write and execute a program to toggle a particular bit in the internal RAM with the use of delay subroutine.</p>
11	3,4	7	<p>1. Features of I/O ports. Interface I/O devices such as LED, buzzer with programs.</p> <p>2. Polling &amp; interrupt methods, executing an interrupt, IE and IP registers.</p> <p>3. Enabling, disabling and priority setting, example programs.</p>	Refer Table 1	<p>1. Write and execute an embedded C program to toggle the LED/buzzer with tone using push-button switch.</p> <p>2. Write ALPs to enable, disable and priority setting of interrupts and</p>

					verify it in IE and IP registers.
12	3,4	7	<p>1. Bit structure and function of TMOD and TCON registers, mode 1 operation of timers.</p> <p>2. Time delay generation &amp; example programs.</p> <p>3. Bit structure of SCON register, SBUF register, TI and RI flags, working of serial port for data transmission and reception.</p>	Refer Table 1	<p>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.</p> <p>2. Observe the square wave of the above program on CRO by downloading the program to the microcontroller kit.</p>
13	3,4	5,7	<p>1. Interfacing 8051 to Multiplexed seven-segment display with assembly/C program.</p> <p>2. Interfacing 8051 to ADC 0804, waveform generation using DAC 0808 with assembly/C program.</p> <p>3. Interfacing 8051 to DC motor, Stepper motor with assembly /C program.</p>	Refer Table 1	<p>Interfacing experiments</p> <p>1. Program to control direction and speed of a stepper motor/ dc motor. Study the data sheets of stepper motor/dc motor.</p> <p>2. Program to control traffic lights</p> <p><b>OR</b></p> <p>Program to generate sine/ rectangular / triangular wave-forms.</p>
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**TABLE 1: Suggested activities for tutorials**

**The list is shared as an example and not inclusive of all possible activities of the course.**

**The list of activities for one week can be shared among teams in a batch of students.**

<b>Week No.</b>	<b>Suggested Activities for Tutorials</b>
<b>01</b>	<p>1. Give a presentation on comparison of different high level languages.</p> <p>2. Prepare a report on advantages and applications of C.</p>
<b>02</b>	<p>1. Write a program to print a pyramid number pattern and explain it.</p> <p>2. Explain operator precedence and associativity with examples.</p> <p>3. Demonstrate implicit and explicit type conversions.</p>
<b>03</b>	<p>1. Write and explain algorithms and flowcharts for simple programs.</p>

	<p>2. Give a presentation on comparison of switch and if-else statements.</p> <p>3. Demonstrate the use of break, continue and goto statements in C.</p>
<b>04</b>	<p>1. Demonstrate the comparison of while, do-while and for loop with an example.</p> <p>2. Write and explain a program to print multiplication tables from 1 to 5.</p>
<b>05</b>	<p>1. Write and explain a program to check whether a given string is palindrome or not.</p> <p>2. Write and explain a program to multiply two matrices.</p> <p>3. Give a presentation on advantages of user defined functions.</p> <p>4. Give a presentation on usage of pointers in C.</p>
<b>06</b>	<p>1. Give a presentation to differentiate RISC &amp; CISC.</p> <p>2. Discuss variants of MCS-51 family and their features.</p>
<b>07</b>	<p>1. Give a presentation on applications of microcontrollers.</p> <p>2. Prepare and explain the memory organization diagram.</p> <p>3. Explain bit structure of PSW and PCON registers.</p>
<b>08</b>	<p>1. Write and explain examples for different addressing modes.</p> <p>2. Find the addressing mode, no. of bytes and no. of machine cycles for different instructions.</p>
<b>09</b>	<p>1. Compare different types of JUMP instructions.</p> <p>2. Explain the pros and cons of embedded C.</p>
<b>10</b>	<p>1. Write embedded C programs for time delay generation using loops.</p> <p>2. Write and explain instructions for arithmetic and logical operations.</p>
<b>11</b>	<p>1. Give a presentation on the importance of I/O ports in microcontrollers and write programs using I/O ports.</p> <p>2. Give a presentation on the need of interrupts in microcontrollers.</p>
<b>12</b>	<p>1. Write and explain bit structures of TCON, TMOD and SCON registers.</p> <p>2. Give a presentation on comparison of mode 1 and mode 2 operations of timers.</p>
<b>13</b>	<p>1. Study the latest technological changes in this course and present the impact of these changes on industry.</p> <p>2. List any 5 other microcontrollers used in real world applications and interpret their datasheets.</p>

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
<b>Total Marks</b>					<b>100</b>

#### 5. Format for CIE (1, 2, 3) Written Test

Course Name	<b>Embedded C Programming</b>	Test	I/II/III	Sem	III/IV
Course Code	<b>20EC43P</b>	Duration	80 Min	Marks	30
<b>Note:</b> Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions	Cognitive Levels	Course Outcome	Marks	
I	1				
	2				
II	3				
	4				
III	5				
	6				
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.					

#### 5.(a) Format for CIE-4 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	1	<u>C Programming</u> Writing two C programs - 30 Marks Entry & Execution - 30 Marks Output -10 Marks	70
2	2	List the various components and the characteristics of each component in a 8051 Microcontroller.	20
3	1,2	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 5. (b) Format for CIE-5 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	2	List the various components and the characteristics of each component in a 8051 Microcontroller.	10
2	3	<u>8051 ALP /8051 C programs for a desired output</u> Writing program - 20 Marks Output - 20 Marks	40
3	4	<u>Interfacing program for an application</u> Writing program - 20 Marks Downloading to kit and Output - 20 Marks	40
4	2,3,4	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							<b>5</b>

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

### 7. Reference:

Sl. No.	Description
1	C Programming By Kernighan and Dennis Ritchie 04.
2	C Programming By Balaguruswamy, TMH Publishers, ISBN-10: 8131716813, 2009.I
3	Scott MacKenzie and Raphael C.W. Phan. The 8051 Microcontroller. (4/e), Pearson education, 2008.
4	Kenneth J Ayala, The 8051 Microcontroller, (3/e), Thomson Delmar Learning.



## 8. SEE Scheme of Evaluation

SL No.	COs	Particulars/Dimension	Marks
1	1	<u>C Programming</u> Writing Program - 10 Marks Entry & Execution -10 Marks Output - 5 Marks	25
2	2	Identify & Explain the functionality of various components in a 8051 Microcontroller	10
3	3	<u>8051 ALP /8051 C programs for a desired output</u> Writing program - 15 Marks Output - 5 Marks	20
4	4	<u>Interfacing program for an application</u> Writing program - 10 Marks Downloading to kit and Output- 15 Marks	25
5	1,2,3,4	Viva-Voce	20
<b>Total Marks</b>			<b>100</b>

## 9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	TURBO C		
3	8051 Microcontroller kits		20
4	Interfacing kits		5 each



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

<b>Programme</b>	Electronics and Communication	<b>Semester</b>	IV
<b>Course Code</b>	20EC44P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	Industrial Automation	<b>Contact Hours</b>	8 hours/week 104 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 3:1:4	<b>Credits</b>	6
<b>CIE Marks</b>	60	<b>SEE Marks</b>	40

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 wide range of industrial controls and automation depends on power electronics. PLC is an industrial computer control system used to control the state of output devices based upon a custom program. SCADA is a centralized system that monitors and controls field devices at remote sites.

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

CO-01	Explain the role and importance of power electronics in today's industrial automation and for a given application list the commonly used components in power electronics.
CO-02	Build a power electronic circuit and demonstrate the working of that circuit for a specific application either in a real or simulated environment.
CO-03	Design, test and troubleshoot a given PLC automation system to meet defined operational specifications in a simulated environment.
CO-04	Explain the concept of SCADA, DCS and HMI and list their various applications in industry.

3. Course Content

We ek	CO	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/week (2 hours/batch twice in a week)
1	1	1	1. Introduction to industrial automation, need for power devices, features of power diode, power BJT.  2. Features of SCR, IGBT and Power MOSFET.  3. DIAC and TRIAC - working, applications.	Refer Table 1	1. Conduct an experiment to find the holding current and latching current of SCR.  2. Conduct an experiment to determine break-over voltage of an SCR.
2	1,2	1	1. Triggering-Need, Triggering circuits- R-triggering, RC-triggering.	Refer Table 1	1. Construct a R triggering circuit and verify its working.

			<p>2. Pulse triggering using UJT relaxation oscillators.</p> <p>3. Commutation-Need, natural and forced commutation of SCR. resonant commutation.</p>		<p>2. Construct a R-C triggering circuit and verify its working.</p>
3	1,2	1,3	<p>1. Auxiliary commutation and Complementary commutation.</p> <p>2. Protection of SCR-Snubber circuit- turn ON, turn OFF and over- voltage.</p> <p>3. Controlled rectifiers- Single phase half-wave controlled rectifier, single phase full-wave bridge controlled rectifier (only resistive load), importance of freewheeling diode.</p>	Refer Table 1	<p>1. Verify SCR triggering by UJT relaxation oscillator using a kit.</p> <p>2. Construct a full-wave controlled rectifier circuit using R-C triggering and verify its working.</p>
4	1,2	1,3	<p>1. Chopper- working principle, duty cycle, chopper control schemes.</p> <p>2. Chopper classifications, Step-up and Step-down choppers.</p> <p>3. Working of first quadrant, second quadrant choppers.</p>	Refer Table 1	<p>1. Verify the working of a constant frequency voltage commutated chopper using a kit.</p> <p>2. Verify the working of a variable frequency voltage commutated chopper using a kit.</p>
5	1,2	1,3	<p>1. Working of two quadrant and four quadrant choppers, Buck and Boost converters.</p> <p>2. Inverters- working principle and types, Half-bridge inverter.</p> <p>3. Full-bridge inverter, Series inverter,</p>	Refer Table 1	<p>1. Verify working of series inverter using a kit.</p> <p>2. Verify working of full bridge inverter using a kit.</p>
6	1,2	1,3	<p>1. Variable dc link inverter, voltage source and current source inverters.</p> <p>2. PWM techniques used in inverters.</p> <p>3. Cycloconverter- classification, working of single phase to single phase midpoint cycloconverter.</p>	Refer Table 1	<p>1. Verify PWM techniques in inverters using a simulator.</p> <p>2. Verify single phase to single phase cycloconverter using a kit.</p>
7	1,2	1,3	<p>1. Photo-electric control of SCR, Light dimmer circuit using DIAC and TRIAC.</p> <p>2. Burglar alarm circuit. Need for electronic control of motors.</p> <p>3. Armature voltage control method and Field control method for speed control of DC shunt motor.</p>	Refer Table 1	<p>1. Verify light dimmer circuit using DIAC and TRIAC.</p> <p>2. Simulate and verify the working of Burglar alarm circuit/Photo electric control of SCR/Speed control of DC shunt motor.</p>

8	2,3	1,3,5	<p>1. Speed control of DC motors using dual converters, speed control of Induction motor.</p> <p>2. PLC-introduction, compare Relay logic control and PLC logic control, block diagram of PLC system, PLC scanning.</p> <p>3. Internal architecture of PLC, memory organization.</p>	Refer Table 1	<p>1. Verify the speed control of universal motor using a kit.</p> <p>2. Verify the speed control of stepper motor using inverter in clockwise and anti-clockwise direction using a kit.</p>
9	3	1,3,5	<p>1. PLC input devices – switches, proximity sensors, photoelectric sensors, temperature sensors, liquid level sensors.</p> <p>2. PLC output devices – solenoids, relay, directional control valve, motors &amp; stepper motors.</p> <p>3. Programming standards, PLC Ladder diagram, ladder diagram for logic gates.</p>	Refer Table 1	<p>1. Familiarization of software for PLC simulation (Keyence/Picosoft).</p> <p>2. Write ladder diagrams and verify the truth table of all logic gates.</p>
10	3	3,5,7	<p>1. PLC input instructions and outputs- coils, indicators, Conversion of Boolean functions from word description to ladder diagram and vice-versa.</p> <p>2. Write the ladder diagrams for different applications Ex i. 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. ii. Staircase light application. iii. Conveyor control application.</p> <p>3. PLC register basics- Input, Holding, Output, PLC arithmetic functions- addition, subtraction, multiplication &amp; division.</p>	Refer Table 1	<p>1. Write a ladder diagram for DOL starter and test the output using PLC trainer kit module.</p> <p>2. Simulate and test the following task using PLC, 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 remain OFF.</p>
11	3	3,5,7	<p>1. PLC Basic comparison functions and its applications.</p> <p>2. PLC Timer functions- on delay timer, off-delay timer, pulsed timer, one shot, applications of timing functions in process control.</p> <p>3. PLC Counter functions- up/down counter, applications of</p>	Refer Table 1	<p>1. Write a ladder diagram, timing diagram and simulate a circuit for the following process control application.</p> <p>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.</p>

			PLC counter functions in process control.		2. 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.
12	3,4	3,5,7	1. PLC and the internet, selection of PLC and its maintenance, PID module. 2. Distributed Control System- Introduction, features, hierarchical architecture, advantages. 3. DCS application in chemical plants/ cement plants/ paper and pulp industries, Introduction to HMI/MMI.	Refer Table 1	1. Write the ladder diagram and execute the Water level controller/Staircase light controller application using PLC trainer kit module. 2. Video demonstration and documentation of DCS application in any plant.
13	4	3,5,7	1. SCADA-Introduction, background, definition, features, typical SCADA system. 2. SCADA architecture, SCADA hardware & software. 3. SCADA protocols, interfacing PLC with SCADA. applications of SCADA.	Refer Table 1	1. Write the ladder diagram and execute the Lift control/Conveyor control application using PLC trainer kit module. 2. Video demonstration and documentation of the SCADA systems.
<b>Total in hours</b>			<b>39</b>	<b>13</b>	<b>52</b>

**Note: 1) In Practice sessions Video demonstration should be followed by MCQs/Quiz/Subjective questions and the evaluation has to be documented.**

**2) In Practice sessions, all discrete circuits should be simulated using suitable software before its construction and verification.**

**TABLE 1: Suggested activities for tutorials**

**The list is shared as an example and not inclusive of all possible activities of the course.**

**The list of activities for one week can be shared among teams in a batch of students.**

<b>Week no.</b>	<b>Suggested activities for tutorials</b>
<b>01</b>	1. Give a presentation on constructional features of SCR, its specifications and ratings. 2. Prepare a report on specifications and ratings of Diac and Triac. 3. Discuss feasibility of Germanium Controlled Rectifier.
<b>02</b>	1. Discuss the importance of triggering an SCR. 2. Explain the comparison of natural and forced commutation of SCR.

<b>03</b>	<ol style="list-style-type: none"> <li>1. List the applications of controlled rectifiers in industries.</li> <li>2. Explain any one real time application of a controlled rectifier.</li> </ol>
<b>04</b>	<ol style="list-style-type: none"> <li>1. Explain any one real time application of choppers.</li> </ol>
<b>05</b>	<ol style="list-style-type: none"> <li>1. Explain the differences between Buck and Boost converters.</li> <li>2. Collect the information on the type and working of inverter used in your lab UPS.</li> </ol>
<b>06</b>	<ol style="list-style-type: none"> <li>1. Differentiate between step up and step down cyclo converter with their applications.</li> <li>2. Explain the role of a cycloconverter in the working of a washing machine.</li> </ol>
<b>07</b>	<ol style="list-style-type: none"> <li>1. Construct and demonstrate any one real time application of SCR/TRIAC(ex:Automatic street lighting/Smoke detector).</li> </ol>
<b>08</b>	<ol style="list-style-type: none"> <li>1. List the leading PLC manufacturers around the world and collect information on applications of PLC systems.</li> <li>2. Prepare a report on advantages of using PLC in automation.</li> </ol>
<b>09</b>	<ol style="list-style-type: none"> <li>1. Collect information on the specifications/parameters / datasheets of input devices used with PLC.</li> <li>2. Collect information on the specifications/parameters / datasheets of output devices used with PLC.</li> </ol>
<b>10</b>	<ol style="list-style-type: none"> <li>1. Develop a fire alarm system which has Fire sensors providing inputs to a SET-RESET function block so that if one of the sensors is activated, the alarm is set and remains set until it is cleared by being reset.</li> <li>2. Two Conveyors feed a main conveyor, find the main conveyor count from the count of parts entering the two conveyors.</li> </ol>
<b>11</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on real time PLC Counter applications.</li> <li>2. Prepare a report on all types of PLC timer functions.</li> <li>3. Give a presentation on PLC advanced comparison functions.</li> </ol>
<b>12</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on applications of HMI/MMI.</li> <li>2. Give a presentation on the different levels of industrial control with respect to networking of PLCs.</li> <li>3. Prepare a report on DCS system integration and DCS flow sheet symbols.</li> </ol>
<b>13</b>	<ol style="list-style-type: none"> <li>1. Study the latest technological changes in this course and present the impact of these changes on industry.</li> </ol>

2. Prepare a report on different ways of deploying SCADA systems along with advantages and disadvantages.
3. Prepare a report on the security threat and vulnerability of SCADA Systems.

#### 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 Skill Test-Practice	6	180	100	Average of two skill tests 20
5	CIE-5 Skill Test-Practice	12	180	100	
6	CIE-6 Portfolio continuous evaluation of Activity through Rubrics	1-13		10	10
Total CIE Marks					60
Semester End Examination (Practice)			180	100	40
<b>Total Marks</b>					<b>100</b>

#### 5. Format for CIE (1, 2, 3) Written Test

Course Name	Industrial Automation	Test	I/II/III	Sem	III/IV
Course Code	20EC44P	Duration	80 Min	Marks	30
<b>Note:</b> Answer any one full question from each section. Each full question carries 10 marks.					
Section	Assessment Questions		Cognitive Levels	Course Outcome	Marks
I	1				
	2				
II	3				
	4				
III	5				
	6				
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.					

### 5. (a) Format for CIE-4 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	1	Identify the various components used in Power Electronics and demonstrate its use for a given application.	20
2	2	Build a power electronic circuit and demonstrate the working of that circuit for a specific application either in a Real or Simulated environment.  Construction of circuit diagram -20 Marks Conduction -20 Marks Output -30 Marks.	70
3	1,2	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 5. (b) Format for CIE-5 Skill Test - Practice.

SL. No.	COs	Particulars/Dimension	Marks
1	3	Design, Test and Troubleshoot a specific PLC Automation System to meet defined operational specifications in a simulated environment.  Writing Ladder diagram (2 applications) - 40 Marks Interfacing to kit - 20 Marks Result - 10 Marks	70
2	4	Concept of SCADA/DCS/HMI and list their various applications	20
3	3,4	Portfolio evaluation of Practice sessions through Rubrics	10
<b>Total Marks</b>			<b>100</b>

### 6. Rubrics for Assessment of Activity (Qualitative Assessment)

Sl. No.	Dimension	Beginner	Intermediate	Good	Advanced	Expert	Students Score
		2	4	6	8	10	
1		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
2		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
3		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
4		Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2
Average Marks= (8+6+2+2)/4=4.5							5

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

### 7. Reference:

Sl. No.	Description
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	"PLC's" by W. Bolton, 4th edition.
4	Programmable Logic Controllers by Frank D Petruzella, 4th Edition, McGraw Hill Publications.



## 8. SEE Scheme of Evaluation

Sl. No.	COs	Particulars/Dimension	Marks
1	1	Identify the various components used in Power Electronics and demonstrate its use for a given application.	10
2	2	Build a power electronic circuit and demonstrate the working of that circuit for a specific application either in a Real or Simulated environment.  Construction of circuit diagram - 10 Marks Conduction -10 Marks Output -10 Marks	30
3	3	Design, Test and Troubleshoot a specific PLC Automation System to meet defined operational specifications in a simulated environment.  Writing Ladder diagram - 10 Marks Interfacing to kit - 10 Marks Result - 10 Marks	30
4	4	Concept of SCADA/DCS/HMI and their applications.	10
5	1,2,3,4	Viva-Voce	20
<b>Total Marks</b>			<b>100</b>

## 9. Equipment/software list with Specification for a batch of 20 students

Sl. No.	Particulars	Specification	Quantity
1	Computers	Intel Core i5 11th gen/8GB RAM/1 TB HDD/256GB SSD/ Graphics 2 GB	20
2	POWERSIM simulation software		
3	Kit for SCR triggering by UJT relaxation oscillator		10
4	Kit for Voltage commutated chopper both constant frequency & variable frequency.		10
5	Series Inverter kit		10
6	Full bridge inverter kit		10
7	PWM inverter kit		10
8	Single phase to Single phase cyclo converter kit		10
9	Light Dimmer kit		10

10	Speed control of universal motor kit		10
11	Speed control of stepper motor kit		10
12	PLC kits		10
13	PLC interfacing kits for Lift control, water level control		3 each



**Government of Karnataka**  
**Department of Collegiate and Technical Education**

<b>Programme</b>	Audit Course	<b>Semester</b>	IV
<b>Course Code</b>	20EC45T	<b>Type of Course</b>	Audit
<b>Course Name</b>	<b>Indian Constitution</b>	<b>Contact Hours</b>	2 hours/week 26 hours/semester
<b>Teaching Scheme</b>	L:T:P :: 2:0:0	<b>Credits</b>	2
<b>CIE Marks</b>	50	<b>SEE Marks</b>	Nil

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

CO-01	<b>CO1</b>	Understand Preamble, salient features and importance of Indian Constitution.
CO-02	<b>CO2</b>	Understand Fundamental rights, duties and Directive principles of state policy.
CO-03	<b>CO3</b>	Understand Parliamentary system of governance, Structure, Functions, Power of Central, state governments (Legislative, Executive) and Judiciary.
CO-04	<b>CO4</b>	Understand Panchayat Raj Institutions and Local self-governments, UPSC, KPSC, NHRC, Status of women, RTE etc.

**2. Course Content**

Week	CO	Detailed Course Content	Contact Hours
1	1	Introduction to constitution of India-Formation and Composition of the Constituent Assembly-Salient features of the Constitution-Preamble to the Indian Constitution	2
2	1,2	Fundamental Rights- Definition, The right to equality, The right to freedom, The right against exploitation, The right to freedom of religion.	2
3	1,2	Cultural and educational rights and The right to constitutional remedies. Fundamental Duties, Directive principles of state policy.	2
4	1,3	Parliamentary system of governance- Structure of Parliament- Lok Sabha and Rajya Sabha. Functions of parliament- Legislative, Executive, Financial Function Powers of Lok Sabha and Rajya Sabha.	2
5	1,3	Procedure followed in parliament in making law, Annual financial statement (Budget) – procedure in parliament with respect to estimates, Appropriation bill, Supplementary, additional grants, Vote on account, votes on credit and exception grant, special provisions, rules of procedure.	2
6	1,3	Structure of union executive, Power and position of President. Vice President, Prime minister and council of ministers.	2
7	1,3	Structure of the judiciary: Jurisdiction and functions of Supreme Court, high court, and subordinate courts.	2
8	1,3	Federalism in the Indian constitution- Division of Powers: Union list, State list and concurrent list. Structure of state legislation, Legislative assembly and Legislative council.	2
9	1,3	Functions of state legislature, Structure of state executive-Powers and positions of Governor, Speaker, Deputy Speaker, Chief Minister and council of minister.	2

10	4	Local self-government- meaning-Three tier system, Village Panchayat-Taluk panchayat Zilla panchayat, Local bodies-Municipalities and Corporations, Bruhath Mahanagara Palike, Functions of Election commission, UPSC, KPSC.	2
11	4	Amendment of the constitution, Human Rights-Definition-constitutional provisions-right to life and liberty-Human Rights of Women-Discrimination against women steps that are to be taken to eliminate discrimination against women in Education, employment, health care, Economic and social life,	2
12	4	Status of Women in India - Women in rural areas, Constitutional Safeguards - Dowry Prohibition act 1961- Domestic violence act 2005- Sexual harassment at work place bill 2006. Human Rights of Children- Who is a child- list the Rights of the Child- Right to education, Protection of Children from Sexual Offences Act (POCSO)-2012-	2
13	1,4	National Human Rights Commission Constitution- Powers and function of the Commission-Employee rights- Provisions made, Contractual-Non contractual employee rights-Whistle blowing-definition-Aspects-Intellectual Property Rights (IPR)-Meaning-Need for protection- Briefly description of concept of patents, Copy right, Trademark	2
<b>Total in Hours</b>			<b>26 Hrs</b>

## REFERENCES

1. Introduction to the Constitution of India- Dr. Durga Das Basu
2. Empowerment of rural women in India-Hemalatha H.M and Rameshwari Varma, Hema Prakashana.

## 4. CIE and SEE Assessment Methodologies

Sl. No	Assessment	Test Week	Duration In minutes	Max marks	Conversion
1.	CIE-1 Written Test	5	80	30	Average of three tests 30
2.	CIE-2 Written Test	9	80	30	
3	CIE-3 Written Test	13	80	30	
4.	CIE-4 MCQ	6	60	20	Average of two CIE = 20
5	CIE-5 Open Book Test	12	60	20	
Total CIE Marks					50
Semester End Examination (Practice)			-	-	-
<b>Total Marks</b>					<b>50</b>