



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

<b>Programme</b>	Electronics and Communication	<b>Semester</b>	III
<b>Course Code</b>	20EC34P	<b>Type of Course</b>	Programme Core
<b>Course Name</b>	Electronic Measurements and Testing Techniques	<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 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	List the types of measurement and common errors that occur while using electronic measuring systems and demonstrate use of statistical analysis to validate specific output from measuring and testing equipment.
CO-02	Explain the standards used for calibration and demonstrate calibration of a measuring and/or testing equipment to ensure it provides reliable output.
CO-03	Select an appropriate sensor or transducer for a given application and demonstrate its use to measure and record the readings for a given project.
CO-04	Test a given lab equipment, identify the reasons for error, troubleshoot or calibrate to ensure the equipment provides the correct reading

### 3. Course Content

We ek	C O	PO	Lecture (Knowledge Criteria)	Tutorial (Activity Criteria)	Practice (Performance Criteria)
			3 hours/week	1 hour/week	4 hours/ (2 hours/batch twice in a week)
1.	1	1,4 ,6	1. Necessity of measurements-direct and indirect methods, Static characteristics of an instrument.  2. Dynamic characteristics of an instrument. Generalized electronic measurement system-Block diagram.  3. Errors-classification of errors, sources of errors.	Refer Table 1	1. Find the static characteristics of analog voltmeter/ multimeter.  2. Find the dynamic characteristics of analog voltmeter/multimeter.
2	1, 2, 4	1,4 ,5, 7	1. Statistical analysis- arithmetic mean, deviation, average deviation, standard deviation, probability of errors and limiting errors.  2. Problems on Statistical analysis.	Refer Table 1	1. Identify the errors and do the calibration for setting up an analog multimeter before performing measurement.

			3. Calibration, Error check, understand specification sheet of digital multimeter.		2. Troubleshoot and service the Digital trainer kits.
3.	1, 2, 4	1,4,5	<p>1. Standards-primary, secondary, working and IEEE standards.</p> <p>2. Bridges- Comparison of AC and DC bridges. Applications of AC and DC bridges.</p> <p>3. Wheatstone bridge-Explanation and applications.</p>	Refer Table 1	<p>1. Build a Wheatstone bridge to find unknown resistance.</p> <p>2. Construct a circuit to measure AC voltage by voltage divider method.</p>
4	2, 3	1,2,3,4,6	<p>1. Electrical Transducers- necessity, selection, classification- active and passive, analog and digital, primary and secondary.</p> <p>2. Strain gauge-principle, gauge factor, features of bonded, unbonded, foil type strain gauges.</p> <p>3. Load Cell, capacitive transducer-principle &amp; features.</p>	Refer Table 1	<p>1. Video demonstration and documentation on multi-function meter used for measuring any electrical parameter.</p> <p>2. Calibrate a load cell to measure the weight of any object. Use suitable components and/or programming to accomplish the task.</p>
5	2, 3	3,4,5,7	<p>1. Hall effect transducers, LVDT, thermistor.</p> <p>2. Thermocouple, piezoelectric transducers, position sensors.</p> <p>3. Proximity sensors, digital optical encoders &amp; PIR sensors.</p>	Refer Table 1	<p>1. Build a temperature sensor circuit using a thermistor.</p> <p>2. Build a simple application using position/proximity sensor.</p>
6	1, 2	1,4,7	<p>1. PMMC meters- principle, DC ammeters and multi range ammeters.</p> <p>2. DC voltmeters using PMMC, multi range voltmeters, loading effect and voltmeter sensitivity.</p> <p>3. Electrodynamometer -principle, ammeter, voltmeter.</p>	Refer Table 1	<p>1. Construct a circuit to verify KVL and measure voltages using analog voltmeter.</p> <p>2. Construct a circuit to verify KCL and measure currents using analog ammeter.</p>
7	1, 2	1,4,5,7	<p>1. Electronic voltmeter- Chopper amplifier type voltmeter.</p> <p>2. AC voltmeter- full-wave rectifier, Peak responding and true RMS voltmeters.</p> <p>3. Ohmmeters- series and shunt type, concept of calibration of meters.</p>	Refer Table 1	<p>1. Study of Regulated DC power supply and measurement of standard voltages at various stages of RPS.</p> <p>2. Identify and rectify the various faults in the Regulated DC power supply.</p>

8	1, 4	1,2 ,4, 5	<p>1. Digital instruments –Introduction, Ramp type DVM.</p> <p>2. Automatization in digital meters- automatic polarity indication, automatic decimal point positioning, automatic ranging and zeroing.</p> <p>3. Electronic counters-block diagram.</p>	Refer Table 1	<p>1. Video demonstration and documentation on testing life cycle of electrical loads using Electronic Counter.</p> <p>2. Troubleshoot and perform minor repair practices on Decade Boxes (Rotary switches, connectors, components connectivity etc).</p>
9	1, 2, 4	1,4 ,5, 6	<p>1. Digital frequency meter, Time interval measurement.</p> <p>2. Digital LCR meter, digital multimeter.</p> <p>3. Microprocessor based instruments, IEEE 488 GPIB instruments.</p>	Refer Table 1	<p>1. Calibrate LCR meter and perform measurement of Resistance, capacitance, and inductance and verify with actual value.</p> <p>2. Troubleshoot and rectify any analog circuit using simulation software (Multisim)</p>
10	1, 2, 4	1,4 ,5, 6	<p>1. Cathode Ray Oscilloscope-block diagram, working of CRT.</p> <p>2. Dual trace CRO, CRO probes, applications of CRO.</p> <p>3. DSO-block diagram, features, Sampling oscilloscope.</p>	Refer Table 1	<p>1. Study the front panel controls of CRO and do its calibration</p> <p>2. Demonstrate the use of CRO to measure phase difference between two waveforms and obtain the lissajous patterns.</p>
11	1, 2, 4	1,4 ,7	<p>1. Function generator- block diagram and applications.</p> <p>2. Standard RF signal generator, sweep frequency generator.</p> <p>3. Harmonic distortion, harmonic analyzing instruments.</p>	Refer Table 1	<p>1. Demonstrate the analysis of different waveforms (amplitude, phase, frequency) from a function generator using CRO.</p> <p>2. Demonstration and documentation on the working of a spectrum analyser. (Video/simulator)</p>
12	1, 4	1,5 ,7	<p>1. Electrical grounding and shielding-concept, interference, shielding of cabinets.</p> <p>2. Precautions to prevent instrument damage, general precautions for instrument safety.</p> <p>3. Testing and troubleshooting-introduction, generalized troubleshooting.</p>	Refer Table 1	<p>1. Do it yourself (DIY) a probe and use the probe to test the circuit continuity in PCB.</p>

13	1, 2, 4	1,4 ,5, 7	1. Precautions to be taken to achieve personnel safety during servicing.  2. Testing Techniques, electronic repair tools.  3. Explain Basic steps of electronic equipment service and maintenance. a) Study of basic procedure of service and maintenance b) Circuit tracing techniques	Refer Table 1	1. Do it yourself (DIY) an antistatic wrist strap useful to handle electronic component.
<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 ways of reducing systematic and random errors.  2. List the basic tools (electronic repair tools) required for servicing electronic equipment and their purpose.
<b>02</b>	1. Present the specification sheets of voltmeter/ammeter/ohmmeter.  2. Demonstrate the procedure to calibrate DC power supply.
<b>03</b>	1. Identify the faults in Digital ICs and Troubleshoot using digital IC tester/ Logic Probe  2. Prepare a report on IEEE standards.
<b>04</b>	1. Give a presentation on applications of strain gauge and explain any one.  2. Prepare a report on advantages and disadvantages of capacitive transducers.
<b>05</b>	1. Write a report on various kinds of transducers used in Biomedical Instrumentation.  2. Demonstrate the application of any sensor.

<b>06</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on KVL and KCL and use of voltmeter and ammeter in taking readings.</li> <li>2. Solve problems on extending range in ammeter and voltmeter.</li> </ol>
<b>07</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on comparison of commercially available electronic voltmeters.</li> <li>2. Prepare a report on calibration of meters.</li> </ol>
<b>08</b>	<ol style="list-style-type: none"> <li>1. Discuss pros and cons of Digital instruments.</li> <li>2. Prepare a report on comparison of analog and digital instruments.</li> </ol>
<b>09</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on performance testing on digital multimeters.</li> <li>2. Collect and present service manuals of measuring instruments.</li> <li>3. Present the applications of IEEE 488 GPIB instruments.</li> </ol>
<b>10</b>	<ol style="list-style-type: none"> <li>1. Give a presentation on applications of CRO.</li> <li>2. Give a presentation on the Technical specification of CRO.</li> <li>3. Collect and present the specifications of DSO.</li> </ol>
<b>11</b>	<ol style="list-style-type: none"> <li>1. Suggest cost-quality effective of any 4 measuring instruments by preparing comparative statements containing function, specification, make, market-price, and warranty</li> <li>2. Collect and present the specifications of signal generator.</li> </ol>
<b>12</b>	<ol style="list-style-type: none"> <li>1. Prepare a report on the grounding and shielding of any lab equipment (ex. oscilloscope). Also present the consequences if not done so.</li> <li>2. Do minor repair practices on Decade Boxes (Rotary switches, connectors, components connectivity etc.,)</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> <li>2. Discuss about Trouble shooting chart.</li> </ol>

## LINKS

1. [https://www.webassign.net/labsgraceperiod/ncsuplseem2/lab\\_1/manual.html](https://www.webassign.net/labsgraceperiod/ncsuplseem2/lab_1/manual.html)
2. [https://youtu.be/i4sI\\_dBWH50](https://youtu.be/i4sI_dBWH50)
3. <https://blog.matric.com/pcb-testing-methods>
4. <https://www.youtube.com/watch?v=AUTcWsR6pwU>
5. [https://www.youtube.com/watch?v=x4B6\\_1C4gEQ](https://www.youtube.com/watch?v=x4B6_1C4gEQ)
6. <https://www.youtube.com/watch?v=-0Pre73mp7A>
7. <https://www.youtube.com/watch?v=lgvCMd5nMw4>
8. <https://www.youtube.com/watch?v=Evw5AqUYJcg>
9. <https://www.youtube.com/watch?v=yasajLJUYvg>



#### 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
Total Marks					100

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

Course Name	Electronics Measurement and Testing Techniques	Test	I/II/III	Sem	III/IV
Course Code	20EC34P	Duration	80 Min	Marks	30

**Note:** 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	Conduct an experiment on characteristics/ Calibration/ Bridge Writing circuit -20 Marks Conduction -20 Marks Result -10 Marks	50
2	3	Conduct an experiment on Sensor/Transducer	40
3	1,3	Portfolio evaluation of Practice sessions through Rubrics	10
Total Marks			100

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

SL. No.	COs	Particulars/Dimension	Marks
1	2	Conduct experiment on CRO/ Measurement of L C R	40
2	4	Conduct an experiment on Troubleshooting RPS/ Repair of Decade Boxes	50
3	2,4	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	Electronic Measurements and Instrumentation -2nd Revised Edition, R. K. Rajput, ISBN: 81- 219-2917-2 234.
2	Electronic Measurements and Instrumentation-3rd Edition, Sanjay Talbar & Akhilesh Upadhyaya, ISBN :81-874-3335-3
3	Electronic Instrumentation -3rd Edition, Kalsi H. S., ISBN: 00-707-0206-3
4	Modern Electronic Instrumentation and Measurement Techniques-2nd Edition, Albert Helfrick & William Cooper, ISBN:81-203-0752-6

**8. SEE Scheme of Evaluation**

SL. No.	COs	Particulars/Dimension	Marks
1	1,2	Identify errors, calibrate and perform measurement using analog multimeter/Wheatstone bridge/LCR meter/CRO	30
2	3	Identify the Sensor/Transducer used in different applications.	10
3	4	Conduct an experiment on Troubleshooting and repair of DTK/ RPS/ Decade Boxes	40
4	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	MATLAB/Multisim/PSPICE/Electronic Workbench Simulation Software		
3	Dual trace oscilloscope	20-30MHz	20
4	LCR meter		10
5	Multi function meter		5
6	Resistors, Capacitors, Inductors ,Thermistor		Consumables as required
7	Digital multimeter		10
8	Analog multimeter		10
9	Function generator		5
10	Position, and Proximity sensors		10 each
11	Transducer		5
12	Load cell		5
13	Tool kit		2 sets
14	Soldering set		10 sets