

**DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING  
NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI**

COURSE PLAN			
Name of the Programme and Specialization	B.Tech. Instrumentation and Control Engineering		
Course Title	ELECTRICAL AND ELECTRONIC MEASUREMENTS		
Course Code	ICPC21	Course credits	3
Pre-requisites Course Code	NIL		
Session	July 2023	Semester / Section	V <sup>th</sup> / B
Name of Faculty	Dr. Shiraz Sohail	Department	ICE
E-mail	ssohail@nitt.edu	Mobile No.	09775550302
Course Coordinator(s) (if, applicable)	NA	Telephone No.	04312504965
Other Course Teacher(s)/Tutor(s) E-mail	NA	Mobile No.	NA
Course Type	<input checked="" type="checkbox"/> Core course <input type="checkbox"/> Program Elective course		
<b>Syllabus (approved in BoS)</b>			
<p><b>Electrical measurements:</b> General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron, dynamometer type, rectifier type, thermal instruments. Extension of instrument range: shunt and multipliers, CT and PT.</p> <p><b>Measurement of Power:</b> Electrodynamometer wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.</p> <p><b>Measurement of resistance, inductance and capacitance:</b> Low, high and precise resistance measurement, Megger, Ohmmeters, Classical AC bridges: Inductance and capacitance measurements. Detectors in bridge measurement, bridge screening, Wagner earth, transformer ratio bridges.</p> <p><b>Electronic and digital measurements:</b> Electronic voltmeter, current measurement with electronic instruments, Digital voltmeter, Analog and digital multi-meters, Digital frequency meters. Digital LCR meter, Q -Meter, Digital wattmeter and energy meters. DSO, MSO, Function generators, Signal generators, Waveform analyzers, Spectrum analyzers, Distortion analyzers, LED, LCD and Organic LED displays.</p>			
<b>COURSE OBJECTIVES</b>			
<p>The subject aims to provide the student with</p> <ol style="list-style-type: none"> <li>1. An understanding of the principle and construction of different electromechanical indicating instruments.</li> <li>2. An understanding of digital way of measuring concepts used in current, voltage, power and energy measurement.</li> <li>3. The ability to analyze the AC and DC bridges for resistance, inductance and capacitance measurement.</li> <li>4. The basic knowledge about the waveform generators, analyzers, and various display device.</li> </ol>			

**COURSE OUTCOME (CO)****On completion of this course the students will be,**

1. Familiar with various measuring instruments (ammeters, voltmeters, current and voltage transformers, different types of power and energy meters) used to detect/measure electrical quantities.
2. Able to perform experiments and determine various types of errors during measurements, as well as to analyze and interpret results.
3. Able to design suitable DC and AC bridges for the measurement of resistance, inductance, capacitance, frequency and related instruments.
4. Able to understand the design of analog and digital measuring techniques used for measurement of electrical /electronic quantities.

Course Outcome (CO)	Aligned Program Outcomes (PO)
On completion of this course the students will be,	
1. Familiar with various measuring instruments (ammeters, voltmeters, current and voltage transformers, different types of power and energy meters) used to detect/measure electrical quantities.	1
2. Able to perform experiments and determine various types of errors during measurements, as well as to analyze and interpret results.	2
3. Able to design suitable DC and AC bridges for the measurement of resistance, inductance, capacitance, frequency and related instruments.	1,2
4. Able to understand the design of analog and digital measuring techniques used for measurement of electrical /electronic quantities.	1,2

**COURSE OVERVIEW**

1. This course provide a comprehensive understanding of a wider range of electrical/electronic measuring devices, analog and digital electronic instruments.
2. The course covers the measurement of electrical quantities like current, voltage, power, energy using the various types of analog indicating instruments like ammeter, voltmeter, wattmeter and energy meter.
3. Further this course covers the measurement of resistance, inductance and capacitance using DC and AC bridges and other related measuring techniques. In electronic measurements, digital multimeter, digital wattmeter principle with various ADC principles are also described.
4. Different types of display/waveform analyzers like function generators, signal generators, distortion analyzers and spectrum analyzers, DSO and arbitrary waveform generators are also discussed.

**COURSE TEACHING AND LEARNING ACTIVITIES**

LECTURE NO.	PERIODS/ WEEKS	TOPIC/ CONTENT	LECTURE DELIVERY MODE
1 -4		<b>Electrical measurements:</b> <ul style="list-style-type: none"> <li>▪ Introduction and General features of electro mechanical instruments</li> <li>▪ Classification of electro</li> </ul>	Chalk and Black board /video mode/PPT

		<b>mechanical instruments</b> <ul style="list-style-type: none"> <li>➤ Principles of Moving coil</li> <li>➤ Principles of Moving iron</li> </ul>	
5-7	2 <sup>nd</sup> , 3 <sup>rd</sup> , and 4 <sup>th</sup> week of August 2023	<u><b>Electrical measurements:</b></u> <ul style="list-style-type: none"> <li>▪ <b>Classification of electro mechanical instruments</b> <ul style="list-style-type: none"> <li>➤ Dynamometer type</li> <li>➤ Rectifier type</li> <li>➤ Thermal type instruments</li> </ul> </li> </ul>	<b>Chalk and Black board /PPT</b>
8-9		<u><b>Electrical measurements:</b></u> <ul style="list-style-type: none"> <li>▪ <b>Extension of instrument range</b> <ul style="list-style-type: none"> <li>➤ Shunt and multipliers</li> <li>➤ Transformer</li> </ul> </li> </ul>	<b>Chalk and Black board /PPT</b>
10-11	5 <sup>th</sup> week of August 2023	<u><b>Measurement of Power:</b></u> <ul style="list-style-type: none"> <li>➤ <b>Electrodynamic wattmeter's</b></li> </ul>	<b>Chalk and Black board /PPT</b>
12	1 <sup>st</sup> and 2 <sup>nd</sup> Week of September 2023	<b>First Class Test (CT-1) –Written Exam</b>	
13-17	2 <sup>nd</sup> , 3 <sup>rd</sup> and 4 <sup>th</sup> week of September 2023	<u><b>Measurement of Power:</b></u> <ul style="list-style-type: none"> <li>➤ <b>Low Power Factor (LPF) wattmeter</b></li> <li>➤ <b>Single phase power measurement</b></li> <li>➤ <b>Three phase power measurement</b></li> <li>➤ <b>Hall effect wattmeter</b></li> <li>➤ <b>Thermal type wattmeter</b></li> </ul>	<b>Chalk and Black board /PPT</b>
18-22		<u><b>Measurement of resistance, inductance and capacitance:</b></u> <ul style="list-style-type: none"> <li>▪ <b>Low, high resistance measurement</b></li> <li>▪ <b>Megger</b></li> <li>▪ <b>Ohmmeters</b></li> </ul>	<b>Chalk and Black board /PPT</b>
23	1 <sup>st</sup> and 2 <sup>nd</sup> Week of October 2023	<b>Second Class Test (CT-2) – Written Exam</b>	
24-26	2 <sup>nd</sup> and 3 <sup>rd</sup> week of October 2023	<u><b>Measurement of resistance, inductance and capacitance:</b></u> <ul style="list-style-type: none"> <li>▪ <b>Classical AC bridges</b> <ul style="list-style-type: none"> <li>➤ Inductance Measurements</li> <li>➤ Capacitance Measurements</li> </ul> </li> </ul>	<b>Chalk and Black board /PPT</b>

		<ul style="list-style-type: none"> <li>▪ Detectors in bridge measurement</li> <li>▪ Bridge screening</li> <li>▪ Wagner earth</li> </ul>		
27-32	4 <sup>th</sup> week of October 2023	<u>Electronic and digital measurements:</u> <ul style="list-style-type: none"> <li>▪ Electronic measurement <ul style="list-style-type: none"> <li>➤ Electronic voltmeter</li> <li>➤ Analog Multimeter</li> </ul> </li> <li>▪ Digital measurement <ul style="list-style-type: none"> <li>➤ Digital voltmeter</li> <li>➤ Digital multi-meters</li> </ul> </li> </ul>	Chalk and Black board /PPT	
33	1 <sup>st</sup> and 2 <sup>nd</sup> Week of Nov 2023	<b>Third Class Test (CT-3) – Written Exam</b>		
34	2 <sup>nd</sup> and 3 <sup>rd</sup> week of November 2023	<u>Electronic and digital measurements:</u> <ul style="list-style-type: none"> <li>▪ Digital measurement <ul style="list-style-type: none"> <li>➤ Digital frequency meters</li> <li>➤ Digital LCR meter</li> <li>➤ Q -Meter</li> <li>➤ Digital wattmeter</li> <li>➤ Energy meters</li> </ul> </li> </ul>	Chalk and Black board /PPT	
35-37		<u>Signal generators, Analyzer and Display:</u> <ul style="list-style-type: none"> <li>▪ Signal generators <ul style="list-style-type: none"> <li>➤ DSO</li> <li>➤ Function generators</li> </ul> </li> </ul>	Chalk and Black board /PPT	
38-41		<u>Signal generators, Analyzer and Display:</u> <ul style="list-style-type: none"> <li>▪ Analyzers <ul style="list-style-type: none"> <li>➤ Waveform analyzers</li> <li>➤ Spectrum analyzers</li> <li>➤ Distortion analyzers</li> </ul> </li> </ul>	Chalk and Black board /PPT	
42-46		<u>Signal generators, Analyzer and Display:</u> <ul style="list-style-type: none"> <li>▪ Displays <ul style="list-style-type: none"> <li>➤ LED</li> <li>➤ LCD and</li> <li>➤ Organic LED displays</li> </ul> </li> </ul>	Chalk and Black board /PPT	
47		Last week of Nov 2023	<b>Doubts clarification, Review of class notes</b>	
<b>COURSE ASSESSMENT METHODS</b>				
Sl.No.	Mode of Assessment	Week/Date	Duration	Percentage
1	Assesment -I	As per academic calendar	1 hour	20
2	Assesment -II	As per academic calendar	1 hour	20

3	Assesment -III (Assignment)	Shall be informed in the class	-----	10
5	Compenstatory Assessment	As per academic calendar	1 hour	20
6	Assesment -IV (End semecter exam)	As per academic calendar	3 hours	50
7	Reassessment	Beginning of next session	3 hours	100

**ESSENTIAL READINGS: Textbooks, reference books Website addresses, journals, etc.**

**Text Books:**

1. Golding's, Electrical Measurements and Measuring Instruments, 6<sup>th</sup> Edition, (Revised & Enlarged): With Solved Examples & MCQ's (In M.K.S. Units), Medtech, Jan 2019.
2. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons, Jan 2015.
3. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press India; 3<sup>rd</sup> edition, 2013.
4. Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley, Electrical and Electronics Measurements and Instrumentation, by McGraw Hill Education (India) Private Limited, 2013

**Reference Books:**

1. H. S. Kalsi, Electronic Instrumentation, McGraw Hill Education; 3<sup>rd</sup> edition, 2017.
2. Albert D. Helfrick, William D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, 1<sup>st</sup> Edition, Pearson, 2016.
3. Ernest O Doebelin and Dhanesh N Manik," Measurements systems Application and design", McGraw Hill publication, 5<sup>th</sup> edition, 2015.

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)**

1. Anonymous feedback through minute card.
2. Direct feedback from the students by having face-to-face meeting individually / as the class as a whole.
3. Feedback from the students during the class committee meetings
4. Students' performance in the class tests

**COURSE POLICY (preferred mode of correspondence with students, re-assessment policy to be specified)**

**MODE OF CORRESPONDENCE (Email/ phone etc):** Email and Phone

**Attendance policy:**

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.

Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

**Re-Test policy**

1. Students who have missed the first or second-class test can register with the consent faculty for the

Re-Test by submitting proper valid justification in written form to write retest.

2. No Re-Test for End semester Exam.

**Grading:**

The passing minimum should be 35% or (Class average/2) whichever is greater.

**Re-Assessment Exam**

- A student may, for valid reasons on production of valid medical certificate and with the approval of HOD be permitted to withdraw from appearing for the End Sem Examination. Withdrawal application shall be valid only if it is made before the commencement of the examination.
- Those who failed in the subject may register for re-assessment examination, which will be conducted for 100% mark (Absolute grading where passing minimum is 35).
- Grades for the students who have withdrawn from writing the End Sem exam will be same as the regular assessment grades. For those who are failed or absent and appearing for reassessment, the maximum grade is restricted to 'E'.
- Re-assessment exam will be conducted in the first week of the next semester or earlier during the vacation.

**Formative Assessment (FA):**

1. Students who have failed after Re-Assessment Exam of the course will have to register and pass the course by Formative Assessment (FA) only.

**Academic dishonesty & plagiarism:**

- Copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

**ADDITIONAL INFORMATION**

The students are advised to clarify their doubts and discuss during the lecture hour. Other than, for out-of-class discussion, they can email their Queries to the Course faculty directly at [ssohail@nitt.edu](mailto:ssohail@nitt.edu).

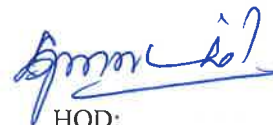
**FOR APPROVAL**



Course Faculty:  
(Dr. Shiraz sohail)



CC-Chairperson:  
( Dr. C Geetha)



HOD:  
( Dr. K Dhanalakshmi)