

## ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

<b>VI Semester: EEE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEEB24	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	
<p><b>OBJECTIVES:</b> The students will try to learn:</p> <p>I. The types and characteristics of instruments employed for measuring electrical quantities            II. The construction, operation and maintenance of different types of instruments            III. The concepts of Cathode Ray Oscilloscope and transducers to measure the physical quantities in the field of science, engineering and technology.</p> <p><b>COURSE OUTCOMES:</b> After successful completion of the course, Students will be able to:</p> <p>CO 1 <b>Classify</b> the measuring instruments based on the method of representation.            CO 2 <b>Compare</b> PMMC and MI instruments in view of construction, extension of range and various errors.            CO 3 <b>Illustrate</b> the working of electrostatic voltmeter with the help of electrostatic effect.            CO 4 <b>Make use of</b> potentiometer for measurement of voltage, current, resistance and power.            CO 5 <b>Make use of</b> instrument transformers to extend range of wattmeter and energy meter.            CO 6 <b>Demonstrate</b> the construction and operation of single phase wattmeter and three phase wattmeter to obtain power in polyphase networks.            CO 7 <b>Interpret</b> the principle of induction effect in the working and calibration of energy meter.            CO 8 <b>Select</b> the DC bridges suitable for measurement of low, medium and high range of resistances.            CO 9 <b>Examine</b> the different types of AC bridges to work out the unknown passive parameters.            CO 10 <b>Identify</b> the various transducers based on the measurement of electrical and non-electrical quantities.            CO 11 <b>Summarize</b> the various working models, features and applications of cathode ray oscilloscope.</p>								
<b>MODULE-I</b>		<b>INTRODUCTION TO MEASURING INSTRUMENTS</b>					<b>Classes: 09</b>	
Introduction: Classification of measuring instruments, deflecting, damping and control torques, types of errors, ammeter and voltmeter: PMMC, MI instruments, expression for deflection and control torque, errors and compensation, extension of range using shunts and series resistances; Electro static voltmeter: attracted type, disc type, extension of range of voltmeters, electro dynamic type voltmeters								
<b>MODULE-II</b>		<b>POTENTIOMETERS AND INSTRUMENT TRANSFORMERS</b>					<b>Classes: 09</b>	
DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, measurement of unknown resistance, current, voltage; AC potentiometers: polar and coordinate type, standardization, applications; Instrument transformers: CT and PT, ratio and phase angle error.								

<b>MODULE-III</b>	<b>MEASUREMENT OF POWER AND ENERGY</b>	<b>Classes: 09</b>
<p>Measurement of Power: Single phase dynamometer type wattmeter, LPF and UPF, double elements and three elements dynamometer wattmeter; Expression for deflection and control torque, extension of range of wattmeter by using instrument transformers, measurement of active and reactive power for balanced and unbalanced Systems.</p> <p>Measurement of Energy: Single phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading using RSS meter, three phase energy meter, introduction to net energy metering (web ref: 4 and 5), maximum demand meters.</p>		
<b>MODULE-IV</b>	<b>DC AND AC BRIDGES</b>	<b>Classes: 09</b>
<p>Measurement of Resistance: Methods of measuring low, medium, high resistance, Wheatstone bridge, carry foster, Kelvin's double bridge, loss of charge method; Measurement of Inductance: Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge; Measurement of Capacitance: Desauty's bridge, Wein's bridge, Schering bridge.</p>		
<b>MODULE-V</b>	<b>TRANSDUCERS AND OSCILLOSCOPES</b>	<b>Classes: 09</b>
<p>Transducers: Definition of transducers, classification of transducers, advantages of electrical transducers, characteristics and choice of transducers, principle of operation of LVDT and capacitor transducers, LVDT applications, strain gauge and its principle of operation, gauge factor, thermistors, thermocouples, synchros, piezo-electric transducers, photovoltaic, photo conductive cells, photo diodes; Cathode ray oscilloscope: Cathode ray tube, time base generator, horizontal and vertical amplifiers, CRO probes, applications of CRO, measurement of phase and frequency, Lissajous patterns, sampling oscilloscope, analog oscilloscope, tubeless oscilloscopes, digital storage oscilloscope (web ref: 6).</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002</li> <li>2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Buckingham and Price, "Electrical measurements", Prentice Hall.</li> <li>2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009.</li> <li>3. A S Morris, "Principles of measurement of instrumentation", Pearson/Prentice Hall of India, 2nd Edition, 1994.</li> <li>4. H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Publications, 1st Edition 1995.</li> </ol>		
<b>Web References:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.researchgate.net">https://www.researchgate.net</a></li> <li>2. <a href="https://www.aar.faculty.asu.edu/classes/">https://www.aar.faculty.asu.edu/classes/</a></li> <li>3. <a href="https://www.electrical4u.com">https://www.electrical4u.com</a></li> <li>4. <a href="https://www.efficientcarbon.com/wp-content/uploads/2013/07/Net-Metering-and-Solar-Rooftop_Whitepaper_EfficientCarbon.pdf">https://www.efficientcarbon.com/wp-content/uploads/2013/07/Net-Metering-and-Solar-Rooftop_Whitepaper_EfficientCarbon.pdf</a></li> <li>5. <a href="https://www.electrical4u.com/digital-storage-oscilloscope/">https://www.electrical4u.com/digital-storage-oscilloscope/</a></li> <li>6. <a href="https://www.iare.ac.in">https://www.iare.ac.in</a></li> </ol>		
<b>E-Text Books:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.jntubook.com">https://www.jntubook.com</a></li> <li>2. <a href="https://www.freeengineeringbooks.com">https://www.freeengineeringbooks.com</a></li> <li>3. <a href="https://www.bookboon.com/en/mechanics">https://www.bookboon.com/en/mechanics</a></li> </ol>		