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Lecture-Notes on the Theory of Electrical Measurements Prepared for the Third-Year Classes of the Cooper Union, Night-School of Science by William A. Anthony.

The matter presented here is prepared by the author for their respective teaching assignments by referring the text books and reference books. Further, this document is not intended to be used for commercial purpose and the committee members are not accountable for any issues, legal or otherwise, arising out of use of this document. Classification, Absolute and secondary instruments, indicating instruments, control, balancing and damping, constructional details, characteristics, errors in measurement, Ammeters, voltmeters: Electrodynamometer type, induction type, single phase and three phase wattmeter, compensation, Energymeters: Induction type siqgle phase and three phase energy meter, compensation, creep, error, testing, Frequency Meters: Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors; testing and applications. DC Potentiometer, Crompton potentiometer, construction, standardization, application. AC Potentiometer, Drysdale polar potentiometer; standardization, application. Block diagram, Sweep generation, vertical amplifiers, use of CRG in measurement of frequency, phase, Amplitude and rise time of a pulse. Block diagram, principle of operation, Accuracy of measurement, Electronic Voltmeter: Transistor Voltmeter, Block diagram, principle of operation, various types of electronic voltmeter, Digital Frequency meter: A Course in Elec. Modern Electronic Instrumentation and Measurement Techniques: The figures in the right-hand margin indicate marks. Answer any six questions including Q. Answer the following questions: Derive the expression for both, with reference to meters used in electrical circuits. Calculate the number of revolutions made by it , when connected to a load carrying 40 A at V and 0. If it actually makes revolutions, find the percentage error. The resistance and reactance of the secondary circuit are 1. With 5A flowing in the secondary winding, the magnetizing mmf is AT and the core loss is 1. Determine the ratio and phase angle errors. Briefly explain the procedure for selecting a transducer. Discuss its basic principle of operation. Write short notes on any two: The meter is tested under half load and rated voltage at unity p. The meter is found to make 80 revolutions in sec. Differentiate between a C. Discuss the theory of a P. T with phasor diagrams. Derive expression for actual transformation ratio, ratio error and phasor angle error of a P. Draw the phasor diagram under null conditions and explain how loss angle of capacitor can be calculated. Write short notes on: Why critical damping is important? Calculate the voltage drop across the resistor to the appropriate number of significant errors. Derive the conditions for balancing the bridge and draw the phasor diagram during balanced condition. How the effect of thermo â€" electric emf is taken into account during measurement? The slide wire has divisions and interpolation can be done to one fourth of a division. The working battery has a voltage of 10 V and negligible internal resistance. Draw the circuit diagram and calculate i The measuring range of potentiometer ii The resolution iii Working current iv Resistance of series rheostat Q. Draw the circuit for measurement of strain and derive the expression of output voltage in terms of strain. What are the means to reduce errors in CT? Explain design and constructional feature to reduce the error. The measuring quantity can be voltage, current, power and energy etc. Generally instruments are classified in to two categories. Instrument Absolute Instrument Secondary Instrument 1. This instrument is really used, because each time the value of the measuring quantities varies. So we have to calculate the magnitude of the measuring quantity, analytically which is time consuming. These types of instruments are suitable for laboratory use. Generally these instruments are calibrated by comparing with another standard secondary instrument. Examples of such instruments are voltmeter, ammeter and wattmeter etc. Practically secondary instruments are suitable for measurement. The pointer indication gives the magnitude of measuring quantity. They are a Deflecting force b Controlling force c Damping force 1. To deflect the pointer from its zero position, a force is necessary which is known as deflecting force. A system which produces the deflecting force is known as a deflecting system. Generally a deflecting system converts

an electrical signal to a mechanical force. When a soft-iron piece is brought near this coil it is magnetized. Depending upon the current direction the poles are produced in such a way that there will be a force of attraction between the coil and the soft iron piece. This principle is used in moving iron attraction type instrument. This principle is utilized in the moving iron repulsion type instrument. This principle is utilized in the moving coil type instrument. If one coil is movable and other is fixed, the movable coil will move away from the fixed one. This principle is utilized in electrodynamometer type instrument. This force is known as controlling force. A system which produces this force is known as a controlled system. When the external signal to be measured by the instrument is removed, the pointer should return back to the zero position. This is possibly due to the controlling force and the pointer will be indicating a steady value when the deflecting torque is equal to controlling torque. The spindle is placed in jewelled bearing, so that the frictional force between the pivot and spindle will be minimum. Two springs are provided in opposite direction to compensate the temperature error. The spring is made of phosphorous bronze. When a current is supply, the pointer deflects due to rotation of the spindle. While spindle is rotate, the spring attached with the spindle will oppose the movements of the pointer. The torque produced by the spring is directly proportional to the pointer deflection. Due to inertia produced by this system, the pointer oscillates about it final steady position before coming to rest. The time required to take the measurement is more. To damp out the oscillation is quickly, a damping force is necessary. This force is produced by different systems. The pointer is fixed to the spindle moves over a calibrated dial. When the pointer oscillates in clockwise direction, the piston goes inside and the cylinder gets compressed. The air pushes the piston upwards and the pointer tends to move in anticlockwise direction. The external pressure is more than that of the internal pressure. Therefore the piston moves down wards. The pointer tends to move in clock wise direction. This disc is made to move in the magnetic field produced by a permanent magnet. An emf is induced in the circular disc by faradays law. Eddy currents are established in the disc since it has several closed paths. The damping force can be varied by varying the projection of the magnet over the circular disc. A permanent magnet is used in this type instrument. Aluminum former is provided in the cylindrical in between two poles of the permanent magnet Fig. Coils are wound on the aluminum former which is connected with the spindle. This spindle is supported with jeweled bearing. Two springs are attached on either end of the spindle. The terminals of the moving coils are connected to the spring. Therefore the current flows through spring 1, moving coil and spring 2. Eddy current damping is used. This is produced by aluminum former. Spring control is used. When the current carrying coil is kept in the magnetic field, it experiences a force.

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complete guide on the techniques used in taking electrical measurements. The reason for this is rather obvious modern measuring requires knowledge of many interdisciplinary topics such as computer techniques, electronics.

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