

Lecture Plan-1

Semester - III

Class: - EEECourse Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :- Introduction to EMMI	Time Allotted:-
1.	Introduction The measurement, no doubt, confirms the validity of a hypothesis but also add to its understanding. New discoveries are not of any practical utility unless the results are backed by actual measurement. EMMI stands for Electronic Measurement and Measuring Instrumentation. It deals with the various electrical quantities measurement by using different instruments.	5 min
2	Division of the Topic Significance of Measurement S.I. units, Absolute standards (International, Primary, Secondary & Working Standards), True Value, Errors (Gross, Systematic, Random).	35 min
3.	Conclusion The measurement, no doubt, confirms the validity of a hypothesis. Measurement is very useful in our life and the instruments can be used for various applications like controlling etc.	5 min
4	Question / Answer Q1 What are various applications of instruments? A1 Measurement of quantities, Control of quantities etc Q2 What is the significance of measurement?	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-2

Semester - III

Class: - EEE

Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :-Static Characteristics	Time Allotted:-
1.	Introduction The system characteristics are to be known, to choose an instrument that most suited to a particular measurement application. The performance characteristics may be broadly divided into two groups, namely static and dynamic. The performance criterion for the measurement of quantities that remain constant, or vary only quite slowly is known as static characteristics of the instrument.	5 min
2	Division of the Topic - Static Characteristic of Instruments . Generalized Instrument Block diagram	35 min
3.	Conclusion Measurement of any system parameter can only be justified when static characteristics are satisfactorily obtained.	5 min
4	Question / Answer Q1. What is Accuracy? A1. It is defined in terms of the closeness with which an instrument reading approaches the true or expected (desired) value of the variable being measured. Q2. What is precision? A2. It is measure of the consistency of reproducibility (repeatability) of the measurement (i.e., the successive reading do not differ). For a given fixed value of an input variable, precision is a measure of the degree to which successive measurement differ from one another.	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper.

Lecture Plan-3

Semester - III

Class: - EEE

Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :- Electromechanical indicating instrument	Time Allotted:-
1.	Introduction It is essential that the moving system is acted upon by three distinct torque (or forces) for satisfactory working. There torques are: deflecting or operating torque, T_d controlling torque, T_c . damping torque, T_v	5 min
2	Division of the Topic -Types of forces acts in Electromechanical indicating instrument -Description about deflecting, controlling & damping forces. -Difference between deflecting, controlling & damping forces.	35 min
3.	Conclusion Working of Electromechanical system is dependent on operation of these torques and characteristics of the instrument also determined by this.	5 min
4	Question / Answer Q1 What is the role of deflecting torque? A1 The deflecting torque, causes the moving system of the instrument to move from its zero position. Q2 What is the importance of damping torque? A2 It will try to occupy a position of rest when the two torques are equal and opposite.	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-4

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :- Electromechanical indicating instrument	Time Allotted:-
1.	<p>Introduction The controlling torque developed in an instrument has two functions: It limits the movement of the moving system and ensures that the magnitude of the deflections always remains the same for a given value of the quantity to be measured.</p>	5 min
2	<p>Division of the Topic Description of control. Requirement of control. Types of control. Comparison between gravity & spring controls.</p>	35 min
3.	<p>Conclusion It brings back the moving system to its zero position where the quantity being measured is removed or made zero. That is, for a steady deflection,</p>	5 min
4	<p>Question / Answer Q1. What are types of Control? A1. Spring control and gravity control. Q2.What is the advantage of gravity control? A2. It is cheap and not affected by temperature variations.</p>	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-5

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :- Bearing supports	Time Allotted:-
1.	Introduction Damping torque is to be developed by using a damping device attached to the moving system. The damping torque is proportional to the speed of rotation of the moving system,	5 min
2	Divison of topics Comparison of damping methods Their Suitability. Description of bearing supports.	35 min
3.	Conclusion the best response is slightly obtained when the da.mping is below the critical value i.e. The instrument is slightly under damped.	5 min
4	Question / Answer Q. 1 What are the types of Damping? A1 Over damped ,under damped and critically damped. Q2 What are the types of suspension? A2 Taut Suspension and Pivot and jewel bearings:	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-6

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: A

S. No.	Topic :- Bearing supports	Time Allotted:-
1.	Introduction With the operating forces being small the frictional forces must be kept to a minimum in order that the instruments reads correctly	5 min
2	Division of the Topic -Pivot-less supports (Simple & taut-band), -Scale information, -Instrument cases - Instrument Covers	35 min
3.	Conclusion Because there is less friction taut band suspensions are can be made more sensitive than the pivot one.	5 min
4	Question / Answer Q1 What are the types of Pivotless support? A1 Simple and taut band. Q2 What is the advantage of taut band support? A2 Taut band instruments are extremely rugged.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-7Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: B

	Topic :- Measuring System Fundamentals	Time Allotted:-
1.	<p>Introduction Absolute instruments give the value of the electrical quantity in terms of absolute quantities (or some constants) of the instruments and their deflections. The quantity to be measured by secondary instruments can be determined from the deflection of the instruments.</p>	5 min
2	<p>Division of the Topic Classification of Instruments (Absolute & Secondary) Indicating, Recording & Integrating instruments. Based upon Principle of operation.</p>	35 min
3.	<p>Conclusion In absolute type of instruments no calibration or comparison with other instruments is necessary. Secondary instrument is calibrated by comparing them with either some absolute instruments or with those which have already been calibrated.</p>	5 min
4	<p>Question / Answer Q1 Write down Classification of instrument based on the Nature of their Operations. A1 Indicating instruments, Recording instruments and Integrating instruments. Q2 Write down classification based on the Kind of Current that can be Measured. A2 Direct current (dc) instruments and Alternating current (ac) instruments.</p>	5 min

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Lecture Plan-8Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- PMMC	Time Allotted:-
1.	<p>Introduction</p> <p>In PMMC meter or (D'Arsonval) meter or galvanometer all are the same instrument, a coil of fine wire is suspended in a magnetic field produced by permanent magnet. According to the fundamental law of electromagnetic force, the coil will rotate in the magnetic field when it carries an electric current by electromagnetic (EM) torque effect. A pointer which attached the movable coil will deflect according to the amount of current to be measured which applied to the coil.</p>	5 min
2.	<p>Division of the Topic</p> <ul style="list-style-type: none"> - Construction, of PMMC type. - Operating principle, of PMMC type. -Torque equation, of PMMC type. -Shape of scale, of PMMC type. 	35 min
3.	<p>Conclusion</p> <p>These are having many advantages like compact in size etc. These can be used for measurement of DC voltage & DC current only.</p>	5 min
4.	<p>Question / Answer</p> <p>Q1 Why PMMC is used? A1 Because it is very accurate.</p> <p>Q2 Which measurements can be done using PMMC? A2 DC voltage and DC current.</p>	5 min

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Lecture Plan-9

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- PMMC	Time Allotted:-
1.	Introduction Range of instrument can be extended in PMMC instruments by using resistance. It is required to increase the measurable range of the instrument.	5 min
2	Division of Topics -Use as Ammeter or as Voltmeter (Extension of Range) -Use on AC/DC or both -Advantages & disadvantages -Errors (Both on AC/DC) of PMMC types.	35 min
3.	Conclusion Range can be extended in ammeter by connecting a shunt resistor in voltmeter by connecting a series resistor	5 min
4	Question / Answer Q1 What is the advantage of PMMC? A1. The power consumption can be made very low. Q2 What is the Disadvantage of PMMC? A2 They are suitable for direct current only.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Doc. No.: DCE/0/15

Revision: 00

Lecture Plan-10

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Electrodynamic Type	Time Allotted:-
1.	Introduction This instrument is suitable for the measurement of direct and alternating current, voltage and power. The deflecting torque in dynamometer is relies by the interaction of magnetic field produced by a pair of fixed air cored coils and a third air cored coil capable of angular movement and suspended within the fixed coil.	5 min
2	Division of the Topic -Construction and operating principle, of Electrodynamic Type. -Torque equation, Shape of scale, of Electrodynamic Type. - Use as Ammeter or as Voltmeter (Extension of Range), Use on AC/DC or both. -Advantages & disadvantages, of Electrodynamic Type. -Errors (Both on AC/DC) of Electrodynamic Type.	35 min
3.	Conclusion It is very useful because it can measure very accurately DC voltage, current and AC voltage, current.	5 min
4	Question / Answer Q1 Which Instrument is called transfer Instrument? A1 Electrodynamometer type. Q2 What is the advantage of Electrodynamometer type instrument? A2 It can be used for AC and DC both.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Doc. No.: DCE/0/15

Revision: 00

Lecture Plan-11

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Moving Iron	Time Allotted:-
1.	Introduction The deflecting torque in any moving-iron instrument is due to forces on a small piece of magnetically 'soft' iron that is magnetized by a coil carrying the operating current.	5 min
2	Division of the Topic Construction and operating principle, of Moving iron type. Types of Moving iron instrument. Torque equation, Shape of scale, of Moving iron.	35 min
3.	Conclusion These have very less loading effect and these require very small force for their operation.	5 min
4	Question / Answer Q1 Which is the widely used instrument in industry? A1 Moving Iron. Q2 Which quantity of AC current and voltage MI type instrument measures? A2 RMS quantity	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-12Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic : Moving Iron	Time Allotted:-
1.	Introduction In moving iron instruments the movable system consists of one or more pieces of specially-shaped soft iron, which are so pivoted as to be acted upon by the magnetic field produced by the current in coil.	5 min
2	Division of the Topic Use as Ammeter or as Voltmeter (Extension of Range), Use on AC/DC or both, Advantages & disadvantages, Errors (Both on AC/DC) of Moving iron type (attraction, repulsion & combined types).	35 min
3.	Conclusion Moving-iron instruments that are generally used to measure alternating voltages and currents.	5 min
4	Question / Answer Q. 1 Which kind of Measurement is possible using Moving Iron instrument? Ans. AC voltage and AC current Q. 2 What are the types of Moving Iron instrument? Ans. Attraction, repulsion & combined types.	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
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Doc. No.: DCE/0/15

Revision: 00

Lecture Plan-13

Semester - III Class: - EEE Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Hot wire Instruments	Time Allotted:-
1.	Introduction The basic principle of operation of the system is the heat transfer from the heated wire to the cold surrounding fluid, heat transfer which is function of the fluid velocity.	5 min
2	Division of the Topic -Construction, operating principle, Torque equation, Shape of scale, use Use on AC/DC or both, Advantages & disadvantages, Errors (Both on AC/DC) of Hot wire type.	35 min
3.	Conclusion Hot wire instruments can be relatively inexpensive and better frequency response obtained.	5 min
4	Question / Answer Q1 What is the advantage of Hot wire instrument? A1 The hot wire anemometer is still the only instrument delivering at the output a truly analogue representation of the velocity up to high frequencies fluctuations Q2 Hot wire instruments can be used for which purpose? A2 For AC and DC both.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
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Revision: 00

Lecture Plan-14

Semester - III Class: - EEE Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Induction type	Time Allotted:-
1.	Introduction In all induction meters we have two fluxes which are produced by two different alternating currents on a metallic disc. Due to alternating fluxes there is an induced emf, the emf produced at one point (as shown in the figure given below) interacts with the alternating current of the other side resulting in the production of torque.	5 min
2	Division of the Topic - Construction, operating principle, of Induction type. -Torque equation, Shape of scale, of Induction type. -Use as Ammeter or as Voltmeter. -Use on AC/DC or both, Advantages & disadvantages. -Errors (Both on AC/DC) of Induction type.	35 min
3.	Conclusion The principle of working and construction of induction type meter is very simple and easy to understand that's why these are widely used in measuring energy in domestic as well as industrial world.	5 min
4	Question / Answer Q1 What is the advantage of induction type instrument? A1 They have high torque is to weight ratio as compared to other instruments.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper.

Lecture Plan-15Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Electrostatic Instrument	Time Allotted:-
1.	Introduction A meter that depends for its operation on forces of Attraction and repulsion between electrically charged bodies is called Electrostatic Instrument.	5 min
2	Division of the Topic Construction, operating principle of Electrostatic type Instruments. Torque equation, Shape of scale of Electrostatic type Instruments.	35 min
3.	Conclusion Principle of operation of Electrostatic Instrument is based on mechanical interaction of electrodes that carry electric charges.	5 min
4	Question / Answer Q. 1 Which type of current and voltage it is able to measure? Ans. AC and DC both. Q. 2 What are the advantages of Electrostatic Instrument? Ans. An Electrostatic Instrument measures the voltage of any particular material surface without transferring excess current charge.	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-16

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: B

S. No.	Topic :- Electrostatic Instrument	Time Allotted:-
1.	Introduction The Voltage range of Electrostatic Voltmeters can be extended by using resistance potential dividers or capacitance potential dividers.	5 min
2	Division of the Topic - Use as Ammeter or as Voltmeter (Extension of Range), of Electrostatic type Instruments -Use on AC/DC or both, Advantages & disadvantages, of Electrostatic type Instruments -Errors (Both on AC/DC) of Electrostatic type Instruments.	35 min
3.	Conclusion Electrostatic instruments draws very negligible power from the mains that's why it is very advantageous to use in industry.	5 min
4	Question / Answer Q1 What are the disadvantages of Electrostatic Instrument? Ans. The scale is not uniform. Q2 What are the advantages of Electrostatic Instrument? Ans. An Electrostatic Instrument measures the voltage of any particular material surface without transferring excess current charge	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Co

Lecture Plan-17Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Electrodynamic wattmeter	Time Allotted:-
1.	<p>Introduction</p> <p>The wattmeter is an instrument for measuring the electric power (or the supply rate of electrical energy) in watts of any given circuit. Electrodynamic wattmeters are used for measurement of utility frequency and audio frequency power; other types are required for radio frequency measurements.</p>	5 min
2	<p>Division of the Topic</p> <p>-Construction, of Electrodynamic type Wattmeter</p> <p>-Operating principle of Electrodynamic type Wattmeter</p>	35 min
3.	<p>Conclusion</p> <p>It is necessary to measure electrical power accurately.</p>	5 min
4	<p>Question / Answer</p> <p>Q1 How many fixed and moving coils are present in Electrodynamic instrument? A1 pair of fixed coils, and a pair of movable coil.</p> <p>Q2 Which coil is called potential coil? A2 Movable coil.</p>	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-18

Doc. No.: DCE/0/15

Revision: 00

Semester - III Class: - EEE Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Electrodynamic wattmeter	Time Allotted:-
1.	Introduction The electrodynamic wattmeter is used to measure power taken from ac or dc power sources. The electrodynamic wattmeter uses the reaction between the magnetic fields of two current-carrying coils (or sets of coils), one fixed and the other movable.	5 min
2	Division of the Topic Torque equation, Shape of scale, of Electrodynamic type Wattmeter. Errors, of Electrodynamic type Wattmeter. Advantages & Disadvantages of Electrodynamic type Wattmeter.	35 min
3.	Conclusion When the current through the fixed-position field winding(s) is the same as current through the load and the current through the moving coil is proportional to the load voltage, then the instantaneous pointer deflection is proportional to the instantaneous power.	5 min
4	Question / Answer Q1 Electrodynamicometer acts on which principle? A1. Reaction between the magnetic fields of two current-carrying coils (or sets of coils), one fixed and the other movable	5 min

Assignment to be given: - NIL

Reference Readings:-

- 3) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 4) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-19

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Induction wattmeter	Time Allotted:-
1.	Introduction Induction wattmeter can be used in A.C. circuits only and are useful only when the frequency and supply voltage are constant.	5 min
2	Division of Topics -Construction, of Induction type Wattmeters; -Operating principle, of Induction type Wattmeters;	35 min
3.	Conclusion The operation of all induction instruments depends on the production of torque due to reaction between a flux and eddy currents induced in a metal disc or drum by another flux.	5 min
4	Question / Answer Q1 Induction wattmeter works on which circuit? A1 It acts on AC measurement only. Q2 Which bearing is used in Induction wattmeter? A2 A thin aluminum disc supported by jewelled bearings.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 1) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-20

Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Induction wattmeter	Time Allotted:-
1.	<p>Introduction</p> <p>Induction instruments depends on the production of torque due to reaction between a flux and eddy currents induced in a metal disc or drum by another flux.</p>	5 min
2	<p>Division of the Topic</p> <p>- Torque equation of Induction type Wattmeters</p>	35 min
3.	<p>Conclusion</p> <p>The magnitude of eddy currents also depends on the flux producing them, the instantaneous value of the deflecting torque is proportional to the square of the current or voltage under measurement</p>	5 min
4	<p>Question / Answer</p> <p>Q1 What is the value of mean deflecting torque? A1 The value of mean deflecting torque is proportional to the mean square of current or voltage.</p>	5 min

Assignment to be given: - NILReference Readings:-

- 2) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 3) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-21Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Induction type Wattmeters	Time Allotted:-
1.	Introduction Induction wattmeter can be used in A.C. circuits only (in contrast with, dynamometer wattmeter can be used both in D.C. and A.C. circuits) and are useful only when the frequency and supply voltage are constant.	5 min
2	Division of the Topic - Shape of scale, Errors, of Induction type Wattmeters - Advantages & Disadvantages; of Induction type Wattmeters	35 min
3.	Conclusion The operation of all induction instruments depends on the production of torque due to reaction between a flux and eddy currents induced in a metal disc or drum by another flux.	5 min
4	Question / Answer Q1 Which part of the instrument provides torque? A1 The spindle also carries a hair spring for providing torque. Q2 What is the advantage of this instrument? A2 They have high torque is to weight ratio as compared to other instruments.	5 min

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- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-22

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic:- Single phase induction type Energy meter.	Time Allotted:-
1.	Introduction In energy meter firstly computes product of current and voltage. Then the result is integrated over the observation time and value of energy is computed.	5 min
2	Division of Topics -Construction, of single phase induction type Energy meter -Operating principle of single phase induction type Energy meter.	35 min
3.	Conclusion Induction type energy meter essentially consists of following components: 1. Driving system 2. Moving system 3. Braking system and 4. Registering system	5 min
4	Question / Answer Q1 How many electro magnets it consist of? A1. It consists of two electromagnets, called " <i>shunt</i> " magnet and " <i>series</i> " magnet, of laminated construction. Q2. Which coil remains connected with main power supply? A2. Pressure coil.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
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Doc. No.: DCE/0/15

Revision: 00

Lecture Plan-23

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Single phase induction type Energy meter,	Time Allotted:-
1.	Introduction The basic working of Single phase induction type Energy Meter is only focused on two mechanisms: Mechanism of rotation of an aluminum disc which is made to rotate at a speed proportional to the power. Mechanism of counting and displaying the amount of energy transferred.	5 min
2	Division of Topics Torque equation, of single phase induction type Energy meter,	35 min
3.	Conclusion Energy meter is an instrument which measures electrical energy. It is also known as watt-hour (Wh) meter. It is an integrating device. Electrical energy is measured in kilo watt-hours (kWh) by this energy meter.	5 min
4	Question / Answer Q1 What is the another name used for Single phase induction type Energy meter? A1 Watt-Hour meter. Q2 What are the applications of Single phase induction type Energy meter? A2 To measure electrical energy consumed in domestic and commercial installation..	5 min

Assignment to be given: - NIL

Reference Readings:-

- 3) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 4) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-24Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Single phase induction type Energy meter,	Time Allotted:-
1.	<p>Introduction</p> <p>The basic working of Single phase induction type Energy Meter is only focused on two mechanisms:</p> <ol style="list-style-type: none"> 1. Mechanism of rotation of an aluminum disc which is made to rotate at a speed proportional to the power. 2. Mechanism of counting and displaying the amount of energy transferred. 	5 min
2.	<p>Division of the Topic</p> <p>- Shape of scale, of single phase induction type Energy meter.</p>	35 min
3.	<p>Conclusion</p> <p>The aluminum disc is supported by a spindle which has a worm gear which drives the register. The register is a series of dials which record the amount of energy used.</p>	5 min
4.	<p>Question / Answer</p> <p>Q1 What are the types of meters are available? A1 Electromechanical and Electronic</p> <p>Q2 How much power it consumes? A2 2 watts.</p>	5 min

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Lecture Plan-25Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Single phase induction type Energy meter,	Time Allotted:-
1.	Introduction Single phase induction type Energy meter suffers from several types of error- .Errors due to stray magnetic fields Errors due to inter-turn capacitance Temperature error	5 min
2	Division of the Topic Errors, of single phase induction type Energy meter. Advantages & Disadvantages of single phase induction type Energy meter.	35 min
3.	Conclusion Induction instruments operate in alternating -current circuits and they are useful only when the frequency and the supply voltage are approximately constant.	5 min
4	Question / Answer Q. 1 What are shading bands? Ans. To bring the flux produced by the shunt magnet exactly in quadrature with applied voltage, the adjustable copper bands are provided on the central limb. These bands are called shading bands.	5 min

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Lecture Plan-26

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Single phase induction type Energy meter,	Time Allotted:-
1.	Introduction In energy meter slow but continuous rotation is obtained even when there is no current flowing through the current coil. And pressure coil is energized which leads to overcompensation of	5 min
2	Division of the Topic - Compensation & creep in energy meter.	35 min
3.	Conclusion Creep error is avoided by two diametrically opposite holes are drilled in the disc the disc will come to rest with one of the holes under the edge of shunt magnet ,the rotation being thus limited to a maximum of half a revolution.	5 min
4	Question / Answer Q1 State two adjustments which are possible in induction type energy meter?. A1 Creep adjustments, Full load unity factor adjustment <input type="checkbox"/>	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-27

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Single phase power factor meters	Time Allotted:-
1.	<p>Introduction</p> <p>The power factor of an AC electrical power system is defined as the ratio of the real power flowing to the load, to the apparent power in the circuit, and is a dimensionless number between -1 and 1. Real power is the capacity of the circuit for performing work in a particular time.</p>	5 min
2	<p>Division of the Topic</p> <p>Construction, of Single phase power factor meters (Electrodynamic type).</p> <p>Operation, principle, of Single phase power factor meters (Electrodynamic type).</p>	35 min
3.	<p>Conclusion</p> <p>Dynamometer type wattmeter works on very simple principle and this principle can be stated as "when any electric current carrying conductor is placed inside a magnetic field, it experiences a mechanical force and due this mechanical force deflection of conductor takes place".</p>	5 min
4	<p>Question / Answer</p> <p>Q1 What are the main parts of induction type energy meters? A1 Driving system, Moving system, Braking system, Registration system.</p>	5 min
		5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-28Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic : Single phase power factor meters	Time Allotted:-
1.	Introduction .Static means that the power meter does not contain any mechanical parts. Static meters are microcontroller based. Current flowing to the load is sensed on a shunt resistor, this is called direct measurement	5 min
2	Division of the Topic Torque equation, of Single phase power factor meters (Electrodynamic type) Advantages & disadvantages of Single phase power factor meters (Electrodynamic type)	35 min
3.	Conclusion Two main types of error is present they are - (1) The value of deflecting torque is very low even though we fully excite the electric current. (2) Errors due pressure coil inductance.	5 min
4	Question / Answer Q.1 Write down disadvantages of Single phase power factor meters? A1. An electro-mechanical power meter registers and displays only an active energy value	5 min

Assignment to be given: - NILReference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

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Lecture Plan-29

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electronic Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Moving Iron types	Time Allotted:-
1.	Introduction Moving Iron Power factor meters are divided into two types Rotating field and Alternating field.	5 min
2	Division of the Topic - Construction, , of Single phase power factor meters Moving Iron types - operation, principle, of Single phase power factor meters , Moving Iron types	35 min
3.	Conclusion The operation of the instrument depends upon a rotating field or a no of alternating current.	5 min
4	Question / Answer Q1 What are the advantages of Single phase power factor meters? A1. An electro-mechanical power meter registers and displays only an active energy value	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-30

Semester - III Class: - EEE Course Code: - EE-209-F
 Subject: - Electronic Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Moving Iron types	Time Allotted:-
1.	Introduction A power factor meter is a kind of electro-dynamometer, which is constructed with two coils that are movable. These coils are set at 90 degrees to one another.	5 min
2	Division of the Topic - Torque equation, of Single phase power factor meters, Moving Iron types. -Advantages & disadvantages of Single phase power factor meters ,Moving Iron types.	35 min
3.	Conclusion This is used for very high frequency measurement (in megahertz)	5 min
4	Question / Answer Q1 Why do we use heterodyne analyzer? A1 For very high frequency measurement. Q2 How can we obtain good frequency response? A2 By using frequency synthesizers.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-31

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Electrical Resonance Type Frequency meters	Time Allotted:-
1.	<p>Introduction</p> <p>Electrical resonance occurs in an electric circuit at a particular resonance frequency where the imaginary parts of circuit element impedance so admittances cancel each other. In some circuits this happens when the impedance between the input and output of the circuit is almost zero and the transfer function is close to one</p>	5 min
2.	<p>Division of the Topic</p> <ul style="list-style-type: none"> - Construction, operation, principle, of Electrical Resonance Type Frequency meters - Torque equation, of Electrical Resonance Type of Frequency meters - Advantages & disadvantages of Electrical Resonance Type Frequency meters 	35 min
3.	<p>Conclusion</p> <p>If the frequency decreases below the normal, value of capacitive reactance becomes more than the inductive reactance and torque is produced.</p>	5 min
4	<p>Question / Answer</p> <p>Q1 What are the types of Electro resonance type frequency meter? A1 Ferro dynamic and Electrodynamic.</p> <p>Q2 Why resonance is used? A2 Resonance is used for tuning and filtering, because it occurs at a particular frequency for given values of inductance and capacitance.</p>	5 min

Assignment to be given: - NIL

Reference Readings:-

- 3) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 4) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-32

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Electrical Resonance Type Frequency meters	Time Allotted:-
1.	Introduction A frequency meter is an electronic instrument that displays the frequency of a periodic electrical signal.	5 min
2	Division of the Topic - Torque equation, of Electrical Resonance Type of Frequency meters - Advantages & disadvantages of Electrical Resonance Type Frequency meters	35 min
3.	Conclusion Advantage of this system is that great sensitivity is achieved.	5 min
4	Question / Answer Q1 How the value of Capacitor is chosen? A1 So that coil occupies a convenient mean position on the iron core.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-33Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Ferrodynamic type Frequency meter	Time Allotted:-
1.	Introduction It consists of a fixed coil which is connected across the supply whose frequency is to be measured. The coil is called magnetizing coil.	5 min
2	Division of the Topic Construction, operation, principle, of Ferrodynamic type Frequency meter. Torque equation, of Ferrodynamic type Frequency meters. Advantages & disadvantages of Ferrodynamic type Frequency meters.	35 min
3.	Conclusion By using frequency synthesizers good frequency response can be obtained.	5 min
4	Question / Answer Q1 What types of measurement is possible ? A1 They can be used for both to measure ac as well dc quantities as scale is calibrated for both..	5 min
		5 min

Assignment to be given: - NILReference Readings:-

- 5) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 6) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-34Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: C

S. No.	Topic :- Electrodynamic type Frequency meter	Time Allotted:-
1.	Introduction All alternating voltage sources are generated at a set frequency or range of frequencies. A frequency meter provides a means of measuring this frequency. Two common types of frequency meters are the vibrating-reed frequency meter and the moving-disk frequency meter.	5 min
2	Division of the Topic - Construction, operation, principle, Torque equation, -Advantages & disadvantages of Frequency meters Electrodynamic type.	35 min
3.	Conclusion Following errors may affect the measurement of Electrodynamic type Frequency meter (a)Errors in the pressure coil inductance. (b) Errors may be due to pressure coil capacitance . (c) Errors may be due to mutual inductance effects.	5 min
4	Question / Answer Q1. What is the advantage of this instrument? A1. Scale is uniform upto certain limit.	5 min

Assignment to be given: - NILReference Readings:-

- 7) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 8) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-35

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Low and High Resistance measurement	Time Allotted:-
1.	Introduction This is the best and commonest method of measuring <i>medium</i> resistance values in the range of 1Ω to the low megohm.	5 min
2	Division of the Topic - Limitations of Wheatstone bridge; -Kelvin's double bridge method, -Difficulties in high resistance measurements,	35 min
3.	Conclusion Kelvin bridge is a modification of the Wheatstone bridge and provides greatly increased accuracy in the measurement of <i>low value</i> resistance, generally below (1Ω).	5 min
4	Question / Answer Q1 Which bridge is used to measure medium resistance? A1 Wheatstone bridge Q2 Which bridge is used to measure low resistance? A2 Kelvin's double bridge.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-36

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Low and High Resistance measurement	Time Allotted:-
1.	Introduction Measurements of high resistance is suffered by different errors that's why conventional methods cannot be used to measure high resistance.	5 min
2	Division of the Topic - Measurement of high resistance by direct deflection, - Loss of charge method, Megohm bridge - Meggar.	35 min
3.	Conclusion The high frequency band is very popular with amateur radio operators, who can take advantage of direct, long-distance (often inter-continental) communications and the "thrill factor" resulting from making contacts in variable conditions.	5 min
4	Question / Answer Q1 Which bridge is used to measure high resistance? A1 Megohm bridge. Q2 Why Meggar is used? A2 To measure high resistance.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-37

Semester - III Class: - EEE Course Code: - EE-209-FSubject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Ac Bridge and Maxwell's Inductance Bridge	Time Allotted:-
1.	<p>Introduction A.C.Bridges are those circuits which are used to measure the unknown resistances, capacitance, inductance, frequency and mutual inductance.</p>	5 min
2	<p>Division of the Topic</p> <ul style="list-style-type: none"> -General balance equation for AC bridges. -Ckt. diagram, Phasor diagram, of Maxwell's inductance -Advantages, disadvantages, of Maxwell's inductance -Applications of Maxwell's inductance 	35 min
3.	<p>Conclusion</p> <p>Maxwell's inductance bridge is very useful for the wide range of measurement of inductance at audio frequencies.</p>	5 min
4	<p>Question / Answer</p> <p>Q. 1 Why Maxwell's Inductance Bridge is used? Ans. To measure unknown inductance.</p> <p>Q. 2 What is the Measuring range of Maxwell's Inductance bridge? The bridge is limited to measurement of low quality coils ($1 < Q < 10$) and it is also unsuitable for low value of Q (i.e. $Q < 1$) from this we conclude that a Maxwell bridge is used suitable only for medium Q coils.</p>	5 min

Assignment to be given: - NILReference Readings:-

A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-38

Semester - III Class: - EEE Course Code: - EE-209-F
Subject: - Electricals Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Hay's Bridge	Time Allotted:-
1.	Introduction Hay's bridge is suitable for measuring Q factor over a wide range.	5 min
2	Division of the Topic -Ckt. diagram, Phasor diagram, Advantages, disadvantages Hay's Bridge - Applications of Hay's bridge	35 min
3.	Conclusion The frequency to be measured is converted into number of pulse train. & then counted by electronic counter.	5 min
4	Question / Answer Q. 1 Hay's bridge is modified form of which bridge ? Ans. Maxwell bridge Q. 2 What is the disadvantage of Hay's bridge? Ans. Hay's bridge is not suitable for measurement of quality factor ($Q < 10$) .	5 min

Assignment to be given: - NIL

Reference Readings:-

A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
Electronics Instrumentation and Measurement Techniques by Cooper

Lecture Plan-39

Semester - III Class: - EEE Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Anderson Bridge	Time Allotted:-
1.	Introduction In the Anderson Bridge the unknown inductance is measured in terms of a known capacitance and resistance.	5 min
2	Division of the Topic Ckt. diagram, Phasor diagram, Advantages, disadvantages of Anderson Bridge Applications of Anderson Bridge	35 min
3.	Conclusion This method is capable of precise measurements of inductance over a wide range of values from a few micro-henrys to several henrys and is the best bridge method.	5 min
4	Question / Answer Q. 1 Anderson bridge is used to measure which passive element? Ans. Inductor. Q. 2 What is the advantage of Anderson bridge? Ans. Wide range of measuring values.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 3) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 4) Electronics Instrumentation and Measurement Techniques by Cooper

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Lecture Plan-40

Semester - III

Class: - EEE

Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Owen Bridge	Time Allotted:-
1.	Introduction Owen's bridge uses standard capacitor, inductor and variable resistors connected with ac source for excitation.	5 min
2	Division of the Topic Ckt. diagram, Phasor diagram, Advantages, disadvantages, Owens Bridge Application of Owens Bridge	35 min
3.	Conclusion Measurement of Inductance is quite simple and is independent of frequency component.	5 min
4	Question / Answer Q. 1 What is the advantage of Owen's bridge? Ans. This bridge is useful for the measurement of inductance over wide range. Q. 2 What is the disadvantage of Owen's bridge? Ans. In this bridge variable standard capacitor is used which is quite expensive item and also the accuracy of this is about only one percent.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 1) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 2) Electronics Instrumentation and Measurement Techniques by Cooper

Doc. No.: DCE/0/15

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Lecture Plan-40

Semester - III Class: - EEE Course Code: - EE-209-F

Subject: - Electrical Measurement and Measuring Instrumentation Section: D

S. No.	Topic :- Wien's Bridge	Time Allotted:-
1.	Introduction Wien's Bridge is used for the measurement of the audio-frequency. Shielding and earthing is used to reduce noise in measurements using AC bridge circuit.	5 min
2	Division of the Topic Ckt. diagram, Phasor diagram, Advantages, disadvantages, of Wien's bridges, Shielding & earthing.	35 min
3.	Conclusion Wien's bridge is not as accurate as the modern digital frequency meters. Wagner's Earthing device is very effective to reduce noise in industrial measurement also.	5 min
4	Question / Answer Q. 1 Which AC bridge is used for frequency measurement? Ans. Wien's bridge Q. 2 What is the range of frequency measurement using wien's bridge? Ans. Audio range.	5 min

Assignment to be given: - NIL

Reference Readings:-

- 3) A course in Electrical and Electronics Measurement & Instrumentation by A.K.Sawhney
- 4) Electronics Instrumentation and Measurement Techniques by Cooper