As per MSBTE's ' I ' Scheme Revised syllabus w.e.f. academic year 2018-2019

ELECTRICAL AND ELECTRONIC MEASUREMENTS

Second Year Diploma SEMESTER – III

Electrical Engineering Program Group
(EE/EP/EU)

Prof. Navnath M. Ghogare Prof. Haridas M. Kakad

Price : ₹ 100/- DMI1045A

Gigatech Publishing House
Igniting Minds

As per MSBTE's ' I ' Scheme Revised syllabus w.e.f. academic year 2018-2019

Electrical and Electronic Measurements

Course Code : 22325

Second Year Diploma

SEMESTER – III

For

Electrical Engineering Program Group (EE/EP/EU)

Prof. Navnath M. Ghogare
DEE, B.E. (Electrical), M. Tech. (Power System)
Lecturer, Electrical Engineering Department,
K. K. Wagh Polytechnic, Nashik-03
Maharashtra, India

Prof. Haridas M. Kakad
DEE, B.E. (Electrical), M.E. (Power System)
Selected-MPSC Assistant Electrical Engineer (Gr-B)
Lecturer, Electrical Engineering Department,
K. K. Wagh Polytechnic, Nashik-03
Maharashtra, India

Download your free e-Book here

Gigatech Publishing House
Igniting Minds

Electrical and Electronic Measurements

Second Year Diploma (Semester – III)

Electrical Engineering Program Group

Prof. Navnath M. Ghogare, Prof. Haridas M. Kakad

First Edition : 2018

Published By : Gigatech Publishing House
631/32, Budhwar Peth, Office No. 105, First Floor,
Shan Bramha Complex, Pune – 411 002.
Phone No. 7757042853

ISBN : 978-81-938081-2-2
Price : ₹ 105/-

Available at All Leading Book Stalls

Distributor
PRADEEP BOOK DISTRIBUTORS
102/3/4 1ST Floor, Shan Bramha Complex, Pune.
Telephone No. : 020 – 24458333, 942 208 7031 / 844 699 5959
Email : pbd0909@gmail.com

Note : For any queries, doubts, suggestions and complaints regarding the subject, please feel free to contact on the below e-mail or phone number. We will be more than thankful for your feedback.
Ph: 7757042853 **E-mail :** info.gigatech1@gmail.com

What is an e-Book?

eBook is digital version of a book that can be read on Mobile, Tablet, Laptop or Computer. eBooks are accessible anywhere, anytime & anyplace on your Digital Devices. You can download ebooks offline to read it without Internet connection. All the Gigatech Publishing House books are available in ebook format also with only kopykitab.com. As a hard book user you can use sample ebooks

Read e-books online or offline on any device:		
Download ebooks & **Read Offline**  1.	**Instant Access**  2.	**zoom in / zoom out**, change page size etc to read it as per your requirements.  3.
You can take notes or **Highlights** in the ebook.  4.	You can **Take Notes** on the ebook.  5.	**Night Mode** Reading  6.

How to download Steps:

1. Download any QR Code reader on your phone from the Google Play/Apple Store.
2. Hold your device over a QR Code so that it's clearly visible on your smartphone's screen.
   Two things can happen when you correctly hold your smartphone over a QR Code.
   i) The phone automatically scans the code.
   ii) On some readers, you have to press a button to snap a picture, not unlike the button on your smartphone camera. If necessary, press the button.
3. Your smartphone reads the code and navigates to the intended destination, which doesn't happen instantly. It may take a few seconds on most devices.

Download your free e-Book here

Preface

This Book **Electrical and Electronic Measurements** is intended to be a textbook for students of Diploma of MSBTE. In most sciences, one generation years down what another has built and what one has established another undoes. In **Electrical and Electronic Measurements**, each generation adds a new story to the old structure. Keeping this in mind, this book is written to have a better introduction of the **Electrical and Electronic Measurements**. This book is presented with simple but exact explanation of subject matter, application of each topic to real life, engineering problems, large number of illustrative examples followed by well graded exercise. We have tried to be rigorous and precise in presenting the concepts in very simple manner. We hope that the students will not only learn some powerful concepts, but also will develop their ability to understand the concept and apply it properly to solve engineering problems. We feel that faculty member will also enjoy reading this book which is enriched with application of each topic.

Acknowledgment

We are grateful to the M.S.B.T.E-Mumbai, the Examining Body, whose 'Syllabus Draft' and Examination Questions have been included in this book for the purpose of illustration and right direction.

The authors acknowledge the help of colleagues and friends for the warm relationship which provides a source of energy in our endeavors.

We are grateful to our family members for the encouragement and constant cooperation and assistance in creation of this book.

We are certainly thankful to the students of diploma who are a constant source of our enthusiasm and encouragement in our endeavors.

We hope the book; an off-shoot of joint venture, will cater all the requirement of students to crack the nut-shell of the subject. We are also thankful to **Gigatech Publishing House TEAM** for their continuous support, hard work and patience in preparing this book.

SYLLABUS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Fundamentals of measurements	1a. Describe the significance of the given measuring instrument. 1b. Classify the given measuring instruments. 1c. Determine static and dynamic characteristics of the measuring instruments with the given data. 1d. Explain the procedure for calibration of given device.	1.1 Measurement: Significance, units, fundamental quantities and standards. 1.2 Instruments : (a) absolute and secondary instruments. (b) analog and digital instruments. (c) mechanical, electrical and electronic instruments. 1.3 Static and dynamic characteristics, types of errors. 1.4 Calibration : need and procedure.
Unit – II Measurement of voltage and current.	2a. Explain with sketches the construction and working principle of the specified Instrument. 2b. Convert the PMMC instrument into DC ammeter for the given range. 2c. Convert the PMMC instrument into DC voltmeter for the given range. 2d. Explain with sketches the working of given type of voltmeter.	2.1 Analog meters: Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) meter, their construction, working, salient features. 2.2 DC Ammeter: Basic, Multi range, Universal shunt. 2.3 DC Voltmeter: Basic, Multi range, simple numerical based on R_S, concept of loading effect and sensitivity. 2.4 AC voltmeter: Rectifier type (half wave and full wave). 2.5 Ohm meter: Series and shunt. 2.6 Clamp-on meter.
Unit – III Measurement of Electric Power	3a. Describe with sketches the construction of the given Wattmeter. 3b. Determine multiplying factor	3.1 Dynamometer type wattmeter: Construction and working. 3.2 Range: Multiplying factor and extension of range.

	for the given meter. 3c. Connect wattmeter for power measurement of the given circuit. 3d. Determine the electrical power and power factor of the given circuit. 3e. Describe the selection procedure of the meters for measuring the given parameter.	3.3 Errors and compensations. 3.4 Active and reactive power measurement : One, two and three wattmeter method. 3.5 Effect of Power factor on wattmeter reading in two wattmeter method. 3.6 Maximum Demand indicator. 3.7 Four quadrant meter. 3.8 Phase sequence.
Unit-IV **Measurement of Electric energy**	4a. Describe with sketches the construction of the given energy meter. 4b. Describe with sketches the connection of the given single phase energy meter for electrical energy measurement. 4c. Determine the errors in the given energy meter. 4d. Select energy meter for the given application with justification. 4e. Calibrate the given type of meter.	4.1 Single and three phase electronic energy meter: Constructional features and working principle. 4.2 Errors and their compensations. 4.3 Calibration of single phase electronic energy meter using direct loading.
Unit –V **Measuring Instruments**	5a. Choose the method for measurement of resistances for given application with justification. 5b. Describe with sketches the specified blocks and working of the given type of oscilloscope. 5c. Describe with sketches the procedure to measure the given parameter using the CRO. 5d. Describe with sketches the various blocks and working of the given type of signal/function generator.	5.1 Measurement of resistance : Low, Medium and High; Megger and earth tester; Multimeter and L-C-R meter. 5.2 Frequency meter. 5.3 Phase sequence and Phase sequence indicator. 5.4 Synchroscope and Infrared meter. 5.5 Single beam/single trace CRO, Digital storage Oscilloscope: Basic block diagram, working, Cathode ray tube, electrostatic deflection, vertical amplifier, time base generator, horizontal amplifier, measurement of voltage / amplitude / time period / frequency / phase angle delay line,

		specifications. 5.6 Signal generator: need, working and basic block diagram. 5.7 Function generator: need, working and basic block diagram, function of symmetry. 5.8 Tri-vector meter.

Suggested Specification Table for Question Paper Design

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of measurements	08	02	04	04	10
II	Measurement of voltage and current.	10	02	04	06	12
III	Measurement of Electric Power	10	01	04	06	11
IV	Measurement of Electric Energy	14	01	04	06	11
V	Measuring Instruments	22	04	10	12	26
Total		**64**	**10**	**26**	**34**	**70**

Legends :

R = Remember, U = Understand, A = Apply and above (Bloom's Revised taxonomy)

Note : This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

Recommended by MSBTE Text Books and Reference Books

Text Books :

Sr. No.	Title of Book	Author	Publication
1	A Text Book of Electrical Technology Vol-I (Basic Electrical Engg.)	Theraja B. L., Theraja A. K.	S. Chand and Co. New Delhi, 2014, ISBN: 9788121924405
2	Basic Electrical Engg.	Mittle V. N.	Tata McGraw-Hill New Delhi, 2005, ISBN : 978-0-07-0088572-5,
3	Electrical Technology	Edward Hughes	Pearson Education, New Delhi, 2003, ISBN – 13: 978-0582405196
4	Electrical and Electronic Measurements and Instrumentation	Rajput R. K.	S.Chand and Co. New Delhi, 2008, ISBN : 9789385676017
5	Electrical and Electronics Measurements and Instru-mentation.	Sawhney A. K.	Dhanpat Rai and Sons, New Delhi, 2014; ISBN : 9780000279744
6	Electrical Measurements and Measuring Instruments	Suryanarayna N. V.	S. Chand and Co. New Delhi, 2001 ISBN : 8121920116

Software/Learning Websites :

a. www.youtube.com
b. www.nptel.ac.in
c. www.wikipedia.com
d. www.eletricaltechnology.org
e. www.howstuffworks.coms
f. www.electrical4u.com

◆◆◆

CONTENTS

◆◆◆

Unit 1

Fundamental of Measurements

Syllabus :

1.1 Measurement: Significance, units, fundamental quantities and standards.

1.2 Instruments :

(a) Absolute and secondary instruments.

(b) Analog and digital instruments.

(c) Mechanical, electrical and electronic instruments.

1.3 Static and dynamic characteristics, types of errors.

1.4 Calibration : need and procedure.

1.1 Measurement :

➡ **Q. 1** What is measurement?

➡ **Q. 2** Define the term measurement?

➡ **Q. 3** What is Purpose of measurement?

Measurement is a process by which one can convert physical parameter to meaningful numbers. Measurement is the activity of obtaining and comparing physical quantities of real-world objects and events.

There are two major function of all branches of engineering design of equipment, process, proper operation and maintenance of equipment and process, both this function are required for measurement.

The device used for comparing the unknown quantity with the unit of measurement or standard quantity is called as measuring instruments.

1.2 Standards:

➡ **Q. 1** State the concept of standard?

➡ **Q. 2** Explain different type of standard?

A standards of measurement is a physical representation of unit of measurement.

It is used to identify the value of other physical quantity by comparing with them.

- **There are different type of standards on the basis of their application and function.**

1. International standards :

It represents the certain unit of measurement by available. These standards are periodically evaluated and checked by absolute measurement in terms of fundamental units.

2. Primary Standards :

These standards are maintain by national laboratory. It has high accuracy and mainly used for calibration and verification.

3. Secondary Standards :

It is a basic reference standards which is used in industrial measurements. The standards available in the area are maintain as their calibration is checked by that particular industrial laboratory.

4. Working Standards :

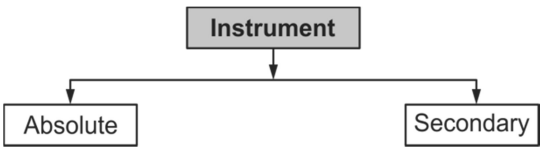
It is used to check accuracy, performance and calibration of laboratory instruments.

1.3 Instruments :

➡ **Q. 1** How the instrument are classified?
➡ **Q. 2** State desirable qualities of measuring instruments?
➡ **Q. 3** Explain absolute and secondary instruments?
➡ **Q. 4** Explain different type of secondary instrument?

– An instrument is a device in which it is used to determine the magnitude or value of the quantity to be measured.

– The measuring quantity can be voltage, current, power and energy etc. Generally instruments are classified in to two categories



- **Following are the desired qualities of measuring instruments:**

1. Accuracy :

Ability of system to respond to true value of measured variable under reference condition.

2. Sensitivity :

The ratio of change in output to the change in input.

3. Precision :

It is a measure of repeatability of measurements.

4. Reproducibility :

It is the closeness among the number of repeated measurement of output for same value of input.

5. Drift :

It is an undesired change in the output input relationship over a period of time.

6. Resolution :

Least incremental value at input or output that can be detected by device.

7. Dead zone :

It is maximum value of quantity under measurement to which the instrument does not respond.

8. Error :

It is deviation of true value from the desired value.

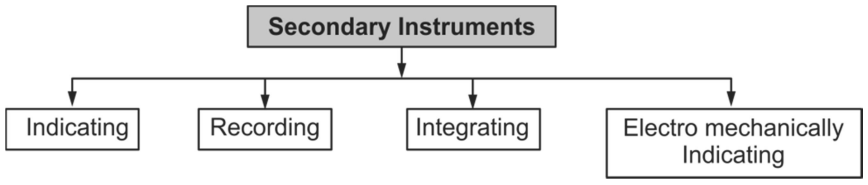
1.3.1 Absolute Instruments :

- An absolute instrument determines the magnitude of the quantity to be measured in terms of the physical constant of instruments.
- 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.

Example : Tangent galvanometer, current balance meter

1.3.2 Secondary Instruments :

- This instrument determines the value of the quantity to be measured directly.
- Generally these instruments are calibrated by comparing with another standard secondary instrument which has already calibrated with another absolute instruments.

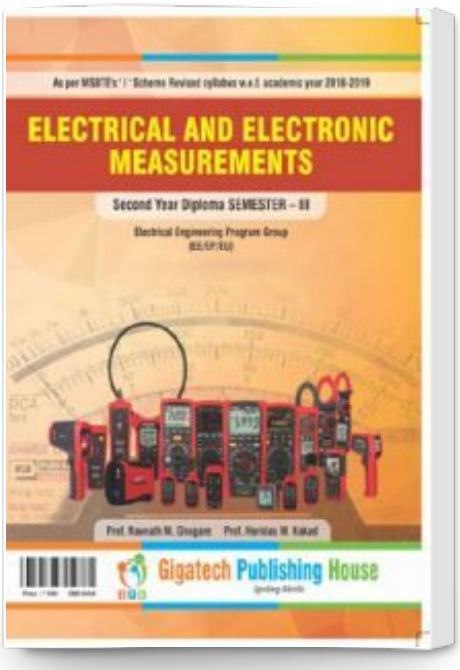


1.3.3 Indicating Instrument :

- This instrument uses a dial and pointer to determine the value of measuring quantity. The pointer indication gives the magnitude of measuring quantity.
- It is a instrument which indicate the magnitude of an electrical quantity at the time when it is being measured. The indication are given by a pointer moving over a graduated dial.

Example : Ammeter, Voltmeter, Wattmeter

Electrical And Electronic Measurements



Publisher : Gigatech Publishing House

ISBN : 9788193808122

Author : Prof. Navnath M. Ghogare, Prof. Haridas M. Kakad