

**COURSE TITLE** : **ENGINEERING METROLOGY**  
**COURSE CODE** : **3111**  
**COURSE CATEGORY** : **B**  
**SEMESTER** : **3**  
**PERIODS PER WEEK** : **6**  
**PERIODS PER SEMESTER** : **90**  
**CREDITS** : **6**

#### **TIME SCHEDULE**

<b>MODULE</b>	<b>TOPIC</b>	<b>PERIODS</b>
1	Introduction to Linear measurements.	22
2	Angular measurements. Miscellaneous measurements	24
3	Gauges and comparators. Surface Finish.	26
4	Measuring machines.	18
	<b>TOTAL</b>	<b>90</b>

#### **COURSE OUTCOMES**

After completion of the study, students should be able to :

1. Understand the linear and angular measurement methods with various measuring instruments.
2. Know the function of gauges and comparators.
3. Know surface finish and methods of measuring surface finish.
4. Understand the working of measuring machines.

#### **SPECIFIC OUTCOMES**

##### **MODULE- I**

##### **1.1.0 Understand the Importance and aim of Metrology and Measurement Techniques**

- 1.1.1 Describe basic principles of measurement
- 1.1.2 Define measurement
- 1.1.3 Identify methods of measurements
- 1.1.4 Distinguish between direct comparison and indirect comparison

1.1.5 Define range, sensitivity, true value, indicate value, error, correction, accuracy, precision.

### **1.2.0 Know Linear measurement methods**

1.2.1 Identify non-precision measurement

1.2.2 Describe various parts and methods of measuring with, surface plate, tool maker's flats, high precision surface plate, glass surface plate and angle plate

1.2.3 Describe various parts and methods of measuring with V block, straight edge, spirit level, combination set, universal surface gauge, and feeler gauge.

1.2.4 List the characteristics of precision measuring instruments.

1.2.5 Illustrate the methods of reading with vernier caliper, vernier height gauge and vernier depth gauge

1.2.6 Explain the methods of reading with outside micrometer and depth micrometer.

1.2.7 Describe the computation of least count of precision measuring instruments.

1.2.8 List the classification of slip gauge.

1.2.9 Describe the working of Vernier height master

## **MODULE-II**

### **2.1.0 Understand the application of Angular Measurement.**

2.1.1 List the various instruments for angular measurements.

2.1.2 Describe the parts and working of vernier bevel protractor.

2.1.3 Illustrate the parts and methods of reading with universal bevel protractor.

2.1.4 Explain the use of sine bar .

2.1.5 Describe the use of clinometers.

2.1.6 Explain the working of auto collimeter

### **2.2.0 Understand Miscellaneous Measurements**

2.2.1 Explain the method to check small taper in a recess

2.2.2 Describe the measurement of internal taper in a blind hole

2.2.3 Illustrate the measurement of angle of a V groove

2.2.4 Explain the procedure of measuring the diameter of large holes.

2.2.5 Describe the measurement of external dovetail slide.

2.2.6 Describe the measurement of internal dovetail slide

## **MODULE-III**

### **3.1.0 Understand the gauges and comparators**

3.1.1 Know the use of dial gauge, limit gauge, go and no go gauge, plug gauge, snap gauge and ring gauge.

- 3.1.2 List the advantages and disadvantages of limit gauges.
- 3.1.3 Describe the working of profile projector.
- 3.1.4 Discuss the function of comparators
- 3.1.5 Identify mechanical comparator – Reed type and Zigma type
- 3.1.6 Identify electrical and electronic comparator
- 3.1.7 Describe the working of optical comparator – zeis optotest comparator
- 3.1.8 Describe the pneumatic comparator – solex type

### **3.2.0 Compute Surface Finish**

- 3.2.1 Describe the importance of surface finish
- 3.2.2 Define surface roughness
- 3.2.3 Discuss the various elements of surface roughness
- 3.2.4 Describe working of Tomlinson's surface meter
- 3.2.5 Describe the various methods of measuring surface finish
- 3.2.6 Describe the principle and working of Michelsons interferometer and optical flats type A and B
- 3.2.7 Discuss the applications of the instruments specified in 3.2.6
- 3.2.8 Describe flatness test
- 3.2.9 Describe parallelism test
- 3.2.10 Compute CLA and RMS values

## **MODULE-IV**

### **4.1.0 Understand the working of measuring machines**

- 4.1.1 Explain the working of Tool maker's microscope
- 4.1.2 Discuss the use of vertical optimeter
- 4.1.3 Explain the working of co-ordinate measuring machine
- 4.1.4 Explain the working of length bar measuring machine
- 4.1.5 Explain the working of universal measuring machine
- 4.1.6 Understand Computer Aided Metrology
- 4.1.7 Describe laser metrology
- 4.1.8 Explain the use of computers in metrology

## CONTENT OUTLINE

### **MODULE-I**

#### **Introduction**

Basic principles of measurement, Measurement – definition, Methods of measurements, Direct comparison, Indirect comparison, Measuring system –, Definitions- Range, Sensitivity, True value , Indicated value, Error, Correction, Accuracy, Precision

#### **Linear Measurement**

Non-precision measurements, , Surface plate, Toolmakers plate and high precision surface plate, Glass surface plate, Angle plate, V Block, Straight edge, Spirit level, Combination set, Universal surface gauge, Feeler gauges, Application of these instruments in engineering production Precision measurement, Characteristics of precision measuring instruments, Vernier caliper – Vernier height gauge, Vernier depth gauge, Micrometer, Micrometer depth gauge, Slip gauge – classification, Building up of slip gauge, Checking height, Classification as per BIS specifications. Height master

### **MODULE-II**

#### **Angular Measurement**

Instruments used for angular measurements, Vernier bevel protractor, Universal bevel protractor, Sine bar – use of sine bar. Clinometer

#### **Miscellaneous Measurement**

Checking the angle of a tapered recess whose angle of taper is very small Measurement of internal taper in a blind hole Measurement of diameter of large hole, Measurement of angle of a V groove, Measurement of external and internal dovetail slide.

### **MODULE- III**

Gauges – introduction – classification of gauges, Standard gauges, Limit gauges – go and no go gauge, Plug gauges, Snap gauges, Ring gauges, Advantages and limitation of limit gauges, Care of gauges. Dial gauge – use of dial gauge – principle of operation, Profile projector or profile gauge Comparators- Introduction – Classification, Mechanical comparator – Reed type and sigma type, Electrical and electronic comparator, Optical comparator – zesis optotest comparator, Pneumatic comparator – solex type

#### **Measurement of surface finish**

Introduction – elements of surface roughness – Evaluation of surface roughness – CLA and RMS Values Methods of measuring surface finish. Interferometer – Michelson's interferometer – principle – working. Tomlinson's surface meter – working .Optical flat – use – principle – classification – type A, type B, Applications – flatness test –Parallelism test

## **MODULE – IV**

### **Measuring machines**

Toolmaker's microscope – uses – working principle – method of measurement Vertical optimeter – uses – working principle – method of measurement Co-ordinate measuring machine – uses – method of measurement Length bar – uses – method of measurement – Universal measuring machines. Computer Aided Metrology – laser metrology – use of computers – machine vision technology microprocessors in metrology –

### **REFERENCE BOOKS**

1. Metrology for Engineers - J.F.W. Galyer & C.R. Shotbolt
2. Engineering Metrology - R.K. Jain
3. Engineering Metrology & Instrumentation - R.K. Rajput
4. A text book of production Technology - P.C. Sharma
5. Mechanical and Industrial Measurement - R.K. Jain
6. Metal working and metrology - Narayan/Sudhakar(Scitech)
7. Engineering Metrology - Narayana (Scitech )
8. Mechanical measurement - Beckwith (Pearson)