

Subject Code: 1ET4020403	Subject Title: Metrology & Instrumentation
Pre-Requisite	--

RATIONALE:

The object of this course is to establish basic fundamental practical knowledge in the field of measurement and inspection. The students of Mechanical Engineering branch are basically concerned with manufacturing various machine components in shops as per given drawing. Today the industrial processing and manufacturing techniques have become complex and complicated & their control is very much difficult by human judgment only. Therefore, the exact and precise measurements are the basic need of the industries. This course of Metrology & Instrumentation, therefore, provides required knowledge and skills & creates self confidence in students so that they can work on shop floor independently for accurate and precise measurements and manufacturing.

COMPETENCY:

Apply basic measurement, concepts of mechanical drafting and concepts of manufacturing engineering for improving the quality standard of the product/ work-piece.

COURSE OBJECTIVE:

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

1. Measure the given mechanical elements and assemblies using linear and angular analog /digital measuring instruments.
2. Check geometrical accuracy of given application.
3. Explain surface roughness checking instruments.
4. Measure and derive important dimensions of various thread forms and gears
5. Select and use non destructive testing methods.
6. Check the dimensions using the gauges.
7. Select and measure variables using appropriate sensors and transducers

TEACHING AND EVALUATION SCHEME:

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)			
Lecture	Tutorial	Practical	Credit	Theory		Practical	
				University Assessment	Continuous Assessment	University Assessment	Continuous assessment
4	-	2	5	60	40	20	30

DETAILS OF COURSE CONTENTS:

SR. NO.	TOPIC	Total Hrs.	WEIGHTAGE in marks
1	Linear and Angular Measurement 1.1 Inspection, quality and quality control-definitions and differences 1.2 Define accuracy, precision and error. 1.3 Principle of vernier scale and least count. 1.4 Surface plates-types, important features, standards/important sizes, applications and precautions in use. 1.5 Types, constructional sketch, major parts and their functions, least count, measuring methods and measurement illustration of Vernier Caliper*, Micrometer*, Telescopic gauge*, Height gauge*, Depth gauge*. 1.6 Slip gauge- types, applications, and wringing method. 1.7 Sketch, major parts and their functions, least count, measuring methods and measurement illustration of Bevel Protector, Sine bar, Angle gauge, Angle Dekkor, Spirit level, Clinometers, Auto collimator 1.8 Calibration – concept and need.	12	14
2	Measurement of Geometrical Surfaces 2.1 Dial indicators/gauge-types, constructional sketch and applications. 2.2 Definition, symbol and measuring methods of : Straightness, Flatness*, Squareness, Parallelism, Perpendicularity, Roundness*, Concentricity, Cylindricity*, Run-out* and Ovality*.	5	6
3	Measurement of Surface Roughness 3.1 Terminology used in connection with surface finish. 3.2 Comparison methods to inspect surface finish-concept and applications. 3.3. Indication of various surface roughness characteristics with surface roughness symbols-interpretation	5	6
4	Gear and Thread Measurement 4.1 Types of gears 4.2 Forms of gear teeth-types and concept 4.3 Gear tooth Terminology 4.4 Sketch, major parts and their functions, least count, measuring methods and measurement illustration of gear tooth Vernier.	12	12

	4.5 Derivation to measure gear tooth thickness using Gear tooth Vernier, Constant chord method and Base tangent method. 4.6 Gear tooth profile measurement. 4.7 Thread-classification, elements, specifications and forms. 4.8 Measurement of major and minor diameters. 4.9 Three and two wire method of measuring effective diameter of external thread-concept, terminology, best wire size, derivation of equation 4.10 Thread micrometer-sketch, method to use and determination of dimension. 4.11 Pitch measurement methods.		
5	Limit gauges, Transducers and Sensors 5.1 Limit gauges-classification, sketch and applications* 5.2 Comparators-concept, types and applications. 5.3 Instrumentation- introduction, performance characteristics. 5.4 Static characteristics of instruments 5.5 Transducers - concept, classifications, physical quantities which can be measured, advantages and disadvantages. 5.6 Electrical transducers - types, working principles and applications.(i) Linear Variable Differential Transformer (LVDT) type pressure gauge. (ii) Resistance type. (iii) Capacitance type. (iv) Inductance type (LVDT). (v) Piezo-electric. 5.7 Sensors-classification and applications.	10	8
6	Non destructive testing 6.1 Concept, need and advantages. 6.2 Important NDT methods, working and applications.	4	6
7	Temperature, Pressure and Flow Measurement 7.1 Introduction 7.2 Classification, working principle, construction, advantages, limitations and applications of temperature measuring devices i- Mercury in glass Thermometer ii - Bimetallic Thermometer iii - Resistance Thermometer iv – Thermister, v - Thermocouple 7.3 Classification, working principle, construction, advantage and application of pressure measuring devices i - Bellows type pressure gauge	8	8

	ii – Diaphragm type pressure gauge iii – Bourdon tube pressure gauge iv - Dead weight piston gauge 7.4 Concept of transducer based pressure measuring devices 7.5 Classification, working principle, construction, advantages, limitations and application of flow measuring devices. i – Bellow type ii – Rotating impeller iii – Rotating lobes iv – Nutating Disc v – Reciprocating piston vi - Obstruction		
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*** Indicates topic should be covered in laboratory**

COURSE OUTCOME:

Students will develop awareness about the technologies involved in tapping such basic measuring and inspection with subject Metrology & Instrumentation for putting them in use effectively for the service of mankind. They will think about the new era of technology for accuracy, precision for quality of product for required task.

LIST OF PRACTICAL:

Sr. No.	Description of Practical	Required Hours
01	Linear and Angular Measurement (In a group of 05 students, students will draw component measured, Instruments used with all parts and maintain the records of measurement using the instruments.) a. Vernier Caliper b. Inside Micrometer c. Outside Micrometer d. Telescopic Gauge e. Height Gauge f. Depth Gauge g. Bevel Protector h. Sine Bar (Measure angle between the two planes with the help of sine bar and slip gauges)	12
02	Check the Straightness and Flatness of the given object using required instruments	02
03	Check the Squareness, Perpendicularity and parallelism of the given object using required instruments	02

04	Check the roundness, cylindricity, concentricity, run out and ovality of the given object using required instruments	02
05	Measure the Gear dimensions of given component using Gear tooth Vernier	02
06	Measure the Gear dimensions of given component using suitable method	02
07	Study of various limit gauges	02
08	Study of Transducers and sensors	02
09	Measure the temperature using thermocouple	02

LIST OF REFERENCES:

Sr. No.	Title of Books	Author	Publication
01	Metrology and Instrumentation	Tahir	
02	Mechanical Measurement	Sirohi R.S., Radha Krishnan H.C.	New Age International
03	Engineering Metrology	R. K. Jain	Khanna Publications
04	Mechanical Measurements and Instrumentation	R K Rajput	Katson
05	Industrial Instrumentation	Donald A. Eckman	
06	Industrial Instrumentation & Control	S K Singh	Tata McGraw-Hill
07	Practical Engineering Metrology	K W B Sdrap	Pitman
08	Mechanical Measurement and Control	D S Kumar	Metropolitan Book Pub.