METROLOGY & COMPUTER AIDED INSPECTION – EL 1
Semester II (Production Engineering) SUB CODE: MEPR205-C
Teaching Scheme (Credits and Hours)

Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
					Hrs	Marks	Marks	Marks	Marks	
Hrs	Hrs	Hrs	Hrs							
3	0	2	5	4	3	70	30	20	30	150

LEARNING OBJECTIVES:
The objective of this course is

- To learn various concepts of instrumentation, metrology & computer assisted inspection.
- To have practical view of various measuring, gauging instruments.

LESSON PLANNING

SR.NO	CHAPTER NO	DATE/WEEK	%WEIGTAGE
1	1,2	1st 2nd 3rd	20
2	3,4	4th 5th 6th	20
3	5,6	7th 8th 9th	20
4	7,8	10th 11th 12th	20
5	9,10,11	13th 14th 15th	20

Total hours (Theory): 45, Total hours (Practical): 30, Total hours: 75

DETAILED SYLLABUS

Chap. No.	Topic
1	**Significance of Measurement and Instrumentation:** Introduction; generalized configuration and functional stages of measuring systems. The transducer and its environment; an overview; sensing process and physical laws. Types of measurement problems, Transducer classification and their modeling; Information, Energy and Incremental Models; Characteristics of instruments, design and selection of components of a measuring system.
2	**Dynamic Response of Instruments:** Mathematical model of a measuring system, response of general form of instruments to various test inputs; time-domain and frequency domain analysis. Elementary transfer functions and Bode plots of general transfer functions.
3	**Errors in Measurement and its Analysis:** Causes and types of experimental errors; systematic and random errors. Uncertainty analysis; computation of overall uncertainty; estimation for design and selection for alternative test methods. **Transducers and Transduction Principles:** Developments in sensors, detectors and transducer technology; displacement transducers; force, torque and motion sensors; piezoelectric transducers; capacitive type transducers; Strain gage transducers; accelerometers, pressure transducers based on elastic effect of volume and connecting tubing.
4	**Data acquisition and Signal Processing:** Systems for data acquisition and processing; modules and computerized data system; digitization rate, time and frequency domain representation of signals, and Nyquist criterion

5	**Metrology and Techniques:** Standards in metrology-definition, Traceability, Characteristics Length & Angular measurements-Review of standard instruments, GD and tolerance procedure-Review of dimension & form tolerance and methods of measurement, Tolerance analysis
6	**Surface and form metrology** : flatness, roughness, waviness cylindricity, etc., Methods of improving accuracy & surface finish, Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences on accuracy.
7	**Standards for length measurement standards and their calibration:** Light interference - Method of coincidence - Measurement errors. Various tolerances and their specifications, gauging assembly, comparators. Angular measurements - principles and measuring instruments. **Laser Applications in Metrology:** LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, On-line and in-process measurements of diameter, Roundness and surface roughness using LASER, Micro holes and topography measurements, straightness and flatness measurement.
8	**Special Measuring Instruments and Techniques:** Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalisation, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.
9	**Sensors in Inspection:** Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection, & Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor technology-Bar code systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactile sensors, Ultrasonic sensors, Odour sensors.
10	**Computer Aided Metrology** : Principles and interfacing, soft metrology -Application of lasers in precision measurements- laser interface, laser scanners, Coordinate measurement machine (CMM), Type of CMM & applications
11	Non contact CMM, Electro optical sensors for dimension, contact sensors for surface finish measurements. Image processing and its Metrology, Acoustical measurements, Digital techniques in mechanical measurements, Assessing and presenting experimental DATA

LIST OF PRACTICALS

Sr. No.	Practical Content
1	STUDY OF LENGTH STANDARDS & ITS CALIBRATION
2	TOLERANCE ANALYSIS FOR A GIVEN PART PRINT
3	MEASUREMENT OF STRAIGHTNESS, FLATNESS BY VARIOUS METHODS
4	MEASUREMENT OF SURFACE ROUGHNESS
5	ANALYSIS OF MACHINE VISION IN MANUFACTURING
6	GAUGE DESIGN FOR A GIVEN APPLICATION
7	MEASUREMENT OF ROUNDNESS USING CMM
8	ERROR ANALYSIS OF VARIOUS MEASURING INSTRUMENTS
9	MODELLING OF MEASURING SYSTEMS
10	MEASUREMENT OF SQUARENESS, ROUNDNESS

INSTRUCTIONAL METHOD AND PEDAGOGY (Continuous Internal Assessment (CIA) Scheme)
- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed
- Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all units while conducting teaching & examination.
- Attendance is compulsory in lectures and Tutorial.
- Viva Voce will be conducted at the end of the semester of 30 Marks.
- One internal exam of 30 marks is conducted as a part of Mid semester evaluation.

STUDENTS LEARNING OUTCOMES:
At the end of the course
The students will gain an experience in the implementation of measuring & gauging techniques.

References Book:
1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e
2. Engineering Metrology G. Thomas and G. Butter Worth PUB
3. Sensors and Control systems in Manufacturing Sabne Soloman McGraw Hill Book
4. Measurement systems: Applications & Design Doebelin International Student Edition
5. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India
6. Interface Technology for Computer Controlled Ulrich-Rembold, Armbruster Marcel Dekker Publications, Manufacturing processes and Ulzmann NY
7. Study manual on tolerance stacks, vol.1 Second edition ASME. 1994
8. Dimensioning and tolerancing of mass Spotts Prentice Hall, 1983