GUJARAT TECHNOLOGICAL UNIVERSITY

MANUFACTURING ENGINEERING (34)

Metrology and Computer Aided Inspection

SUBJECT CODE: 2143402

B.E. 4TH SEMESTER

Type of course: Under Graduate level.

Prerequisite: Nil.

Rationale: Exposing the students to various modern metrological instruments and the procedure used to operate these instruments.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**BASIC CONCEPTS OF MEASUREMENTS** Need for measurement – Dimensional and Form tolerances – Precision and Accuracy –Errors in Measurements – Causes – Types – Handling of measuring instruments –Maintenance of Instruments – Standards and Practice – Metrology lab – Environment and conditions.	**06**	20%
2	**LINEAR AND ANGULAR MEASUREMENTS** Measurement of Engineering Components – Comparators, Slip gauges, Rollers, Limit gauges – Design and Applications – Angle dekkor – Alignment telescope – Sine bar –Bevel protractors – Types – Principle – Applications.	**04**	20%
3	**FORM MEASUREMENTS** Measurement of Screw thread and gears – Radius measurement – Surface finish measurement – Auto collimator – Straightness, Flatness and roundness measurements– Principles – Application.	**08**	20%
4	**OPTICAL MEASUREMENTS** Optical microscope, interference microscope, Tool makers microscope, Vision systems, Precision instrument based on Laser – Use of Lasers – Principle – Laser Interferometer– Application in Linear and Angular measurements – Testing of machine tools using Laser Interferometer.	**12**	20%
5	**ADVANCES IN METROLOGY** Co-ordinate measuring machine – Constructional features – Types – Applications of CMM – CNC CMM applications – Computer Aided Inspection – Machine Vision –Applications in Metrology.Nanometrology – Introduction – Principles – Nanometer metrology systems – Methods of measuring length and surfaces to nano scale result with interferometers and other devices.	**15**	20%

Suggested Specification table with Marks (Theory):

R Level	U Level	A Level	N Level	E Level

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

TEXT BOOKS

1. Gaylor, Shotbolt and Sharp, "Metrology for Engineers", O.R.Cassel, London, 5th Edition, 1993.
2. R.K.Jain, "Engineering Metrology", Khanna Publishers, 19th Edition, 2005
3. Thomas, "Engineering Metrology", Butthinson & Co., 1984.
4. Industrial Metrology, Graham T. Smith, Springer-Verlag London Ltd 2002
5. White house, D. J, "Handbook of Surface & Nanometrology", The institute of Physics,London, 1994.
6. M.Mahajan, "A text-Book of Metrology", Dhanpat Rai & Co. (P) Ltd. 2006.

Course Outcome:

After learning the course the students should be able to:

1. Students will describe basic concepts of Metrology
2. Students will select linear measuring instrument for measurement of various components
3. Students select angular and taper measurement devices for measurement of various components
4. Students will discriminate between various screws by measuring their dimensions.
5. Students will separate different gears through measurement of various dimensions of gears
6. Students will discriminate capabilities of machining process by measuring surface finish of the component produced
7. Students will evaluate quality of surface produced using various methods
8. Students will describe basic concepts of mechanical measurement and errors in measurements.
9. Students will select appropriate temperature measuring device for various applications
10. Students will describe methods of measurement for various quantities like force, torque, power, displacement, velocity/seed and acceleration.

List of Experiments:

Following experiments are suggested for Laboratory work

S.No	NAME OF THE EXPERIMENTS
1.	Linear Measurement Using Vernier Height Gauge & Micrometer (Internal & External Depth)
2.	Angular measurement using Combination Set, Bevel Protractor , Sine Bar and Clinometers
3.	Measurement of Screw Thread Diameter Using the Floating flat form. Measuring machine.
4.	Measurement of threads parameters using tool maker's microscope.
5.	Measurement of the Straightness and Squareness Using Autocollimator
6.	Linear Measurement Using Dial Gauge, Slip and Calibration of Dial Gauge.

7.	Calibration Of Bore Gauge, Inside Micrometer And Measurement Of The Component
8.	Electronic Comparator
9.	Profile Projector
10.	Problem On Limits & Fits and Design Of Limit Gauge

Design based Problems (DP)/Open Ended Problem:

All above performance are to be carried out in the laboratory and students will prepare experiments and note down reading and conclusion. The can prepare for calibration and compare results with existing and with alternate methods of measurements. At least 5 open ended problems are proposed for better understanding the subject and to apply real life application.

The projects are listed below:

1. Calibration of temperature measuring devices
2. Design and prepare for strain/force/torque measurements experiments
3. Setup preparation and experiments on linear and angular measurements
4. Experiment for gear and screw thread measurements
5. Setup preparation and experiments on Displacement, Speed/Velocity and acceleration measurement

Major Equipments:

1. Temperature Measurements Equipments/Devices/Sensors
2. Surface Measurements Equipments/Devices/Sensors
3. Linear/Angular Measurements Equipments/Devices/Sensors
4. Resistive Potentiometer, Tachometers, Piezoelectric Accelerometer
5. Gears/Screw Threads Measurements Equipments/Devices/Sensors
6. Miscellaneous measurements equipments

List of Open Source Software/learning website:

1. http://nptel.ac.in/courses/112106138

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.