MME-CODE: METROLOGY INSTRUMENTATION AND CONTROL

PROGRAMME: B. TECH **YEAR: 2016** **SEMESTER: FOUR**
COURSE: CORE **CREDITS: 3.0** **HOURS: 40**

COURSE OVERVIEW AND CONTEXT:

This course covers the key aspects of current instrumentation technology and is designed to enable maintenance personnel to carry out commissioning, calibration and maintenance of the typical devices used for measurement and control in industrial systems. The objectives of this course is to understand the importance of measuring instruments and know about the latest developments in the field of metrology. The course notes are quite extensive and explain how the various devices are used, without getting involved in the underlying theory. The course will discuss about the standardization of measuring methods to be achieved by laying down inspection methods for any product right at the time when production technology is prepared, methodology, maintenance and the accuracies of measurement by periodical calibration of the metrological instruments, the solution of problems arising on the shop floor regarding methods of measurement, the designs for all gauges and special inspection fixtures. It also covers the basics of control and shows the importance of measurement in control.

PREREQUISITES COURSES: Fundamental of Physics, Workshop Technology, Materials, Basics of measurement

TEXT BOOKS:

1. Engineering Metrology , I C Gupta , Dhanpat Rai
2. Engineering Metrology , R K Jain , Khanna Publishers
3. Mechanical Measurement and Instrumentation , R K Rajput
4. Automatic Control Systems –Benjamic C. Kuo

REFERENCE BOOKS:

1. Metrology and Measurements , Beewoor and Kulkarni
2. Mechanical Measurements and control , D.s. Kumar
3. Engineering Metrology and Measurements , Dr G K Vijayaragahavan
4. Handbook of Industrial Metrology , ASME
5. Engineering Metrology , D M Anthony
6. Engineering Metrology , Collet and Hope
7. Metrology and Gauging , Parson S, Mcdonald

VIDEO RESOURCES:

1. www.btechguru.com/**engineeringvideos**/listLectures.php?cid...bid...
2. www.cosmolearning.com/courses/...and-**metrology**/**video**-lectures/
3. www.youtube.com/playlist?list=PL41FA714195562989

WEB RESOURCES:

1. Wikipedia on Particular Headings
2. http://www.ignou.ac.in/ignou/aboutignou/school/soet/smdme
3. http://www.library.wisc.edu/selectedtocs/cb0396.pdf
4. www.me.iitb.ac.in/~ramesh/ME338/**metrology**6.pdf
5. http://www.mechanicalengineeringblog.com/800-engineering-metrology-basic-concepts-of-measurements-methods-terms-of-measurement/
6. http://www.me.iitb.ac.in/~ramesh/ME338/metrology6.pdf
7. http://www.pacontrol.com/download/Instrumentation-Training-Tutorial2.pdf

COURSE OUTCOMES (COs): On completion of this course, the students will have:

CO1	Students will be able to appreciate the importance of measurement and measuring instruments.	Unit 1
CO2	Students will acquire fundamentals of various instruments used in Industries	Unit 2
CO3	Students will be able to compare various instruments and characteristics and use of each one.	Unit 1
CO4	Students will be able to select an appropriate instrument for the measuring of the various parameters and to correlate specific applications	Unit 1,2,3,4,5
CO5	Acquire fundamentals of control applications.	Unit 6

UNITS	CONTENTS	**Student development**
01	**BASIC CONCEPTS OF MEASUREMENT :** Measurement – Need, Types, Precision, Accuracy, Reliability. Errors – Causes, Types sources etc. Limits, Fits, Type of fits, Tolerances, Determination of tolerances	Employability
02	**LINEAR AND ANGULAR MEASUREMENTS:** Measurement of Engg Components, comparators, slip gauges, Rollers, Limit Gauges – Design and applications – Auto collimator , Angle Dekkor, Alignment telescope – Sine Bar, Bevel Protractor-Types, Principle ,Applications.	Employability, Skill development
03	**FORM, LENGTH, TEMPERTATURE, FLOW, PRESSURE, MEASUREMENTS:** **M**easurement of screw threads and gears – radius measurement - Surface finish measurement, Straightness, Flatness, Roundness Measurement – Principles and application. Temperature Flow, Length measurement	Employability, Skill development

04	**LASER METROLOGY:** Laser based instrument, Use of laser, principle, laser interferometer – Application in Linear and angular measurements – Testing of machine tools using laser interferometer.	Employability, Skill development
05	**ADVANCES IN METROLOGY:** Machines of Metrology – Coordinate measuring machine – Types, application of CMM, Applications of CMM. Computer Aided Inspection, Introduction, Methods, Machine Vision, Applications in Metrology	Employability, Skill development
06	**ELEMENTS OF CONTROL SYSTEMS:** Introduction, Importance – Classification – Open and closed systems, Servomechanisms, Examples with block diagrams– Temperature, speed & position control systems. P, PI, PID Control, Transfer Function, SFG.	Employability

PEDAGOGY

- **Presentations (Individual/Group)**

The course will be taught using white/green board teaching and power point presentation. The concepts will be adequately illustrated with examples to make applications.

Students to come prepared initially for the topics to be discussed in the class

(Student counseling, tutoring, and individual assignments /group projects/ assignment)

- **Class Test**
- **Assignments**
- **Chalk and talk**

EVALUATION CRITERIA

Description	Weight age	Schedule
1. Internal Assessment	30%	Detailed Below
2. Mid-term Exam	20%	Academic Calendar
3. End term Exam	50%	Academic Calendar

Internal Assessment: Marks 100 (shall be done based on the following):

Sl. No.	Description	Weightage
1	Class Tests (2 tests)	

	01 test before Mid Examination; 01 test after mid examination	50%
2	Assignments (**01 + 01 = 02 Assignments**)	10%
3	General Discipline + Interaction	10%
4	Attendance	10%
5	Comprehensive Viva	20%

These 5 components will be taken into consideration with the above weightage to compute the internal assessment marks for the Total 100 marks. **[30% of Marks]**

a) Home Assignment:
The assignments will consist of questions which would require extra study and reference of books to complete it. The assignment will be the combination of simple complex and application oriented questions.

b) Class Test and Quizzes:
Two class tests will be conducted in the complete semester, one before Mid and other after mid semester. It may contain 3 -4 questions comprising basic, complex and application oriented question.

c) General Discipline
Based on student's regularity, punctuality, sincerity and disciplined behavior in the class, the students will be awarded marks.

d) Attendance
Based on student's Attendance in the class, the students will be awarded marks.

e) Comprehensive Viva
A detailed viva voice exam of the whole syllabus of the subject will be taken before the end semester exam.

***Mid- Sem Examination*: 20% Weightage**
Mid- Sem examination shall be of 90 minutes duration and shall be a combination of simple complex and application oriented numerical and derivations. Evaluated mid examination scripts will be shown after valuation.

***End -Sem Examination:* 50% Weightage**
End-Sem examination shall be of three hours duration. The examination paper shall be a combination of simple complex and application oriented numerical and derivations.

Attendance

Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

DETAILED SESSION PLANOUT

Lt. No	Pedagogy	Detail of References	No. of Sessions	Topics Covered	Assignment/Test
UNIT I Basic Concepts of Measurement					
01	Board/ppt	General	01	Introduction and significance of the subject, Its importance with the domain and designing	
02	Board/ppt	1,2,3	01	Measurement, Need, definition, calibration, Significance of measurement, standards of measurements –primary, secondary, tertiary. Applications. Basic concepts like, accuracy, precision, repeatability, reproducibility, sensitivity, Range etc. Types of Measurements.	
03	Board/ppt	3	01	Error, Definition, Types of errors, Gross, random, Systematic, sources of errors.. Introduction to Limits and Fits	
04	Board/ppt	1,2	01	Limits, fits and tolerance – General aspects, Definitions Basic dimensions, basics of fits, Designation of holes, shafts and fits.	

05	Board/ppt	1,2	01	ISO System of limits and fits, Type of fits, Transition fit, clearance fit and interference fit.. Problems related to limits and fits	
UNIT II LINEAR AND ANGULAR MEASUREMENT					
06 07	Board/ppt	1,3	02	Introduction to Vernier calipers, Vernier height gauge, micrometer, Comparator, featurers, uses, types , selection of comparator, slip gauges Limit gauges –Introduction, Types, Design considerations and applications	
08	Board/ppt	1,2,3	01	Collimator, autocollimator, principle of working, , Hilger angle Dekkor, applications of autocollimator	
09 10	Board/ppt	2,3	02	Angular Measurement, Instrument for angular measurement, Sine bar, Bevel Protractor, types ,Principle and applications.. Alignment Telescope.	**ASSIGNMENT ONE**
UNIT III FORM, LENGTH, TEMPERTATURE, FLOW, PRESSURE, MEASUREMENTS					
11 12	Board/ppt	1,2,3	02	Measurement of screw thread –Introduction, elements of threads, Classification of threads, specification of threads, form of threads, errors in threads , screw thread gauges , radius measurement	

13 14	Board/ppt	1,2,3	02	Gear Measurement –Introduction, Types of gear form of gear teeth , Gear tooth terminology Gear measurement	
15 16	Board/ppt		02	Working principal of Resistive Potentiometer, Linear variable differential transducers, Electro Magnetic Transducers, Mechanical, Electrical and Photoelectric Tachometers, Piezoelectric Accelerometer, Seismic Accelerometer,	**CLASS TEST ONE**
17 18			02	Temperature Measuring Devices: Thermocouples, Resistance Temperature Detectors, Thermistor, Liquid in glass Thermometers, Pressure Thermometers, Pyrometer, Bimetallic strip. Calibration of temperature measuring devices, Numerical Examples on Flow Measurement.	
	MID SEMESTER EXAMINATION				
19 20 21	Board/ppt	1,3	03	Surface finish measurement –Introduction, Profile, specification etc. Measurement of straightness, definition, , straight edge, Flatness, Definition, Measurement Principle of Squareness measurement –Indicator method, Engineers square Measurement of roundness - Introduction, working principle , Measurement of machined shaft	

UNIT IV LASER METROLOGY					
22	Board/ppt	1,3	01	Principle of LASER, Working principle, Laser Interferometer, Applications in linear and angular measurements	
23 24	Board/ppt	1,3	02	Testing of Machine tool and other applications using LASER Interferometer	**ASSIGN MENT TWO**
UNIT V ADVANCES IN METROLOGY					
25	Board/ppt	1,3	01	What are the latest and advances in Metrology? Applications of advances in Metrology	
26	Board/ppt	1,3	01	Coordinate measuring Machine , Construction, Working principle	
27 28	Board/ppt	1,3	02	Types of CMM, Applications of CMM, CNC CMM	
29 30 31	Board/ppt	1,2,3,4	03	Computer Aided Inspection, Application, Comparison with conventional Inspection, Machine vision, Advantages of Computerized system. Applications of Computer Aided metrology	**Class test Two**

32 33	Board/ppt	-	02	Force measurement: load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo controlled dynamometer, absorption dynamometers. Power Measurements. Measurement of strain: Mechanical strain gauges, electrical strain gauges, strain gauge: materials, gauge factors, theory of strain gauges and method of measurement, bridge arrangement, temperature compensation.	

UNIT VI ELEMENTS OF CONTROL SYSTEMS					
34	Board	-	01	Introduction, Importance – Classification – Open and closed systems	
35	Board	-	01	Servomechanisms	
36	Board	-	01	Examples with block diagrams– Temperature, speed & position control systems.	
37 38 39	Board	-	03	P, PI, PID Control, Transfer Function, SFG.	
End Semester Examination					

***One Session = 01 hour**

**Dates of Tests & Quizzes will be announced one week in advance in the class *.*

Prepared By:
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