

**COURSE NAME : DIPLOMA IN MECHANICAL AND PRODUCTION
ENGINEERING/PRODUCTION TECHNOLOGY**

COURSE CODE : ME/PT/PG/MH/MI

SEMESTER : FIFTH FOR ME/PG/PT AND SIXTH FOR MH/MI

SUBJECT TITLE : MEASUREMENTS AND CONTROL

SUBJECT CODE :

Teaching and Examination Scheme

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

@-Internal assessment TH-Theory PR- practical TW-Term work

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

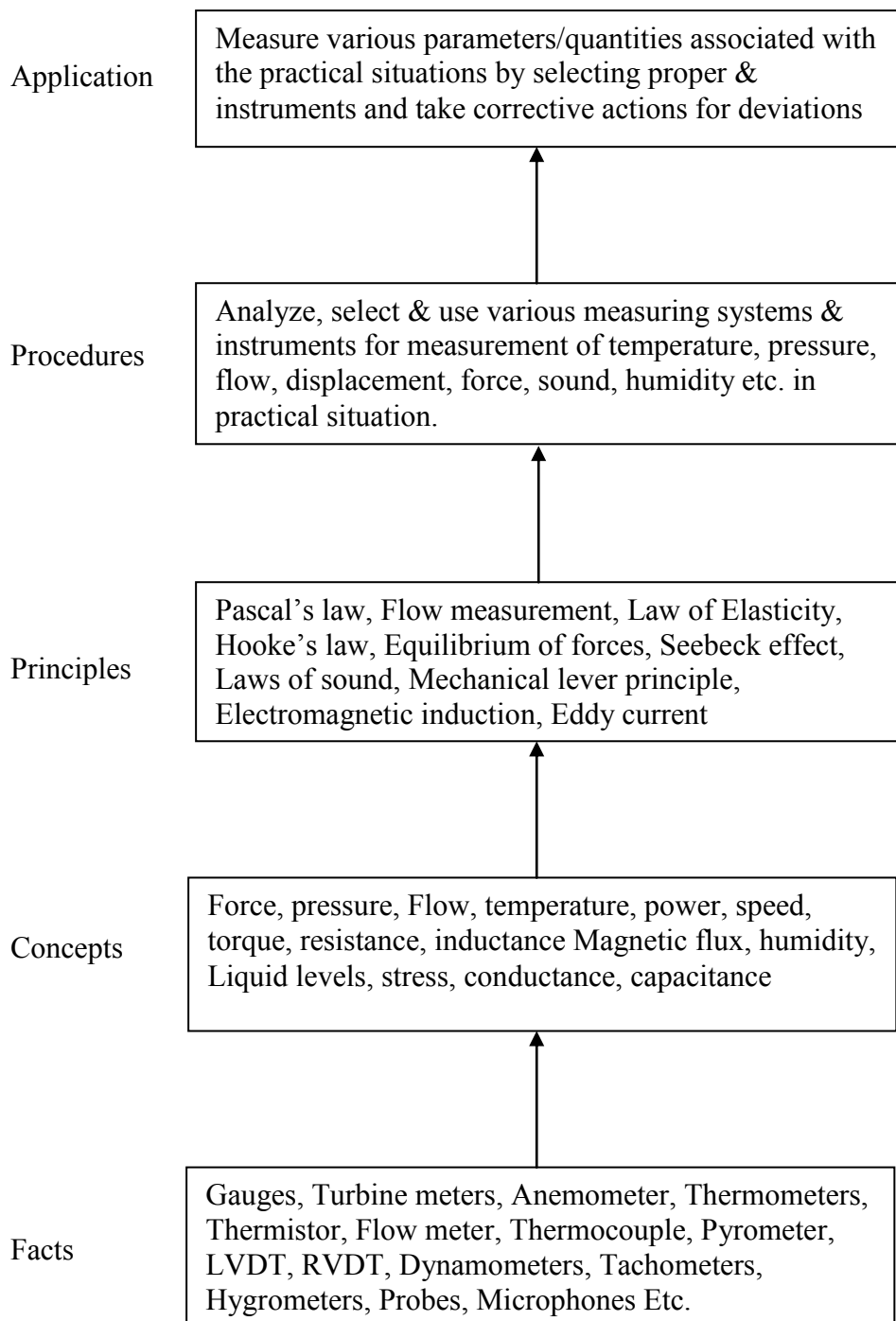
The art of measurement plays an important role in all branches of engineering. With advances in technology, measurement techniques have also taken rapid strides, with many types of instrumentation devices, innovations, refinements. The course aims at making a Mechanical Engineering student familiar with the principles of instrumentation, transducers & measurement of non electrical parameters like temperature, pressure, flow, speed, force and stress and methods of control systems for engineering applications.

Objectives:

Student will be able to:

1. Understand the principle of operation of an instrument.
2. Appreciate the concept of calibration of an instrument.
3. Select Suitable measuring device for a particular application.
4. Identify different types of errors.

Learning Structure:



Contents: Theory

Topic and content	Hours	Marks
<p>1: Introduction and significance of Measurement 18 marks</p> <p>Specific objectives- The students will be able to understand</p> <ul style="list-style-type: none"> ➤ Terminology related to measurement ➤ Various types of errors ➤ Concept of transducers <p>Contents:</p> <p>1.1 Types of measurement, classification of instruments Static terms and characteristics- Range and Span, Accuracy and Precision, Reliability, Calibration, Hysteresis and Dead zone, Drift, Sensitivity, Threshold and Resolution, Repeatability and Reproducibility, Linearity.</p> <p>1.2 Dynamic characteristics- Speed of response, Fidelity and Dynamic errors, Overshoot. 06 marks</p> <p>1.3 Measurement of error- Classification of errors, environmental errors, signal transmission errors, observation errors, operational errors. 04 marks</p> <p>1.4 Transducers : Classification of transducers, active and passive, resistive, inductive, capacitive, piezo-resistive, thermo resistive 08 marks</p>	08	18
<p>2: Displacement and Pressure measurement 18 Marks</p> <p>Specific objectives- The students will be able to</p> <ul style="list-style-type: none"> ➤ Explain working of displacement transducers ➤ Explain construction and working of low pressure and high pressure measuring instruments. <p>Contents:</p> <p>2.1 Displacement Measurement Capacitive transducer, Potentiometer, LVDT, RVDT, Specification, selection & application of displacement transducer. Optical measurement scale and encoders 08 Marks</p> <p>2.2 Pressure Measurement Low pressure gauges- McLeod Gauge, Thermal conductivity gauge, Ionization gauge, Thermocouple vacuum gauge, Pirani gauge. High Pressure gauge-Diaphragm, Bellows, Bourdon tube, Electrical resistance type, Photoelectric pressure transducers, piezoelectric type, Variable capacitor type 10 Marks</p>	10	18
<p>3: Temperature measurement 16 Marks</p> <p>Specific objectives- The students will be able to</p> <ul style="list-style-type: none"> ➤ Explain electrical and non electrical methods of temperature measurements ➤ Describe high temperature measuring instruments such as 	06	16

<p>pyrometers</p> <p>Content:</p> <p>3.1 Non-electrical methods- Bimetal , Liquid in glass thermometer and Pressure thermometer 04 Marks</p> <p>3.2 Electrical methods- RTD, Platinum resistance thermometer, Thermistor, Thermoelectric methods - elements of thermocouple, Seebek series, law of intermediate temperature, law of intermediate metals, thermo emf measurement. 08 Marks</p> <p>3.3 Pyrometers- radiation and optical 04 Marks</p>		
<p>4 :Flow measurements 12 Marks</p> <p>Specific objectives- The students will be able to</p> <ul style="list-style-type: none"> ➤ Describe variable area, variable velocity flow meters ➤ Special flow meters-electro-magnetic and ultrasonic flow meter <p>Content :</p> <p>4.1 Variable area meter-Rota meter, Variable velocity meter- Anemometer 06 Marks</p> <p>4.2 Special flow meter- Hot wire anemometer, Electromagnetic flow meter, Ultrasonic flow meter ,Turbine meter ,Vortex shedding flow meter 06 Marks</p>	06	12
<p>5 :Miscellaneous Measurement 16 Marks</p> <p>Specific objectives- The students will be able to</p> <ul style="list-style-type: none"> ➤ Explain characteristic of sound and Measurement of sound intensity ➤ Measure shaft power ➤ Describe contact and non contact type of speed measuring instruments ➤ Explain working of strain gauges <p>Content :</p> <p>5.1 Introduction to sound measurement and study of Electro dynamic microphone and Carbon microphone.</p> <p>5.2 Humidity measurement –Hair hygrometer, Sling psychrometer,</p> <p>5.3 Liquid level measurement – direct and indirect methods.</p> <p>5.4 Force & Shaft power measurement -Tool Dynamometer (Mechanical Type), Eddy Current Dynamometer, Strain Gauge Transmission Dynamometer.</p> <p>5.5 Speed measurement -Eddy current generation type tachometer, incremental and absolute type, Mechanical</p>	08	16

<p>Tachometers, Revolution counter & timer, Slipping Clutch Tachometer, Electrical Tachometers, Contact less Electrical tachometer, Inductive Pick Up, Capacitive Pick Up, Stroboscope</p> <p>5.6 Strain Measurement-Stress-strain relation, types of strain gauges, strain gauge materials, resistance strain gauge-bonded and unbonded, types(foil, semiconductor, wire wound gauges), selection and installation of strain gauges load cells, rosettes.</p>		
<p>6 : Control systems 20 Marks</p> <p>Specific objectives- The students will be able to</p> <ul style="list-style-type: none"> ➤ Know various types of control systems and their comparison ➤ State field applications of control systems <p>Contents:</p> <p>6.1 Block diagram of automatic control system, closed loop system, open loop system, feed back control system, feed forward control system, servomotor mechanism, 06 marks</p> <p>6.2 Comparison of hydraulic, pneumatic, electronic control systems, 06 marks</p> <p>6.3 Control action: Proportional, Integral , derivative , PI,PD, PID 04 marks</p> <p>6.4 Applications of measurements and control for setup for boilers, air conditioners, motor speed control 04 marks</p>	10	20

Note- Numerical based on chapter 1,4,5 only

Practical:

Skills to be developed:

Intellectual Skills:

1. Analyze the result of calibration of thermister
2. Interpret calibration curve of a rotameter
3. Evaluate the stress induced in a strain gauge
4. Verify the characteristics of photo transistor and photo diode

Motor Skills:

1. Test and calibration of a thermocouple
2. Handle various instruments
3. Draw the calibration curves of rotameter and thermister
4. Measure various parameters using instruments

List of Practical:

- 1 Understand the methods of measurements and instrument characteristics with demonstration of any one measuring device.
- 2 Displacement measurement by inductive transducer (LVDT)
- 3 Measurement of negative pressure using McLeod gauge / Bourdon tube pressure gauge. Conversion of pressure in different units.
- 4 Measurement of temperature by using Thermocouple.
- 5 Measurement of flow by using rotameter.
- 6 Measurement of strain by using a basic strain gauge and verify the stress induced.
- 7 Speed Measurement by using Stroboscope / Magnetic / Inductive Pick Up.
- 8 Measurement of force & weight by using a load cell.
- 9 Liquid Level Measurement by using Capacitive Transducer system.
- 10 Study of control system with one suitable application (boiler) arranging industrial visit at sugar factory / paper mill / textiles / food processing industry.
- 11 Mini project-A group of 4 students shall take a mini project of searching information about advanced instrumentation / control system using internet and submits its report. Use of this knowledge in project(6th Sem) is highly appreciable.
- 12 Visit various departments/laboratories in own institute and understand how the measurement devices are fitted on machines/equipments, the procedure of measurement and calibration. (viz. Applied mechanics/ Electronics/ Instrumentation dept)

Learning Resources:**Books:**

Sr. No.	Author	Title	Publication
01	D.S.Kumar	Mechanical Measurements & Control	Metropolitan Publications, New Delhi
02	R.K.Jain	Mechanical & Industrial Measurements	Khanna Publications, New Delhi
03	A.K.Sawhney	Mechanical Measurements & Instrumentation	Dhanpat Rai & Sons, New Delhi.
04	E. O. Doebelin	Measurement Systems	Tata McGraw Hill Publications
05	R.V. Jalgaonkar	Mechanical Measurement & Control	Everest Publishing House, Pune
06	C.S. Narang	Instrumentation Devices & Systems	Tata McGraw Hill Publications
07	B.C.Nakra and K.K.Chaudhary	Instrumentation, Measurement and Analysis	Tata Mc Graw Hill Publication

08	Thomas Beckwith	Mechanical Measurement	Pearson Education
09	James W Dally	Instrumentation for Engg. Measurement	Wiley India

Curriculum revision project 2012
LIST OF EQUIPMENT AND MACHINERY
(Essential equipment/hand tools required for conducting practical's)

1. Name of course/Department:-Mech. Engg. Dept.
2. Name of laboratory: Measurement and control lab.

Sr. No.	Name of Equipment.	Technical Specifications	Minimum Qty./No's required	Remark if any
1	Displacement measurement using inductive transducer(LVDT)	Inductive sensor with micrometer head for displacement measurement	One	4-5 setups must be kept ready for 4-5 weeks. A Group of 5-6 students must do practical on each setup in rotation. Advance planning before commencing of semester is highly appreciable. --One lab common for measurement for all disciplines with multiple setups is highly appreciable
2	McLeod gauge with high vacuum pump /Bourdon tube trainer	McLeod gauge With arrangement for high vacuum pump	One	
3	Temperature measurement using Thermocouple	Thermocouple assembly with heating arrangement Display 3.5 digital display	One	
4	Flow measurement using Rotameter	Rotameter trainer with motor pump tank with water recycling arrangement	One	
5	Strain gauge trainer(strain / force measurement)	Sensor- 4 arm bridge with strain gauge mounted on canti-lever capacity – 2 kg. Display- 3.5 digital display	One	
6	Stroboscope	Range upto 5000 RPM Display –LED digital	One	
7	Inductive pick up for speed measurement	Sensor – inductive Variable speed motor arrangement 3.5 digital display	One	
8	Loadcell	Sensor- 4 arm bridge with strain gauge capacity – 2 kg. Display- 3.5 digital display	One	
9	Liquid level	Sensor –capacitive type	One	

	measurement using capacitive system	with glass jar fitted with water tank 3.5 digital display		
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