

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**COURSE CURRICULUM**

Course Title: Instrumentation Device Materials
(Code: 3321702)

Diploma Programmes in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	Second Semester

1. RATIONALE

Instrumentation is an essential component of the modern Industry. Therefore it is desired that the diploma engineering student should be able to identify the materials used for electrical, thermal, Optical and mechanical Instrumentation devices based on its properties.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- i. **Use relevant material for various instrumentation devices.**

3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	100
3	0	0	3	70	30	00	00	

Legends: L-Lecture; T – Tutorial/Teacher Guided Student Activity; P - Practical; C – Credit;; ESE - End Semester Examination; PA - Progressive Assessment.

Note: It is the responsibility of the institute heads that marks for **PA of theory & ESE and PA of practical** for each student are entered online into the GTU Portal at the end of each semester within the dates specified by GTU.

4. DETAILED COURSE CONTENT

Unit	Major Learning Outcomes	Topics and Sub-topics
Unit– I Electrical Materials	1a. Describe the properties of various conducting and resistive materials	1.1 Conductivity, Resistivity, thermal conductivity, resistivity, temperature coefficient of resistance
	1b. Identify the types of resistors	1.2 Carbon composition, carbon film, cracked carbon, metal oxide film, wire-wound, variable resistors.
	1c. Calculate the value and tolerance of resistor using color codes	1.3 Standard color code of resistors. 1.4 Standard ranges of resistors.
	1d. Describe the relevant properties of various classes of insulating materials	1.5 Insulating materials such as ceramic, mica, glass, rubber, resins, wax varnishes, Porcelain, Polymer,
	1e. Describe testing of materials of insulator	1.6 Flash over test (For Insulator according to British Standard)
	1f. Identify the types of materials used for various capacitors	1.7 types of Capacitors - paper, silvered paper, mica, silvered mica, ceramic plastic foil, electrolytic, variable capacitor (single and ganged);
	1g. Determine the value of capacitor using color codes	1.8 Standard color code for capacitor.
Unit– II Magnetic Materials	1h. Identify the type of material used for inductors	1.9 Inductors - fixed and variable inductors
	1i. Describe the properties of various semiconductor materials	1.10 Type of semiconductors - Intrinsic, extrinsic,
	2a. Classify different magnetic materials	2.1 Paramagnetic, Diamagnetic, Ferromagnetic, Ferrimagnetic, Anti-ferromagnetic, Soft and hard magnetic materials, ferrites
Unit –III Thermo electric materials	2b. Describe the relevant properties of various magnetic materials	2.2 Magnetisation curve, hysteresis loop, Magnetostriction and factors affecting permeability and hysteresis
	2c. Select the relay based on its properties	2.3 Mechanical, Electromagnetic, Solid state relay, reed relay and their contact materials (Cu, Au, Pt, Fe, Ag)
	3a. Describe the properties of materials used in Thermocouple	3.1 Principle of Thermocouple, types Thermocouple (B,E,J,K,N,R,S,T,M,P, Chromel-gold/iron , Type C (tungsten 5% rhenium – tungsten 26% rhenium), operating temperature ranges, Current and Voltage range,
	3b. Identify colour code of different extension leads of Thermocouple	3.2 Construction of Thermocouple
	3c. Describe the relevant properties of materials used in RTD	3.3 Resistance Temperature Detector (RTD) Pt, Cu, Ni. Temperature range
	3d. Describe the relevant properties of materials used	3.4 Material Possessing Positive Temperature Co-efficient (PTC) and Negative Temperature

Unit	Major Learning Outcomes	Topics and Sub-topics
	in Thermistor	Co-efficient(NTC) of resistance, Thermistor
Unit – IV Instrumentation primary component materials	4a.Name the type of materials used in Instrumentation primary component	<p>4.1 Materials used in ‘Bourdon tube’ Phosphor Bronze, Stainless Steel Beryllium copper and Monel.</p> <p>4.2 Materials used in ‘diaphragms’ Butyl rubber, Nitril rubber, Neoprene, Natural/synthetic rubber, White natural rubber, White butyl, Viton, Hypalon, aluminum, beryllium copper, bi-metal, brass, bronze, copper, exotic metals, exotic metal alloys, ferrous, gold, spring steel, tempered steel, steel & stainless steel, Carbon steel, Cobalt steel, capsule.</p> <p>4.3 Materials used in ‘Bellows’ Polyurethane, PVC, Neoprene Coated Nylon, Hypalon Coated Nylon, Aluminum Coated , Fiber glass, Teflon Coated Fiber glass, Silicon Impregnated Fiber glass.</p> <p>4.4 Materials used in ‘Control valve’ Iron, Cast steel, Bronze, Monel , Butyl, Alloy 20 Buna_N, Yeoprene, Viton, EPT, Silicon, Hypalon 316 S.S. with their properties.</p> <p>4.5 Materials used in Orifice, Venturi, Pitot tube, Flow-nozzle(Brass, CS, SS316,SS304, SS316L, Monel, Hastelloy-C).</p>
Unit– V Optoelectronic devices materials	5a. Discuss the relevant properties of materials used in various optoelectronic devices	<p>5.1.Photo emissive cells (antimony with alkali metals like caesium, potassium, sodium)</p> <p>5.2.Photoconductive cells - Cadmium sulphide (CdS), Cadmium Selenide(CdSe), Lead Selenide, Lead Telluride and Indianoid</p> <p>5.3.Photovoltaic cells - Silicon including single-crystalline Silicon, multi crystalline Silicon, and amorphous Silicon</p> <p>5.4.Photodiode & Phototransistor - Germanium 800 – 1700, Indium gallium arsenide 800 – 2600, Lead sulphide ~1000 Silicon – 3500</p> <p>5.5.Semiconductor materials used for LED,LCD,LDR,IR,LASER</p>

5. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total
I	Electrical materials	10	10	05	03	18
II	Magnetic Materials	08	08	02	02	12
III	Thermoelectric materials	08	08	05	02	15
IV	Instrumentation primary component materials	06	06	02	02	10
V	Optoelectronic Devices Materials	10	08	04	03	15
	Total	42	40	18	12	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom’s revised taxonomy)

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

6. SUGGESTED LIST OF EXPERIMENTS

-----Not applicable-----

7. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

- 7.1 Students should deliver a seminar in groups on materials used in various Instrumentation devices and advances/latest trends in instrumentation devices & materials.
- 7.2 Students may be asked to collect photographs using internet which is relevant to field application of various topics & have to prepare learning materials using it.
- 7.3 Students activities like: course/ topic based seminars, preparation of chart/ poster/ real life component on plywood board for wall mounting, Internet based assignments.

8. SUGGESTED LEARNING RESOURCES

A. List of Books

S.No.	Author	Title of Books	Publication
1	Sawhney, A. K.	Electrical & Electronic Measurement and Instrumentation	Dhanpat Rai & Sons, 2005 or later
2	Jain, R. K.	Mechanical and Industrial Measurement	Khanna Publishers, 2005 or later
3	LIPTAK. B G	Instrument Engineers' Handbook, Volume Two: Process Control and Optimization	C R C Press , 2000 or later
4	Considine and Ross	Process Instruments And Control Handbook	McGraw-Hill , 2005 or later
5	MI Gupta, Ajay Sharma	Electrical Engineering Material & Electronic Components	Dhanpat Rai Publishing Co (p) Ltd, 2003
6	Madhuri Joshi	Electronic Components and Materials	Shroff Publishers & Distributors Private Ltd.
7	S.K. Bhattacharya	Electrical & Electronics Engineering Materials Component	Khanna

B. List of Software/Learning Websites

1. www.ims.uconn.edu/~alpay/Courses/.../Lecture%2019.ppt
2. ecmdownloads.weebly.com/uploads/7/5/4/.../magnetic_properties.ppt
3. http://www.corrosionfluid.com/total_valve_solutions.aspx
4. <http://www.corrosionfluid.com/expansion-joints-bellows-flexible-connectors-ptfe-plastic-rubber.aspx>
5. <http://www.corrosionfluid.com/piping.aspx>
6. <http://www.globalsupplyline.com.au/pdfs/catalogues/apv/Valve-Material-Application.pdf>
7. <http://www.customadvanced.com/bellows-materials.html>
8. <http://www.pressuresolutions.co.za/pdf/technical/P202%20Pressure%20Gauge%20Construction.pdf>
9. http://www.engineeringtoolbox.com/saunders-valves-flow-coefficients-d_227.html
10. <http://www.thomasnet.com/illinois/metal-diaphragms-22421002-1.html>

11. http://www.globalspec.com/learnmore/sensors_transducers_detectors/pressure_sensing/pressure_sensors_instruments
12. <http://www.pyromation.com/catalog/gen06.pdf>
13. http://www.radio-electronics.com/info/data/semicond/photo_diode/structures-materials.php
14. http://www.eere.energy.gov/basics/renewable_energy/pv_cell_materials.html

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnic

1. **Prof. R .R. Manchiganti** , HOD IC ENGG., Government Polytechnic, Gandhinagar
2. **Prof. A. M. Patel**, I/C HOD IC ENGG., Government Polytechnic, Palanpur
3. **Prof. M.M. Mulchandani**, OSD, CEC, AHMEDABAD
4. **Prof. S. K. Raval**, Lecturer IC ENGG., Government Polytechnic Ahmedabad
5. **Prof. M. A. Modi**, Lecturer IC ENGG., Government Polytechnic, Palanpur

Co-ordinator and Faculty Member from NITTTR Bhopal

1. **Dr.(Ms) C.S.Rajeshwari**, Professor, Dept. of Electrical & Electronics Engg,
2. **Dr.(Mrs) Anjali Potnis**, Assistant Professor, Dept. of Electrical & Electronics Engg,