

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

Course Title: Instrumentation Devices and Components
(Code: 3321703)

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

1. RATIONALE

In the present industrial scenario, it is desired that diploma engineering students should be able to identify, classify and troubleshoot various electronic components, amplifiers and oscillators used in different instrumentation systems. Therefore, this course has been designed to take care of this need.

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 different types of instrumentation components and 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	200
4	0	4	8	70	30	40	60	

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 Passive Components for Instrumentation	1a. Define the terms R, L, C, X, Z	1.1 Resistance, Inductance, Capacitance, Reactance, Impedance.
	1b. Determine value of R, L, C in various circuits	1.2 Series and Parallel combination of passive components
	1c. Compare the features of RL, RC and RLC circuits and their application as integrator and differentiator	1.3 RL, RC and RLC circuits and their application as integrator and differentiator
	1d. Describe working principle of transformer. 1e. State the need for fuse, Contactor and switch 1f. Name the different types of Fuses, Contactors and switches	1.4 Transformers : step-up, step-down, auto, Isolation and Control transformers 1.5 Miscellaneous devices: fuse, wired and glass (slow blow, fast blow, resettable, FRC). i) Contactors: 1- phase and 3-phase ii) Switches: SPDT, DPDT, 1-NO, 1-NC, Iron clad, Reed, Limit
Unit– II Active Components for Instrumentation	2a. Classify 2, 3, 4-layer semiconductor devices	2.1 Two, Three and Four layer Semiconductor devices.
	2b. Describe the working principle of PN junction and zener diode 2c. Plot output characteristics of PN junction and zener diode. 2d. Test terminals of the given semiconductor devices 2e. List applications of given semiconductor devices	2.2 Two terminal devices viz. diodes (PN junction, Zener, Varactor diode, photo diode, Light emitting diode, schottky diode, Varistor, PIN diode, IMPATT, Tunnel diode, crystal diode, Gunn diode, Laser diode, DIAC.
	2f. Describe the working principle of NPN transistor 2g. Test terminals of the given semiconductor devices 2h. List applications of given semiconductor devices	2.3 Three terminal devices: NPN, PNP; JFET, MOSFET, Power transistor, Darlington transistor
Unit–III Feedback Amplifiers and Oscillators	3a. Describe the concept of different types of feedback with their applications. 3b. Compare types of feed back	3.1 Feedback (Positive , Negative)
	3c. Describe working of CE NPN Amplifier. 3d. Compare the various amplifiers based on biasing, coupling and application	3.2 BJT Amplifier based on: i) CE, CB and CC Amplifier ii) Biasing: Class A, Class B, class C iii) Coupling :RC, Transformer, Direct iv) Application: AF, RF and Instrumentation

Unit	Major Learning Outcomes	Topics and Sub-topics
	3e. List requirements for oscillations. 3f. Classify oscillators 3g. List applications of different types of oscillators.	3.3 Oscillators: RC-Phase-shift, Colpitts, Hartley, Crystal Oscillator, Wein bridge Oscillator etc.
Unit- IV Operational Amplifier	4a. Describe the functions and characteristics of operational amplifier. 4b. Describe the application of OPAMP.	4.1 Ideal OP-AMP, block diagram Characteristics, Differential gain, Common mode gain, CMRR, Slew rate, Gain- bandwidth product, virtual ground concept Operation of OPAMP with and without negative feedback. 4.2 Inverting, non-inverting and unity gain amplifier, integrator, differentiator, comparator, summing amplifier, logarithmic amplifier, voltage to frequency converter, frequency to voltage converter, instrumentation amplifier.
Unit – V Instrumentation Components, Indicators, Recorders and encoders.	5a. Describe the working of various types of indicators, recorders, actuators and encoders	5.1. Indicators, plotters, Recorders 5.2. Valve, actuator, valve positioner, filled systems, relay, digital encoders and decoders.
	5b. Describe basic working and respective characteristics of given instrumentation components.	5.3 Bourdon tube, bellows, Diaphragms, capsules, swirl & de swirl, proving ring, piston cylinders, Flapper Nozzle, Pneumatic relay.
	5c. List application of given instrumentation components.	5.4 Regulators and lubricators, thermo wells, floats, plum bobs, displacers, elbow taps, orifice plates, Venturi tube, Pitot tube, flow nozzles, Proving ring.
	5d. List color code of different extension leads of thermocouples.	5.5 All types of Thermocouple leads
	5e. List applications of given instrumentation components. 5f. Test given instrumentation components.	5.6 Proximity sensor: Inductive, Capacitive and Optical. 5.7 Limit switch & Safety switches: level, flow, displacement, pressure, temperature, and speed.

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks (Duration – 56 Hours)			
			R Level	U Level	A Level	Total
I	Passive Components for Instrumentation	10	5	6	4	15
II	Active Components for Instrumentation	12	8	6	4	18
III	Feedback Amplifiers and Oscillators	10	4	6	2	12
IV	Operational Amplifier	14	7	6	2	15
V	Instrumentation Indicators, Recorders and Encoders	10	2	6	2	10
	Total	56	26	30	14	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 EXERCISES/PRACTICALS

The experiments should be properly designed and implemented with an attempt to develop different types of skills leading to the achievement of the above mentioned expected competency.

S.No.	Unit No.	Practical Exercise	Approx Hours Required
1.	I	Measure value of resistance, capacitance & inductance of the given passive components.	02
2.	I	Measure value of the impedance of the given RL, RC & RLC circuits.	06
3.	I	Measure value of Series and parallel combination of Resistors.	02
4.	I	Measure value of Series and parallel combination of inductors & capacitors.	04
5.	I	Build differentiator circuit and obtain output for various types of test input signals.	02
6.	I	Build/test integrator circuit and obtain output for various types of test input signals.	02
7.	I	Identify following components viz. Transformers, Fuses, Contactors and Switches.	02
8.	I	Test following components viz. Transformers, Fuses, Contactors and Switches.	06
9.	II	Identify various types of 2, 3 & 4 layer semiconductor devices.	02
10.	II	Test the performance of PN junction diode & plot its VI characteristics.	02
11.	II	Test the performance of various 2 terminal semiconductor devices & plot their VI characteristics.	06
12.	III	Test the performance of CE transistor configuration as an amplifier.	02
13.	III	Obtain the frequency response of CE amplifier.	02
14.	III	Build various oscillator circuits and measure their output frequencies.	06

15.	IV	Build the inverting and non-inverting amplifier using OPAMP and test their performance characteristics.	04
16.	IV	Test the performance of OPAMP as Instrumentation Amplifier	02
17.	IV	Test the performance of OPAMP as integrator and differentiator.	02
18.	IV	Test the performance of OPAMP as voltage to frequency and frequency to voltage converter.	02
19.	IV	Test the performance of OPAMP as unity gain amplifier.	02
20.	IV	Test the performance of OPAMP as logarithmic amplifier.	02
21.	IV	Test the performance of OPAMP as comparator.	02
22.	V	Test the performance of instrumentation components like Valve and actuators.	04
23.	V	Verify the output of a digital encoder and decoder.	02
24.	V	Test the performance of instrumentation components like Bourdon tube, bellows, Diaphragms & capsules.	04
25.	V	Test the performance of instrumentation components like proximity sensors & limit switches.	06
Total			78

7. SUGGESTED LIST OF STUDENT ACTIVITIES

- 7.1 Students may be given exercises based on various instrumentation devices and components to calculate important terms related to above topics.
- 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 Teachers guided self learning activities, Course/library/internet/lab based mini projects, industrial visit etc.
- 7.4 Students activities like: course/ topic based seminars, Internet based assignments.

8 SUGGESTED LEARNING RESOURCES

A. List of Books

S.No.	Author	Title of Books	Publication/Year
1	Sawhney A K	Electrical and Electronic Measurement and Instrumentation	Dhanpat Rai and Sons
2	Jain R K	Mechanical and Industrial Measurement	Khanna Publishers
3	Robert L. Boylestad, Louis Nashelsky	Electronic Devices and Circuit Theory	Pearson/Prentice Hall, 2009
4	Arun K. Ghosh	Introduction to Instrumentation & control	Prentice Hall, 2005
5	Jones E. B.	Instrument Technology, Vol - I, II	Hollywell
6	H. S Kalsi	Electronic Instrumentation	TMH 2010
7	R Gaikwad	Operational Amplifiers and applications	PHI latest edition

B. List of Major Equipment/ Instrument

- 8.1 Function generator(sine, square, triangle etc.with frequency range 10 Hz to 100 kHz)
- 8.2 DC power supply (-30 →0→+30 V with at least 1A current capacity)
- 8.3 Breadboard

- 8.4 Various types of Transformers, Fuses, Contactors, Switches, transistors, diodes, resistors, OPAMP ICs, Thyristors, UJT, Optoelectronic components, Bourdon tube, Bellows, Diaphragms, Regulators and lubricators ,Flapper nozzle, Thermocouples, Proximity sensors.
- 8.5 Measuring equipments like CRO (preferably dual channel, 20Mhz)
- 8.6 Multi meter
- 8.7 Circuit/Trainer board/ Demonstration modules of relevant components & devices.

C. List of Software/Learning Websites

- 1 <http://en.wikipedia.org>
- 2 <http://en.wikipedia.org/wiki/Transistor>
- 3 <http://www.mikroe.com/old/books/keu/04.htm>
- 4 http://www.allaboutcircuits.com/vol_3/chpt_4/1.html
- 5 <http://www.polyera.com/basic-devices/organic-thin-film-transistors>
- 6 <http://transistorhistory.50webs.com/xstr.html>
- 7 <http://www.radio-electronics.com/info/data/semicond/bipolar-transistor-bjt/transistors-basics-tutorials.php>
- 8 <http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/diodecon.html>
- 9 <http://www.tpub.com/neets/book7/25.htm>
- 10 www.wisc-online.com/objects/index.asp?objID=SSE3103
- 11 <http://itee.uq.edu.au/~eng2800/Lecture%20Notes/Opamps.pdf>
- 12 <http://www.wisc-online.com/objects/ViewObject.aspx?ID=SSE3103>
- 13 http://en.wikipedia.org/wiki/Electronic_oscillator
- 14 <http://en.wikipedia.org/wiki/Thermocouple>
- 15 http://en.wikipedia.org/wiki/Operational_amplifier
- 16 http://sharingmatrix.com/file/13056281/Electronic_Devices_and_circuit_theory.rar
- 17 <http://uploading.com/files/cmmb535c/Electronic%2BDevices%2Band%2Bcircuit%2Btheory.rar/>

9. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnic

- 1 **Prof.R.R. Manchiganti**, HOD IC ENGG., Government Polytechnic, Gandhinagar
- 2 **Prof. R. P. Merchant**, HOD IC ENGG., Government Polytechnic, Gandhinagar
- 3 **Prof. Ashvin M. Patel**, I/C HOD IC ENGG, Government Polytechnic, Palanpur
- 4 **Prof. M V Dabhi**, Lecturer IC ENGG., Government Polytechnic, Gandhinagar
- 5 **Prof. A K Bilakhia**, Lecturer IC ENGG, Government Polytechnic, Gandhinagar

Co-ordinator and Faculty Member from NITTTR Bhopal

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