GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Instrumentation and Control Engineering

Course / Subject Code : DI01C17031(Only for C to D Students)

Course / Subject Name : Instrumentation Workshop

W. e. f. Academic Year:	2024 - 2025
Semester:	1st
Category of the Course:	ESC-02

Prerequisite:	Knowledge of basic mathematics skill is needed.
Rationale:	Electrical, Electronic, Instrumentation and allied engineering diploma holders are expected to handle various general-purpose tools and measuring instruments in the instrumentation workshop. They have to supervise work related to assembly of units, measurement of various electric parameters and solder and de-solder the electronic components and circuits in the workshop. They are also expected to test the instrumentation loop using appropriate tools and measuring instruments in an industry. This course helps to develop skills to select and use appropriate tools, equipment and measuring instruments.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Choose various electrical, electronic, mechanical, and pneumatic components for use in instrumentation devices.	Applying
02	Use the right tool to make electrical and electronic connections.	Applying
03	Use the right tool to make mechanical and pneumatic connections.	Applying
04	Follow safety rules to prevent accidents.	Applying

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
0	1	4	3	0	0	20	30	50

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
01 - Basics of Electrical and Electronics	1.1 Basic Electrical and Electronic components: Resistor, Capacitor, Inductor, Transformer, Batteries, Fuse, Diode, Transistor, Switch, Relay, and M.C.B. (Miniature Circuit Breaker). 1.2 Measuring device identification: Multi-meter and Clamp-on meter, C.R.O. (Cathode Ray Oscilloscope), and D.S.O. (Digital Storage Oscilloscope). 1.3 Alternating Current (A.C.) source identification: Single phase, and Three Phase. 1.4 Direct current (D.C.) Source identification: Battery and Variable DC Source. 1.5 Function generator. 1.6 Electrical connections and Electronic connections. 1.7 Soldering and Desoldering the electronic components on P.C.B. (Printed Circuit Board). 1.8 Basic Electrical tools: Wire stripper, Electrical wire plier, Screwdriver, Wire Crimper, Insulation Tape , Electrical cable lug, Electrical cable Ferrule, Electric tester, and Electrical conduit.	10	34
02 - Basics of Pneumatics and Mechanical connections	2.1 Pneumatic connection and Mechanical connection. 2.2 Pneumatic connectors identification: Pneumatic pipe fitting, and Pneumatic tubes. 2.3 Basic mechanical tools: Hammer, Allen Wrench Set (Hex Set), Tongue-and-Groove Plier, Tape Measure, Adjustable Wrench, Pipe Wrench, Combination Spanner, Flaring tool, Pipe Bender and Drilling Machine. 2.4 Basic Pipe thread identification: National Pipe Thread (NPT) type Thread, and British Standard Pipe (BSP) Type Thread. 2.5 Basic tools of Piping and Instrumentation connection: Impulse line, 2-way manifold valve, 3-way manifold valve, 5-way manifold valves, U-bolt, Mounting clamp, and Mounting Bracket.	10	33
03 - Workshop Safety	3.1 Safety aids and equipment: Personal Protective Equipment (PPE), Safety face shield, Sand bucket, Emergency lights, Emergency signs, Fire alarm system, First aid kits, Spill control kit, and Disposal box.	10	33
-	**Total**	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
0	**0**	**100**	**0**	**0**	**0**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:
(a) Books:

Sr. No.	Title of Book	Author	Publication and ISBN details
01	Transducers and Instrumentation	Murty D.V.S	Prentice Hall India Learning Private Limited, 2nd edition, ISBN-10:8120335694, ISBN-13:978-8120335691 .
02	Electronic Instrumentation and Measurements	H.S. Kalsi	McGraw Hill Education (India) Private Limited, Forth edition, ISBN-10 : 9353162513 ISBN-13 : 978-9353162511
03	Electronic Instrumentation and Measurements	David A. Bell	Oxford University Press India, Third edition, ISBN-10 : 019569614X, ISBN-13 :978-0195696141 .
04	Elements of Electronic Instrumentation and Measurements	Joseph J. Carr	ASIN: 8131712117, Publisher : Pearson Education India, ISBN-10 : 9788131712115, ISBN-13 : 978-8131712115 .
05	Encyclopedia of Electronic Components Volume 1: Resistors, Capacitors, Inductors, Switches, Encoders, Relays, Transistors: Resistors, Capacitors, Inductors, Semiconductors, Electromagnetism	Charles Platt	O'Reilly, 1st edition, ISBN-10: 1449333893, ISBN-13 : 978-1449333898 .

06	Printed Circuit Boards: Design and Technology	Bossart	McGraw Hill Education, ISBN-10 : 0074515497, ISBN-13 : 978-0074515495 .
07	Build Your Own Printed Circuit Board	Al Williams	ASIN : 007142783X, Publisher : TAB Books Inc , ISBN-10: 0070054088, ISBN-13 : 978-0070054080 .
08	Pneumatic Engineering	Mistry Heeresh	Createspace Independent Publishing Platform, ISBN: 9781493727582, 9781493727582.
09	Making Printed Circuit Boards	Jan Axelsen	McGraw-Hill Education, ISBN-10 : 0830639519, ISBN-13 : 978-0830639519
10	The First Book of Electronics Workshop: Can't Beat a Practical Approach!	Chowdhry Shankar Bhawani	River Publishers, 1st edition, ISBN-10 :879310247X, ISBN-13 : 978-8793102477.
11	A Textbook of Electrical Workshop Practices	Dr. Umesh Rathore, Naresh Kumar Sharma	S.K. Kataria & Sons, ISBN:978-93-5014-695-8 .
12	MECHANICAL WORKSHOP PRACTICE, 2ND EDN	John K.C (Author)	ASIN : 812034166X, Publisher : Prentice Hall India Learning Private Limited, 2nd edition. ISBN-10 : 9788120341661, ISBN-13 : 978-8120341661.
13	Handbook for Laboratory Safety	Benjamin R. Sveinbjornsson,and Sveinbjorn Gizurarson.	Publisher : Elsevier - Health Sciences Division (5 May 2022) ISBN-10 : 0323993206. ISBN-13 : 978-0323993203.
14	100 Tips to Workshop Safety	-	Stobart Davies Ltd., ISBN-10 : 0854420703, ISBN-13 : 978-0854420704.

15	Instrumentation Symbols and Identification	Instrument Society of America	ISA, Revised edition (November 30, 1985), ISBN-10 : 0876648448, ISBN-13 : 978-0876648445.

(b) Open source software and website:

1. https://ndl.iitkgp.ac.in/
2. https://egranthalaya.nic.in/
3. https://nsdcindia.org/ebookreader
4. https://epathshala.nic.in/
5. https://shaileshdhoriyani.webs.com/apps/blog (for basic electronic components)
6. https://www.electrical4u.com/types-of-resistor (for Resistor)
7. https://www.electronics-tutorials.ws/resistor/res_1.html (for Resistor)
8. https://www.electronicshub.org/types-of-diodes/ (for Diodes)
9. https://nptel.ac.in (for online courses and video of all engineering branches)
10. www.electronicsforu.com (for basic electronic projects and technical videos)
11. https://www.vlab.co.in (Virtual Lab for all engineering branches)
12. Fritzing – PCB Designing Open Source Software.
13. KiCAD – PCB Designing Open Source Software.
14. http://dl.mitsubishielectric.com/dl/fa/document/catalog/lvcb/yn-c-0729/y07291307.pdf (for MCB)
15. https://www.electricaltechnology.org/2019/07/mcb-mccb-elcb-rcb-rcd-rccb-rcbo.html (for MCB, ELCB,RCCB)
16. https://ndma.gov.in/Resources/awareness/fire-safety (For Fire and safety)
17. https://www.osha.gov/personal-protective-equipment#:~:text=Personal%20protective%20equipment%20may%20include,vests%20and%20full%20body%20suits. (For Safety aids and equipment)
18. https://www.youtube.com/

Suggested Course Tutorial List:

Sr. No.	Tutorial	Unit No.	Approx. Hrs. Required
01	Define: Resistor, Capacitor, Inductor, Transformer, Batteries, Fuse, Diode, Transistor, Switch, Relay, and M.C.B. (Miniature Circuit Breaker).	1	1
02	Enlist the different functions of Multi-meter and Clamp-on meter, C.R.O. (Cathode Ray Oscilloscope), D.S.O. (Digital Storage Oscilloscope), and Function generator.	1	1

03	Define: Alternating Current (A.C.) source and Direct current (D.C.) Source.	1	1
04	Enlist different types of Electrical connections and Electronic connections.	1	1
05	Define: Soldering and Desoldering the electronic components.	1	1
06	Write the use of Wire stripper, Electrical wire plier, Screwdriver, Wire Crimper, Insulation Tape, Electrical cable lug, Electrical cable Ferrule, Electric tester, and Electrical conduit.	1	2
07	Enlist different types of Pneumatic connections and Mechanical connections.	1	1
08	Enlist Pneumatic pipe fittings and Pneumatic tubes of different standard size.	2	1
09	Write the use of Hammer, Allen Wrench Set (Hex Set), Tongue-and-Groove Plier, Tape Measure, Adjustable Wrench, Pipe Wrench, Combination Spanner, Flaring tool, Pipe Bender and Drilling Machine.	2	1
10	Define: National Pipe Thread (NPT) type Thread, and British Standard Pipe (BSP) Type Thread.	2	1
11	Define: Impulse line, 2-way manifold valve, 3-way manifold valve, 5-way manifold valves, U-bolt, Mounting clamp, and Mounting Bracket.	2	1
12	Write the use of Personal Protective Equipment (PPE), Safety boots, Workshop hand glows, Safety goggles, Lab apron, Safety face shield, Sand bucket, Emergency lights, Emergency signs, Fire alarm system, First aid kits, Spill control kit, and Disposal box.	3	2
	Minimum 8 Tutorials		**15 Hrs**

Suggested Course Practical List:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
01	Identify various electronic components such as resistor, capacitor, inductor, transformer, batteries, fuse, diode, transistor, switch, and relay.	1	2
02	Identify the Terminals, Connections and switches for different Functions available in multimeter.	1	2
03	Identify the Terminals, Connections and switches for different Functions available in clamp-on meter.	1	2

04	Identify the Terminals, Connections and switches for different Functions available in C.R.O..	1	4
05	Identify the Terminals, Connections and switches for different Functions available in D.S.O..	1	4
06	Identify the terminals used for single phase A.C. supply.	1	2
07	Identify the terminals used for three phase A.C. supply.	1	2
08	Identify the terminals of battery used for D.C. supply.	1	2
09	Identify the terminals of Variable D.C. Source used for D.C. supply.	1	2
10	Identify the Terminals, Connections and switches for different Functions available in Function generator.	1	2
11	Identify the different types of provided Electrical connections and Electronic connections.	1	2
12	Soldering electronic components on Printed Circuit Board (P.C.B.).	1	4
13	De-soldering electronic components on P.C.B..	1	4
14	Identify various Electrical tools such as Wire stripper, Electrical wire plier, Screwdriver, Wire Crimper, Insulation Tape , Electrical cable lug, Electrical cable Ferrule, Electric tester, and Electrical conduit.	1	2
15	Wire the M.C.B. to supply electrical power in instrument panel.	1	2
16	Identify the different types of provided pneumatic connections and mechanical connections.	2	2
17	Identify different types and sizes of pneumatic pipe fittings and tubes.	2	2
18	Identify Hammer, Allen Wrench Set (Hex Set), Tongue-and-Groove Plier, Tape Measure, and Adjustable Wrench.	2	2
19	Identify Pipe Wrench, Combination Spanner, Flaring tool, Pipe Bender and Drilling Machine.	2	2
20	Identify pipes with National Pipe Thread (NPT) type Thread, and British Standard Pipe (BSP) Type Thread.	2	2

21	Identify Impulse pipe line, 2-way manifold valves, 3-way manifold valves, and 5-way manifold valves.	2	2
22	Connect the impulse pipeline to the 2-way manifold valve.	2	2
23	Connect the impulse pipeline to the 3-way manifold valve.	2	2
24	Connect the impulse pipeline to the 5-way manifold valve.	2	4
25	Make a hole in the metal sheet using a drilling machine.	2	4
26	Bend the capillary Stainless steel pipe using pipe bender.	2	4
27	Flare the end of the copper capillary pipe using a flaring tool.	2	4
28	Connect the two sections of pneumatic pipe using the provided pneumatic pipe fittings.	2	2
29	Mount the given transmitter using a U-bolt, Mounting clamp, and Mounting Bracket on a 2” inch pipe.	2	2
30	Identify Personal Protective Equipment (PPE), Safety face shield, Sand bucket, Emergency lights, Emergency signs, Fire alarm system, First aid kits, Spill control kit, and Disposal box.	3	2
31	Use safety equipment and aids during workshop sessions.	3	4
32	Perform a fire safety mock drill.	3	4
	Minimum 16 to 18 Practical Exercises		**60 Hrs**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications	Pr. No.
01	1- Packet of Resistor, Capacitor, Inductor, Transformer, Batteries, Fuse, Diode, Transistor, Switch, Relay, and M.C.B.	1, 13, 14, 15

02	1- unit each of Multi-meter and Clamp-on meter, C.R.O. (Cathode Ray Oscilloscope), D.S.O. (Digital Storage Oscilloscope).	2, 3, 4, 13, 14
03	Single phase A.C. supply with socket and Three Phase A.C. supply with socket.	6, 7, 13, 14, 15
04	1- unit each of Battery and Variable 24 V.D.C. Source.	8, 9
05	1- unit of Function generator.	10
06	1- unit each of Soldering - Desoldering Station	11, 12, 13, 14
07	1- unit each of Wire stripper, Electrical wire plier, Screwdriver set, Wire Crimper, and Electric tester.	13, 14
08	1-Packet of Electrical cable Ferrule, and Electrical cable lug.	13, 14
09	5Meter long Electrical conduit pipe.	13, 14, 15
10	1- unit each of Panel box with dimension 1400mm x 1200mm x 300mm.	15
11	1-Packet of Pneumatic pipe fittings- T- connector type and Elbow type for 3/8” inch pneumatic pipe.	16, 17, 28
12	5 meter long polyurethane pipe of $^{3}/_{8}$” inch	16, 17, 28
13	5 meter long copper capillary pipe of $^{3}/_{8}$” inch	27
14	5 meter long capillary Stainless steel pipe of $^{3}/_{8}$” inch	21, 22, 23, 24, 26
15	1- unit each of Hammer, Allen Wrench Set (Hex Set), Tongue-and-Groove Plier, Tape Measure, Adjustable Wrench, Pipe Wrench, Combination Spanner, Flaring tool, Pipe Bender and Drilling Machine.	18, 19, 25, 25, 26, 27, 29
16	0.5m M.S. pipe of ½” inch outer diameter with N.P.T..	20
17	0.5m M.S. pipe of ½” inch outer diameter with B.S.T..	20
18	1-unit each of 2-way manifold valve, 3-way manifold valve, and 5-way manifold valves.	21, 22, 23, 24
19	5 units each of U-bolt, Mounting clamp, and Mounting Bracket.	29
20	1 meter long Stainless steel pipe of 2” inch	29

21	1-unit each of Personal Protective Equipment (PPE), Safety face shield, Sand bucket, Emergency lights, Emergency signs, Fire alarm system, First aid kits, Spill control kit, and Disposal box.	30, 31, 32

Suggested Project List:

1. Prepare a board consist of different Resistor, Capacitor, Inductor, Transformer, Batteries, Fuse, Diode, Transistor, Switch, Relay, and M.C.B..
2. Connect the available electrical components and complete the wiring of the panel.
3. Demonstration board for Electrical connections and Electronic connections.
4. Demonstration board for pneumatic connections and mechanical connections.
5. Connect the Polyurethane Tube using pneumatic connectors.
6. Bend the capillary Stainless steel pipe using pipe bender.
7. Make basic electronic circuit on P.C.B.
8. Wear Personal Protective Equipment (P.P.E.) and take a photo of yourself.

Suggested Activities for Students:

1. Prepare specification sheets of some electrical, electronic, mechanical, and pneumatic components.
2. Give seminar on various electrical, electronic, mechanical, and pneumatic components.
3. Undertake a market survey of different Electrical and Mechanical tools.
4. Prepare Job Hazard analysis report for soldering and De-soldering.
5. Prepare Standard Operating Procedure for Drilling Machine, Tube bending, C.R.O., D.S.O., and control panel wiring.
6. Prepare the charts that classify Safety aids and equipment.