GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)

Semester- V

Course Title: Virtual Instrumentation

(Course Code: 4351705)

Diploma program in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	Fifth

1. RATIONALE

The course provides introduction to virtual instrumentation. Using virtual instrumentation the students can design and analyze various circuits and control systems. This course has been designed so that students can familiarize with various simulation software tools to build and simulate the different types of Electronics and Control Systems.

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2. COMPETENCY ('Program Outcome' according to NBA Terminology)

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:

- Apply concepts of virtual instrumentation in different applications

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) CO1: **Define virtual instrumentation concepts**
b) CO2: **Compare traditional and virtual instrumentation.**
c) CO3: **Describe data acquisition system for virtual instrumentation**
d) CO4. **Simulate different electronic and control system using virtual instrumentation environment**
e) CO5: **Apply Virtual Instrumentation techniques for Environment Sustainability.**

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the subcomponents of the COs.

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Install circuit Simulating and Analyzing software and familiarize with the system requirements and essential features/specifications of the software in use.	1	02
2	Introduction To Basic of Prosim/PSpice/Multisim software	1	02
3	Install LabVIEW software with necessary component	2	02
4	Introduction To LabVIEW environment .	2	02
5	Simulate a VI for LED on-off using switch	2	02
6	To perform Boolean operations using virtual instrumentation software	2	02
7	Generate first N Numbers using virtual instrumentation software	1	02
8	Perform basic arithmetic operations using virtual instrumentation software .	1	02
9	Determine poles and zeros of given first order transfer function	1	02
10	Determine root locus of given first order transfer function	1	02
11	Study different system Toolbox in virtual instrumentation software	1	02
12	Simulate basic half-wave rectifier and plot its output	1	02
13	Simulate basic full-wave rectifier and plot its output	1	02

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
14	Create mathshcript to find solution in virtual instrumentation software	1	02
15	Simulate for loop for a given example	1	02
16	Simulate while loop for a given example	2	02
17	Generate square wave using virtual instrumentation software	2	02
18	Generate triangular wave using virtual instrumentation software.	2	02
19	Create data acquisition system for temperature measurement using virtual instrumentation environment	3	02
20	Compare PC based system and PXI system.	3	02
21	Develop program to find out frequency of a given signal.	3	02

Note

i. *More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.*

ii. *The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Ability to Identify and solve engineering problems	20
2	Ability to Prepare experimental setup	20
3	Ability to Conduct the experiment	20
4	Ability to Record observations correctly	20
5	Ability to Interpret the result and conclude	20
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the Pros is a guide to procure them by the administrators to usher in uniformity of practical in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications.
1	Computer with Prosim/PSpice/Multisim software. .
2	Computer with Matlab /Scilab software.
3	Computer with LabVIEW software.

7. AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and Pros More could be added to fulfil the development of this competency.

a. Positively Influence others as a leader/a team member.
b. Meet the expectations of your superior/teacher/guide.
c. Cooperate your team mates and colleagues.
d. Help worker/staff/personnel nearby you.
e. Obey your higher officials/trainers/guide/manager.
f. Respect more experienced persons in your field.
g. Aid new comers/new joinees in your field.
h. Empathize your coworkers.
i. Tolerate the unpleasant and extreme environment conditions in the field.
j. Follow safety practices while using electrical appliances.
k. Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of Revised Bloom's taxonomy in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit-I **Introduction to Virtual Instrumentation**	1a Introduction to virtual instrumentation 1b Compare virtual instrumentation and traditional instrumentation 1c Role virtual instrumentation in real-time world	1.1 Historical perspective of virtual instrumentation Basics of Virtual instrumentation 1.2 Block diagram and Architecture of Virtual Instrumentation 1.3 Data flow techniques in virtual instrumentation 1.4 Compare virtual instrumentation and traditional instrumentation 1.5 Application of virtual instrumentation in real-time world 1.6 Role of hardware in virtual instrumentation 1.7 Role of software in virtual instrumentation 1.8 basic concepts of graphical system design model
Unit-II **Programming techniques in Virtual Instrumentation environment**	2a Basics of Graphical User Programming (GUI) 2b Compare conventional programming and GUI based programming 2e Prepare basic program in virtual instrumentation software 2f compare graphical programming and text based programming	2.1 VI programming techniques VIs and sub-VIs, 2.2 Basics of Loops and charts 2.3 Basics of Arrays, graphs 2.4 Case and sequence structures, formula nodes, local and global variables, string and file I/O, math script.

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit III Elements Of Data Acquisition in virtual instrumentation environment	3a Introduction to Data acquisition system 3b Selection criteria of hardware for data acquisition system 3c Basics of ADC, DAC, DIO 3d Basics of Counters and timers 3e Timing, Interrupts; RS232C/ RS485	3.1 Explain concept of Data acquisition system 3.2Enlist and explain Selection criteria of hardware for data acquisition system 3.3Describe Basics of ADC, DAC, DIO 3.4Describe Basics of Counters and timers 3.5Describe concept RS232/ RS485 module
Unit – IV Operating System And Hardware Overview	4aPC architecture, current trends, operating system requirements, 4b PC based instrumentation, 4c Interface requirement for virtual instrumentation 4d Basics of analog and digital interfaces 4e Compare PC based and PXI based system	4.1PC architecture, current trends, operating system requirements, 4.2 Explain PC based instrumentation, 4.3Interface requirement for virtual instrumentation 4.4Basics of analog and digital interfaces 4.5Compare PC based and PXI based system
Unit – V Virtual Instrumentation for Environment Sustainability	5aAdvantage of virtual instrumentation for environment sustainability 5b Role of virtual instrumentation in environment conservation 5c measurement and plotting of environment parameter in VI environment	5.1 Advantage of virtual instrumentation for environment sustainability 5.2 Role of virtual instrumentation in environment conservation 5.3 measurement and plotting of environment parameter in VI environment

Note:
The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Introduction to Virtual Instrumentation**	12	4	6	2	18
II	**Programming Techniques in Virtual Instrumentation Environment**	10	1	4	5	16
III	**Elements of Data Acquisition in virtual instrumentation environment**	8	1	3	4	16
IV	**Operating System And Hardware Overview**	8	1	3	4	12
V	**Virtual Instrumentation For Environment Sustainability**	4	1	2	1	08
	Total	**42**	**8**	**18**	**16**	**70**

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

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

10. SUGGESTED LIST OF STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student related co-curricular activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

A. Industrial visit for students in order to have an exposure to the real-world environment
B. A workshop/seminar where students can have interaction with industry personnel.
C. Simulate different system and generate output
D. Model preparation. E.g. prepare model of heated type air dryer.
E. Present a seminar on any one technical topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Display of animation videos of industrial loops.
ii. Arrange industrial visit to nearby process industry.

iii. Compliment student for his/her work done during the practical in order to motivate him/her by student and Instruct him/her remedies to improve his work if required.
iv. Arrange expert lectures of instrumentation engineers working in process industries.
v. Utilize Massive Open Online Courses (MOOCs) to teach various topics/sub-topics.
vi. Research through net i.e. internet based home assignments.
vii. Assign preparation of mini projects.
viii. Guide students to focus on energy savings in industry and home.
ix. Guide students on how to address issues on environment and sustainability.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be individually undertaken to build up the skill and confidence in every student to become problem solver so that he/she contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should not exceed three.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact an integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than 16 (sixteen) student engagement hours during the course. The student ought to submit a micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Make a working virtual circuit of rectifier
b) Make a working virtual circuit of AC-dc power supply.
c) Make a working virtual circuit of filter, amplifier base on respective branch subject.
d) Make a virtual model of first order plant system in scilab.
e) Make a working model of P-controller of the first order plant system.
f) Make a project of calculator in LabVIEW.
g) Make a project of Boolean gates in LabVIEW.
h) Water level detection with LabVIEW. ...
i) Temperature sensing with LabVIEW. ...
j) Temperature conversion with LabVIEW. ...
k) Quadratic roots calculation with LabVIEW. ...
l) Measuring and controlling temperature with LabVIEW. ...
m) Speech recognition with LabVIEW. ...
n) Home automation with energy Gentrification simulation in LabVIEW

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Books	Author	Publication
1	Virtual Instrumentation Using Labview	JOVITHA JEROME ·	PHI Learning
2	A Guide To Matlab: For Beginners And Experienced Users	Ronald L. Lipsman, Jonathan Rosenberg	Cambridge University Press
3	Modelling And Simulation In Scilab/Scicos	Stephen L. Campbell	Springer

14. List of Software/Learning Websites

- MATLAB,
- SCILAB
- Prosim
- PSpice
- LabVIEW
- www.mathworks.in
- www.ni.com

15. PO-COMPETENCY-CO MAPPING

Semester V	Applied Instrumentation- (Course Code: 4351701)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ develop-ment of solutions	PO 4 Engineering Tools, Experimen-tation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Manage-ment	PO 7 Life-long learning
Competency	To maintain industrial processes.						
CO1: Define virtual instrumentation concepts	2	1	-	1	1	-	1

CO2: Compare traditional and virtual instrumentation	2	1	1	1	1	1	1
CO3: Describe data acquisition system for virtual instrumentation	1	2	2	2	2	1	2
CO4: Simulate different electronic and control system using virtual instrumentation environment	2	1	1	2	1	2	1
CO5: Application of Virtual Instrumentation for Environment Sustainability	2	1	1	2	2	1	1

***Legend:** '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Member – Board of Studies (GTU), Electrical and Allied branches

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