

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRICAL ENGINEERING (07) INDUSTRIAL ELECTRONICS AND INSTRUMENTATION SUBJECT CODE: 2720722 M.E. 2nd SEMESTER

Type of course: Engineering

Prerequisite: Fundamentals of subjects like analog and digital electronics, electrical machines, power electronics etc.

Rationale:

Electronic devices and circuits are intensively integrated into all aspects of modern industrial control systems. The course is aimed to provide exposure to electronic components and instrumentation used for industrial applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
		ESE			OEP	PA	RP			
3	2#	0	4	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	MOTOR CONTROL: Introduction to some components like push-buttons, relays, limit switches, timers etc. used in industrial motor control, Concept of Interlocking, Sequence Control, Jogging, Plugging, Anti-plugging and Wiring Diagrams for Motor Control	09	18
2	TRANSDUCERS FOR POWER ELECTRONICS & DRIVES : Current transformers (iron core, ferrite core), voltage transformers, incremental shaft encoders, resolvers, torque sensors, shunts and potential dividers	05	10
3	DIGITAL MEASUREMENT TECHNIQUES: Digital techniques of measurement of voltage, current, power, energy, speed and position and direction of rotation, true RMS measurement, FFT based measurement	09	16
4	SIGNAL CONDITIONING CIRCUITS: Inverting & non inverting amplifiers, Differential Amplifier, Instrumentation amplifier, op-amp as comparator, ZCD circuits, rail to rail input and output of op-amps, CT burden , active and passive filters, isolation amplifiers, level shifting and summing amplifier, opto-couplers, V/i and i/V converters, 4-20 ma current loop, resolver to digital converter	10	20
5	DATA ACQUISITION AND CONVERSION : SAR and sigma-delta A/D converters, D/A converters, resolution and errors of ADC/DAC,	05	10

	architecture of data acquisition systems (DAQ)		
6	EMI & EMC : Introduction, causes of EMI, interference coupling mechanism, basics of circuit layout and grounding, concepts of interfaces, filtering and shielding	05	10
7	OTHER INDUSTRIAL APPLICATIONS: Principle of Induction Heating, High frequency power source for induction heating, Requirements, Merits and Applications, Theory and Principle of Dielectric heating, Dielectric Materials and properties, Electrodes and its coupling methods, Thermal Losses, Applications Electrical Welding, Classification, Sequence of Operations, Interval Triggering and Gating circuit, Weld Power Circuit, Resistance Welding, Spot-welding, Arc Welding, Power Converters for Heating and Welding applications.	09	16

Reference Books:

1. Stephen L. Herman, Walter N. Alerich, "Industrial Motor Control", 4th ed., Delmar Publishers, New York, 1999.
2. Albert D. Helfrick, William D. Cooper, "Modern Electric Instrumentation and Measurement Technique", Prentice Hall India, 1992.
3. T.S. Rathore, "Digital measurement techniques", Narosa Publishing House, 2nd ed., 2013.
4. C. Rangan, G. Sarma, V.S. V. Mani, "Instrumentation devices & systems, Tata McGraw Hill, 2004.
5. Doebelin E.O, "Measurement Systems - Application and Design", 5th ed., McGraw-Hill, New York, 2004.
6. G.K. Mithal, M. Gupta, "Industrial and Power Electronics", Khanna Publishers, 19th ed., 2004.
7. T. E. Kissell, "Industrial Electronics", Prentice Hall of India, 3rd ed., 2006.
8. Recent Literature, Datasheets and Application Notes.

Course Outcome:

After learning the course the students should be able to:

- Demonstrate concepts of different transducers and use them in industrial applications
- Design measurement and signal conditioning circuits for industrial applications
- Design wiring schemes for industrial control
- To take corrective measures for EMI

List of Open Source Software/learning website:

1. MIT OPEN COURSEWARE by Massachusetts Institute of Technology
- website: ocw.mit.edu
2. Courses available through NPTEL.
- website : nptel.ac.in

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first

two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.