

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3162415

Semester – VI

Subject Name: Industrial Electronics

Type of course: Professional Elective-II

Prerequisite: Basic Electronics, Electrical Machines and Applications, Basic Power Electronics Devices, Circuits and Applications, Power Electronics in Consumer Products

Rationale: The course is aimed to enable students to comprehend various applications in industry. This subject will be helpful to enhance the knowledge of Electronics, various control components, sensors, servo systems and opto- electronics etc. used in industries.

Teaching and Examination Scheme:

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|-----------------|---|---|---------|-------------------|---------|-----------------|----|-------------|
| L | T | P | | Theory Marks | | Practical Marks | | |
| | | | ESE (E) | PA (M) | ESE (V) | PA (I) | | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

Content:

| Sr. No. | Content | Total Hours | Weightage |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-----------|
| 1 | Magnetic Control Circuits/Systems: <ul style="list-style-type: none">• Introduction-Contactor control circuit components-Push button, Contactor, Relays-Types of relays, Timers, Fuse, Limit switch, Float switch, Design of Control Circuits - Interlocking methods, Sequence Control.• Control circuits-Schematics and wiring diagrams for motor control circuits-Direct online starter for three phase IM, direct reversing of three phase IM, star-delta starter etc., automatic and manual operation, Two speed motor control, forward reverse operation of motors, Inching circuit for three phase Induction motors, Plugging-dynamic-regenerative braking of IM, Protection of three phase induction motor. | 08 | 20% |
| 2 | Servo Motors and Synchros: <ul style="list-style-type: none">• Introduction- Electrical DC servomotors, speed torque characteristic, closed loop operation.• Stepping Servo motors, principle of operation, Stepping Motors with Small Step Angle, Torque-Displacement Characteristic of a Stepping Motor, Speed-Torque Characteristic Behavior of Stepping Motors, Stepping Motors for Position Control Applications.• AC Servo Motors-Principle of Operation, Variable Speed AC Motors, Mathematical Model, Frequency Converter.• Electro-hydraulic Servo Motors-A Simple Mechanically Controlled Servo System, Electro-hydraulic Servo Valves, Hydraulic Servo Motors,• Synchros- transmitter receiver pair, application. | 10 | 20% |
| 3 | Opto-Electronics/Photoelectric Device: <ul style="list-style-type: none">• Introduction-Light dependent resistor (LDR), Light emitting diode, Photo diodes, Photo transistors, Photo voltaic cells, Photo conductive cells, Photo electric emission, Photo electric relays, Opto-couplers, Applications.• Optical fiber-Materials of optical fiber, characteristics of fiber optic systems, Advantages of the optical fiber, Applications, Fiber optic cable. | 06 | 15% |

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering Subject Code: 3162415

| | | | |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-----|
| 4 | Ultrasonics: <ul style="list-style-type: none"> • Introduction-generation of ultrasonic waves, Piezoelectric generator, Piezoelectric oscillator, Magnetostriction oscillator, Applications-Ultrasonic soldering and welding, cutting and machining of hard materials, ultrasonic study of structure of matter, sound signaling or depth sounding, Flaw detection, degassing of liquids by ultrasonic waves, application in medicine, thermal effects of ultrasonic. | 06 | 15% |
| 5 | AC Power Conditioner: <ul style="list-style-type: none"> • Introduction, power supply noise, effect of noise, RFI noise reduction, surge reduction, Metal oxide varistor, silicon suppressor, types of power line disturbances, effect of power line disturbances on sensitive electronics equipment, buck-boost type servo stabilizer, Constant voltage transformer or Ferro-resonant ac regulator, Tap changer, solid state stabilizer, Uninterruptible power supply (UPS)- on-line UPS, off-line UPS. | 06 | 15% |
| 6 | Discrete Position and advanced Sensors: <ul style="list-style-type: none"> • Proximity Sensors-Inductive Proximity Sensors, Capacitive Proximity Sensors, Ultrasonic Proximity Sensors, Optical Proximity Sensors • Angle Position Sensors, Incremental Encoder, Absolute Encoder • Accelerometer, Inclinometer. | 06 | 15% |

Suggested Specification table with Marks (Theory): (For BE only)

| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 20 | 30 | 30 | 10 | 10 | --- |

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

1. **Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
2. **Understanding:** Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
3. **Applying:** Carrying out or using a procedure for executing or implementing.
4. **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.
5. **Evaluating:** Making judgments based on criteria and standards through checking and critiquing.
6. **Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

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.

Reference Books/Material:

1. Biswanath Paul, "Industrial Electronics and Control", PHI Learning Private Limited-2014
2. John R. Hackworth, Frederick D. Hackworth, Jr., "Programmable Logic Controllers: Programming Methods and Applications", Prentice Hall -2004.
3. G. K. Mithal, Dr. Maneesha Gupta, "Industrial and Power Electronics", Khanna Publisher-2001

GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3162415

4. S. K. Bhattacharya, S. Chatterjee, "Industrial Electronics and Control", Tata McGraw-Hill Publishing Company Ltd.
5. Harish C. Rai, "Industrial and Power Electronics: Device, Circuits, Systems and Applications", Umesh Publications.
6. http://www.synchroconverters.com/Navy_Training_on_Synchro_s.pdf

Course Outcomes:

At the end of the course, student should be able to:

| Sr. No. | CO statement | Topics Mapped | Marks % weightage |
|---------|--------------------------------------------------------------------------------------------|---------------|-------------------|
| CO-1 | Develop the control logic for motor control application using magnetic control components. | 1 | 20 |
| CO-2 | Select servo systems in industrial requirement. | 2 | 20 |
| CO-3 | Make use of ultrasonic, power conditioners in industries. | 4, 5 | 30 |
| CO-4 | Select sensors & opto-electronic devices for a particular industrial application. | 3, 6 | 30 |

Suggested List of Experiments:

1. To study various control components and represent symbolically.
2. To develop control logic for DC motor control.
3. To develop control logic for star-delta starter.
4. To develop forward-reverse control circuit for motors.
5. To experiment the plugging operation of three- phase Induction motor with appropriate control logic circuit.
6. To investigate working operation of stepper motor.
7. To study Synchro transmitter and receiver pair as error detector.
8. To obtain characteristics of Light dependant resistance,
9. To investigate electrical and optical characteristics of photo diode.
10. To investigate electrical and optical characteristics of photo transistor.
11. To obtain transfer characteristics curve of the Opto-coupler.
12. To study working principle of ultrasonics wave generators.
13. To study working of buck boost type servo stabilizer.
14. To study working of solid-state stabilizers.
15. To study on-line Uninterrupted Power Supply and off-line Uninterrupted Power Supply.
16. To conduct an experiment of proximity switches to evaluate its working principle.

Major Equipment:

CRO/DSO, Multi-meters, volt/current meters, Breadboard, necessary components, servo motor, stepper motor etc.