

Government of Karnataka
Department of Technical Education
Board of Technical Examinations, Bengaluru

Course Title: Industrial Electronics		Course Code:15MC42T
Mode (L:T:P) : 4:0:0	Credits:4	Core/ Elective: Core
Type of Course: Lectures & Student Activities		Total Contact Hours: 52
CIE= 25 Marks		SEE= 100 Marks

Pre-requisites: Knowledge of Applied Science & Basic Electrical and Electronics Engineering,

Analog Electronics and Fundamentals of Digital electronics

Course Objectives: Understand the application of semiconductor power devices and circuits,

Motor control devices and develop motor control systems

Course Outcome: At the end of the semester, the student should be able to

1. Understand the power semiconductor devices, circuits and their applications.
2. Know the power distribution system and its significance.
3. Know the working of motor control devices
4. Know the working of magnets, solenoids, relays, timer and counters.
5. Control the speed of motors for different applications
6. Develop motor control circuits

Course Outcome		Cognitive Level	Linked with PO	Teaching Hours
CO1	Understand the power semiconductor devices, circuits and their applications	U	1,2	10
CO2	Know the power distribution system and its significance	U	1,2	08
CO3	Know the working of motor control devices	U	1,2	08
CO4	Know the working of magnets, solenoids, relays, timer and counters	U	1,2	08
CO5	Control the speed of motors for different applications	U/A	1,2	10
CO6	Develop motor control circuits	U/A	1,2	08
		Total sessions		52

Legend: R; Remember, U: Understand A: Application

Mapping of Course Outcomes with Program Outcomes

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
Industrial Electronics	3	3	-	-	-	-	-	-	-	-

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If $\geq 40\%$ of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If $< 5\%$ of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

Course Content and Weightage For SEE

Unit No	Unit Name	CO	Hour	Marks allocated for different Cognitive level Questions			Marks weightage (%)
				R	U	A	
1	Power Semiconductor Devices Circuits	1	10	-	30	-	20.69
2	Power Distribution System And Industrial Electrical Diagrams	2	08	-	20	-	13.79
3	Motor Control Devices And Circuits	3	08	-	25	-	17.24
4	Magnets, Solenoids, Relays, Timers And Counters	4	08	-	20	-	13.79
5	Control the speed of motors for different applications	5	10	-	10	20	20.69
6	Develop Motor Control Circuits	6	08	-	-	20	13.79
	Total		52	145 Marks			100

Contents

Unit-I

Power Semiconductor Devices Circuits

Construction, working, characteristics and applications of SCR, DIAC, TRIAC, UJT, MOSFET, IGBT, SCR triggered by R, RC, UJT (Relaxation oscillator) Triggering circuits, controlled rectifiers: operation of 1 Φ Half-wave, 1 Φ Full-wave, Applications, Inverters: Working of Series, Parallel and Bridge, Applications Choppers: Working of Step-up and Step-Down, Applications Cycloconverters: Working of 1 Φ -1 Φ Cycloconverters, Applications.

10 Hours

Unit-II

Power Distribution System and Industrial Electrical Diagrams

Introduction, Stages in power delivery system, Emergency power supply system: On site alternator, UPS system, Inplant distribution. Power sources: Batteries, Switch mode power supply. Electrical symbols, Diagrams, Wiring diagram, Schematic diagram, Block diagram, Single line diagram, Ladder diagram.

8 Hours

Unit-III

Motor Control Devices and Circuits

Pilot Devices: Manually operated switches: Toggle switch, Slide switch, DIP switch, Rotary switch, Push button switch, Drum switch. Mechanically operated switches: Limit switch, Micro switch, Temperature switch, Pressure switch, Float switch, Flow switch. Manual control devices: Disconnect switch, Manual motor starter Contactors and motor starters: Contactors, Magnetic motor starter, and Solid state contactor.

8 Hours

Unit-IV

Magnets, Solenoids, Relays, Timer and Counters

Introduction, electromagnets, Solenoid: Basic solenoid action, Inline (or ON/OFF) solenoid valve, Solenoid valves: 3-way 2 position, Applications of solenoids. Relays: Electro mechanical

control relays, Solid state relays, Timing relays, Latching relays, Relay logic. Timers: Introduction, Pneumatic timer, Electromechanical motor driven timer, Solid state Electronic timer, Application of timers, Counters: Mechanical counter, Electro mechanical counter, Solid state counters, Programmable timer/counter. Sequencers: Introduction, Programmable sequencers.

8 Hours

Unit-V

Control the speed of motors for different applications

Stepper motor: Construction, Operation of stepper motor, Control of stepper motors, Application of stepper motors - Print wheel control system – Disc head control system - Robot arm. Servo Motors: AC servo motor, Construction, operation, Torque speed characteristics. Servo amplifiers, Applications. DC servo motors: Construction, operation, Characteristics, Amplifiers. Brushless DC motors. Speed control of small motor, DC drive system, Variable frequency AC drive system.

10 Hours

Unit-VI

Develop Motor control Circuits

Control circuits and load circuits: Two wire control circuit, Three wire control circuit, Three wire start/stop circuit with multiple start/stop push button, Three wire control circuit with indicator lamp, Reverse motor starter, Jogging.

8 Hours

Reference

- 01 Industrial Electronics - E Kissell, PHI Publication
- 02 Modern Industrial/Electrical Motor Controls - E Kissell, PHI Publication
- 03 Motor Control Technology For Industrial Maintenance - E Kissell, PHI Publication
- 04 Industrial motor control, Stephen L Herman, Delmar cengage Learning
- 05 ABC of Electrical Engg, B.L. Theraja, S. CHAND

e-References/ Urls

www.omega.com/prodinfo/stepper_motors.html

www.analog.com/Isolator-Article

www.gobookee.com/power-electronics-circuits-devices-and-applications

[www.industrialtext.com/Support/Electrical Diagram & PI&D](http://www.industrialtext.com/Support/Electrical_Diagram_&_PI&D)

Student Activity

Activity No.	Description of the Student Activity
1	Visit a nearby MSME/ workshop and prepare a hand written report on wiring diagrams or servicing techniques of motors, control drives, relay or Maintenance of Machine tools or Different motors, drives, control panels etc

Note:

1. Group of max four students should do any one of the above activity or any other similar activity related to the course COs and get it approved from concerned Teacher and HOD.
2. No group should have activity repeated or similar
3. Teacher should ensure activities by group must cover all COs
4. Teacher should assess every student by using suitable **Rubrics** approved by HOD

Rubrics

Dimension	Exemplary	Accomplished	Developing	Beginning	Roll No. of the Student				
	5/4	3	2	1	1	2	3	4	5
Organization	Information presented in logical, interesting sequence	Information in logical sequence	Difficult to follow presentation-- student jumps around	Cannot understand presentation-- no sequence of information	Ex: 2				
Subject Knowledge	Demonstrates full knowledge by answering all class questions with explanations and elaborations	At ease with expected answers to questions but does not elaborate	Uncomfortable with information and is able to answer only rudimentary questions	Does not have a grasp of the information. Cannot answer questions about subject	3				
Graphics	Explain and reinforce screen text and presentation	Relate to text and presentation	Occasionally uses graphics that rarely support text and presentation	Uses superfluous graphics or no graphics	4				
Oral Presentation	Maintains eye contact and pronounces all terms precisely. All audience members can hear	Maintains eye contact most of the time and pronounces most words correctly. Most audience members can hear presentation	Occasionally uses eye contact, mostly reading presentation, and incorrectly pronounces terms. Audience members have difficulty hearing	Reads with no eye contact and incorrectly pronounces terms. Speaks too quietly	5				
Total Score=2+3+4+5=14/4=3.5=4									

Institutional Activity

Activity No	Description of the Institutional Activity
1	Organize Seminar, workshop, Lecture, from an experts in the following domain: 1. Modern trends in Industrial Electrical and Electronics. 2. Modern trends in Motor controls
2	Organize an industrial visit.
3	Motivate student to take case study on Applications of thyristors to inculcate self and continuous learning.

Course Assessment Pattern

Particulars			Max Marks	Evidence	Course outcomes
Direct Assessment	CIE	Three test (Average of three tests)	20	Blue books	1,2,3,4,5,6
		Student Activity	05	Student Activity Sheets	1,2,3,4,5,6
	SEE	End of the course	100	Answer scripts at BTE	1,2,3,4,5,6
Indirect Assessment	Student Feedback on course	Middle of the course		Feedback forms	1, 2&3
		End of the course		Feedback forms	1,2,3, 4, 5&6

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 th week of sem 10-11 Am	I/II SEM		20			
	Year:					
Name of Course coordinator : CO's: _____			Units: ____			
Question no	Question	MARKS	CL	CO	PO	
1						
2						
3						
4						

Note: Internal Choice may be given in each CO at the same cognitive level (CL).

Model Question Paper (CIE)

Date and Time	Semester	Course	Max Marks			
3Test (13 th week of sem) 10-11 Am	IV SEM	Industrial Electronics	20			
	Year: 2015-16	Course code:15MC42T				
Name of Course coordinator : All questions carries equal marks			Units:5,6 CO: 5,6			
Question No	Question	CL	CO	PO		
1	Explain the DC drive system OR Explain the variable frequency AC drive system	A	5	1,2		
2	Explain the operation of servo system. OR Explain the methods to control the speed of DC motor	A	5	1,2		
3	Develop the control circuit and load circuit for motor starter using only ON/OFF switch using two wire method OR Develop the control circuit and load circuit for motor starter using only ON/OFF switch using three wire method..	A	6	1,2		
4	Develop using three wire method START/STOP circuit with multiple START/STOP push buttons OR Develop the control circuit and load circuit for motor to rotate both in clockwise and anticlockwise direction	A	6	1,2		

Model Question Paper
IV Semester Diploma in Mechatronics Engineering
Industrial Electronics

Instructions: Answer any six questions from part A and Seven full questions from part B

PART-A

Answer any six questions.

5X6=30 marks

1. Differentiate between UJT and SCR
2. Explain the working of TRIAC.
3. Explain power distribution system
4. Explain UPS with a neat block diagram
5. Explain Single line diagram. with an example
6. Explain the working of Toggle switch with diagram.
7. Explain the working of Selector switch with diagram.
8. Explain operation of stepper motor
9. Explain characteristics of servo motor

PART- B

Answer any seven full questions.

10x7=70 Marks

1. Explain the working of step-up chopper with circuit diagram and waveforms. **10m**
2. Explain the working of 1 Φ Cyclo converters with circuit diagram and waveforms. **10m**
3. Explain stages in delivery of power to an industrial user. **10m**
4. Explain the working of: i. Solid state contactor ii. Disconnect switch **(5+5)m**
5. Explain the operation of Relay and List its Applications **(7+3)m**
6. Explain the counters and Timers **(5+5)m**
7. Explain the methods to control the speed of AC motor **10m**
8. Explain the methods to control the speed of DC motor **10m**
9. Develop the control circuit and load circuit for motor starter using only ON/OFF switch using two wire method **10m**
10. Develop the control circuit and load circuit for motor to rotate both in clockwise and anticlockwise direction. **10m**

Model Question Bank
IV Semester Diploma in Mechatronics Engineering
Industrial Electronics

Unit-I

Power Semiconductor Devices Circuits
Cognitive level - Understanding

1. Explain the power semiconductor devices of thyristor
2. Explain briefly the power transistors.
3. Explain SCR, Diac and Triac
4. Explain briefly the following
 - i. Forward break power voltage ii. Holding current iii. Latching.
5. Explain the construction, working, characteristics and application of TRIAC.
6. Discuss the advantages and disadvantages of TRIAC
7. Differentiate between SCR and TRIAC
8. Differentiate between DIAC and TRIAC
9. Differentiate between UJT and SCR
10. Discuss the merits and demerits of IGBT
11. Explain two transistor analogy of SCR
12. Explain the construction, working, characteristics and application of SCR
13. Explain the construction, working, characteristics and application of
 - a. MOSFET b. IGBT c) UJT
14. Explain the construction, working, characteristics and application of DIAC.
15. Explain the construction, working, characteristics and application of TRIAC.
16. Explain the controlled rectifier
17. Explain an inverter
18. Explain the chopper
19. Explain the cyclo- converter
20. Explain the working of inverter (Series/ Parallel/Bridge)
21. Discuss the applications of:-
 - a) Controlled rectifier b) Inverter
 - c) Chopper d) Cyclo-converter
22. Explain the working of chopper (step-up/step-down)
23. Explain the working of controlled rectifier (Half-wave/ Full wave)
24. Explain the working of 1 Φ Cyclo converters.

Unit-II

Power Distribution System and Industrial Electrical Diagrams

Cognitive level - Understanding

1. Explain power distribution system.
2. Explain UPS with a neat block diagram.
3. Explain stages in delivery of power to an industrial user
4. Explain SMPS with a neat block diagram.
5. Explain the working of on-site alternator emergency power systems.
6. Explain in-plant distribution with diagram.
 - a) Power control centre.
 - b) Motor control centre.
7. Explain the following power sources:-
 - a) Batteries
 - b) Switch mode power supply
8. Explain Block diagram with an example
9. Explain Ladder diagram with an example
10. Explain Single line diagram. with an example
11. Explain Schematic diagram with an example
12. Explain Wiring diagram with an example
13. Explain the industrial electrical diagrams of:
 - I) Block diagram
 - II) Ladder diagram
 - III) Single line diagram.
 - IV) Schematic diagram
 - V) Wiring diagram

Unit-III

Motor Control Devices and Circuits

Cognitive level - Understanding

1. Explain the motor connection and technology.
2. Explain control devices
3. Explain pilot devices.
4. Explain manually operated switch
5. Explain mechanically operated switch
6. Explain the following manually operated switch with neat diagram:-
 - a) Toggle switch
 - b) DIP switch
 - c) Slide switch
 - d) Rotary switch
 - e) Thumb wheel switch
 - f) Selector switch.
 - g) Push button switch
 - h) Drum switch
7. Explain the following contactors and motor starters:-
 - i. a) Contactors
 - b) Magnetic motor starter.
 - ii. c) Solid state contactor
8. Explain the following mechanically operated switch with neat diagram:-

- iii. a) Limit switch b) Micro switch.
 - iv. c) Temperature switch d) Pressure switch.
 - v. e) Float switch f) Flow switch.
9. Explain the following manual control devices
- vi. Disconnect switch ii. Manual motor starter iii. Manual drum switch.

Unit-IV

Magnets, Solenoids, Relays, Timers and Counters

Cognitive level – Understanding

1. Explain solenoids.
2. Explain the construction of solenoid
3. Discuss the applications of solenoids
4. Explain the operation of solenoid.
5. Explain inline solenoid valve.
6. Explain different types of relays.
7. Explain the different types of timers.
8. Discuss the applications of timers
9. Explain the different types of counters.
10. Explain the different types of sequencers

Unit-V

Control the speed of motors for different applications

Cognitive level - Understanding

1. Explain the working of stepper motor
2. Discuss the types of stepper motor and its applications
3. Explain the servo system
4. Explain the working of servo motors
5. Explain the characteristics of servo motor
6. Explain the construction, operation of AC servo motor with its application
7. Explain the construction, operation of DC servo motor with its application.
8. Explain the construction, operation of Brushless DC motor with its application

Cognitive level - Application

1. Explain the methods to control the speed of DC motor.
2. Explain the DC drive system.
3. Explain the variable frequency AC drive system
4. Explain the methods to control the speed of AC motor

Unit-VI

Develop Motor Control Circuits

Cognitive level - Understanding

1. Explain the control circuits and load circuits
2. Explain the jogging

Cognitive level - Application

1. Develop the control circuit and load circuit for motor starter using only ON/OFF switch using two wire method.
2. Develop the control circuit and load circuit for motor starter using only ON/OFF switch using three wire method.
3. Develop using three wire method START/STOP circuit with multiple START/STOP push buttons.
4. Develop the control circuit and load circuit for motor to rotate both in clockwise and anticlockwise direction.
5. Develop the control circuit and load circuit for motor to move in jogging/ Inching both in clockwise and anticlockwise direction.