

Course Code	Course Name	Credits
MEC404	Industrial Electronics	03

Objectives:

1. To study power electronic switches and circuits and their applications.
2. To acquaint with basics of analog and digital circuits for the design of mechanical processes control.
3. To study structure, working and characteristics of different types of industrial electric motors and their selection for a particular application.

Outcomes: Learner will be able to...

1. Illustrate construction, working principles and applications of power electronic switches.
2. Identify rectifiers and inverters for dc and ac motor speed control.
3. Develop circuits using OPAMP and Timer IC 555.
4. Identify digital circuits for industrial applications.
5. Demonstrate the knowledge of basic functioning of microcontrollers.
6. Analyze speed-torque characteristics of electrical machines for speed control.

Module	Detailed Contents	Hrs.
1.	Semiconductor Devices: Review of diodes, V-I characteristics and Applications of: rectifier diode, zener diode, LED, photodiode; SCR V-I characteristics, UJT triggering circuit, turning-off of a SCR (preliminary discussion), basics of Gate Turn Off (GTO), Structure and V-I characteristics of Triac (modes of operation not needed) and Diac, Applications of Triac-Diac circuit; Characteristics of Power BJT, power MOSFET, IGBT; Comparison of SCR, Triac, Power BJT, power MOSFET, IGBT	08
2.	Phase controlled rectifiers and Bridge inverters: Full wave controlled rectifier using SCR's(semi controlled, fully controlled) with R load only, Block diagram of closed loop speed control of DC motors, Basic principle of single phase and three phase bridge inverters , block diagrams including rectifier and inverter for speed control of AC motors (frequency control only)	07
3.	Operational amplifiers and 555 Timer: Operational amplifier circuits, Ideal OPAMP behaviour, common OPAMP ICs; Basic OPAMP circuits- Inverting amplifier, Non-inverting amplifier, Voltage follower (Buffer), Comparator, Instrumentation Amplifier, Active first order filter: Low pass and high pass filter; Power Op Amps, IC-555 timer-Operating modes: monostable, astablemultivibrator	05
4.	Digital logic and logic families: Boolean algebra and logic gates. logic families: Logic Levels, Noise Immunity, Fan Out, Propagation Delay, TTL and CMOS logic families, Flip flops: Set Reset(SR), Trigger(T), clocked F/Fs; Registers, Multiplexer and Demultiplexer applications	05

5.	<p>Microprocessor and Microcontrollers: Overview of generic microprocessor, architecture and functional block diagram, Comparison of microprocessor and microcontroller MSP430 architecture, assembly language programming, C compiler programming, basics of interfacing with external input / output devices (like reading external analog voltages, digital input output) Applications of microcontroller: Temperature measurement, Speed Measurement using Proximity Sensor, Piezoelectric Actuator Drive</p>	08
6.	<p>Motors: Review and comparison of DC motors and AC induction motors, Basic principles of speed control of AC induction motor, Basics of BLDC motor, Linear Actuator motor, Servo Motor; Motor Specifications, suitability of each motor for various industrial applications, Selection and sizing of motors for different applications. Applications for pumps, conveyors, machine tools, Microcontroller based speed control for Induction Motor.</p>	06

Assessment:

Internal Assessment for 20 marks: Consisting Two Compulsory Class Tests First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour.

End Semester Examination: Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

References:

1. Power Electronics M.H. Rashid, Prentice-Hall of India
2. Power Electronics, P S Bhimbra
3. Power Electronics, VedamSubramanyam, New Age International
4. Power Electronics, Ned Mohan, Undeland, Robbins, John Wiley Publication
5. Electronic Devices and Circuits, Robert Boylestad and Louis Nashelsky, Prentice-Hall
6. Industrial Electronics and Control by S K Bhattacharya, S Chatterjee, TTTI Chandigarh
7. Modern Digital Electronic, Jain R P, Tata McGraw Hill, 1984
8. Digital principal and Application, Malvino and Leach, Tata McGraw Hill, 1991
9. Fundamentals of Microcontrollers and Embedded System, Ramesh Gaonkar, PENRAM
10. MSP430 Microcontroller Basics, John H. Davies, Newnes; 1 edition 2008

Links for online NPTEL/SWAYAM courses:

1. <https://nptel.ac.in/courses/108/108/108108122/>
2. <https://nptel.ac.in/courses/108/105/108105066/>
3. <https://nptel.ac.in/courses/108/101/108101091/>
4. <https://nptel.ac.in/courses/106/108/106108099/>
5. <https://nptel.ac.in/courses/108/105/108105102/>
6. <https://nptel.ac.in/courses/108/102/108102146/>

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