

GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS (29) INDUSTRIAL ELECTRONICS & CONTROL SUBJECT CODE: 2722914 SEMESTER: II

Type of course: OPEN ELECTIVE

Prerequisite: Fundamental knowledge power devices and power electronics circuits, ac/dc motors, ICs, Mathematical modeling, simulation.

Rationale: To learn Power Electronics in applied manner with perspective of Industrial Electronics Engineering applications. To provide coverage of power devices and power electronics circuits and their applications in Power Supplies, the control of ac/dc motors, and heating and welding processes.

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)			
					ESE	OEP	PA	RP		
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Power Devices Power diode : characteristics and types, Power transistor -Power MOSFET – IGBT: structure and working, device and switching characteristics, SCR - TRIAC - GTO -MCT : static V-I and switching characteristics, Protection of power devices : Snubber circuit, over voltage & over current protection, gate protection.	8	17%
2	RF Heating High frequency power source for induction heating, requirements, merits and applications of induction heating; Dielectric heating: Theory and principle, Properties of dielectric material, electrodes and its coupling methods, thermal losses, applications.	6	13%
3	Welding Control Classification, Sequence of operations, interval triggering and gating circuit, interval time counter, weld power circuit; resistance – spot - arc type weldings, Energy storage welding system , Switch-Mode welding.	4	10%
4	Power Supplies Regulated linear power supplies, Voltage regulator ICs- Linear, adjustable SMPS: fly back, feed - Forward, push- pull, bridge type .UPS- online, offline & hybrid type, Reliability, Batteries for UPS.	10	22%
5	Motor Control DC Drives: Steady state characteristic of dc motors, Regenerative & dynamic braking, Control of DC motor using converters and choppers, Closed loop control (PLL) scheme. AC Drives: Speed-torque characteristic of induction motor, Static stator voltage control, V/f control, Static rotor resistance control, Slip power recovery scheme, Synchronous motor Drives .Stepper Motor Control.	10	22%

	μ P/ μ C/DSP- control .Drives Selection.		
6	Applications HVDC, Static VAR Compensators, battery operated vehicle, battery charger, Electronics lamp blast, Emergency lighting system, Static circuit breaker, Electric Traction, CVT, Servo Controlled Voltage stabilizer, Inverter.	6	16%

Reference Books:

1. Biswanath Paul, "Industrial Electronics And Control", PHI publication, 2nd edition, 2009
2. G.K.Mithal , Dr M.Gupta, "Industrial and Power Electronics",
3. Thomas E. Kissell, "Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls", Prentice Hall, 2000
4. Agam Kumar Tyagi, "MATLAB and SIMULINK for Engineers",Oxford University,2011.
5. J.B.Gupta "Utilization Of Electric Power & Electric Traction" S. K. Kataria & Sons, 2009
6. S.K.Bhattachrya "Industrial Electronics and Control" TMH publication
7. M.D.Singh & K B Khanchandani "Power Electronics" TMH,2008

Course Outcomes:

After learning the course the students should be able to:

1. Understand the difference between linear electronics and power electronics, importance and requirement of power electronics in engineering field.
2. Understand different power electronics switches, their applications and their protection circuits.
3. Analyze the performance of different types of motor control techniques.
4. Understand significance of different types of power supply and its various applications.
5. Understand significance of heating, welding process.
6. Apply the conceptual knowledge for various applications.

List of Practical and Open Ended Problems: (As assigned by concerned teacher).

1. To study the static/dynamic characteristics of power electronics device(s).
2. To study the Protection of power devices.
3. Design of an UPS configuration.
- 4 To study the Induction heating system.
5. To study the performance of Dielectric heating.
6. To study the performance of Welding methods.
7. Design of an SMPS.
8. Design of a Linear Regulated Power Supply .
9. Simulation of DC machine and drives system.
10. Simulation of AC machine and drives system.

Major Equipments:

DSO (Power Scope), Probes, Trainer Kits, other basic equipments like meters, load-banks, motors, variable Power Supply, etc.

List of Open Source Software/learning website:

Open Source Software:

- Sci-Lab

Learning website:

- <http://nptel.iitm.ac.in/courses.php>

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