

Topics by Lecture

Text: "Power Electronics: circuits devices and applications" by M. Rashid, Pearson Prentice Hall, third edition. (44 class meetings)

UNIT 1

1. Introduction to the Class; Course overview.
2. Power Semiconductors and Diodes: Diode characteristics, recovery dynamics; diode types, diode models; current and voltage sharing, snubber circuits (2.1-2.8).
3. Diode Rectifiers: Single-phase, half-wave rectifiers, performance parameters, harmonics; continuous discontinuous conduction (3.1-3.3).
4. Single-phase full-wave rectifiers: performance analysis, harmonics, continuous and discontinuous conduction (3.4-3.5).
5. Rectifier circuit design: Ratings; ripple reduction, dc filters, L and C filters (3.10-3.12).
6. Multi-phase rectifiers, star rectifiers; three-phase bridge rectifiers; performance, RL load, harmonics (3.6-3.9).
7. Thyristors: Characteristics, turn-on and turn-off dynamics; thyristor types, GTO, MCT (7.1-7.6).
8. Controlled Rectifiers: phase control, single-phase full converter with R load, performance (10.1-10.3).
9. Single-phase full converter with an RL load (10.3).
10. Three-Phase half-wave Converter (10.5). Three-phase full converter, performance (10.6).
11. Review of the Fourier series, power converter harmonics.
12. Power Transistors: brief overview of BJT, MOSFET, IGBT: characteristics of BJT (4.1-4.2); MOSFET characteristics (4.3); IGBT characteristics (4.6); series and parallel operation, protection, models (4.7-4.9).
13. DC-DC Converters: Step-down operation, duty cycle, converter with RL load (5.1-5.3).
14. Step-up operation: converter with R load, performance (5.4-5.6).
15. DC-DC Converters: Converter classification (5.7).
16. Switching mode regulators: Buck regulators, boost regulators (5.8). Examples.
17. Buck-boost regulator (5.8). Example.
18. Cuk regulator; multi-output boost converters, rectifier-fed boost converters (5.9-5.11).
19. Chopper circuit design (5.12), examples.

UNIT 2

20. DC Power Supplies fly-back converter (14.1-14.2).
21. DC power supplies: forward converter, push-pool converter (14.2).
22. DC power supplies: Half-bridge, full-bridge and bidirectional power supplies (14.2).
23. DC-AC Conversion: The half-bridge inverter, principle of operation, resistive, lagging and leading load, harmonics (6.1-6.3).
24. The full-bridge inverters, single 180- and 120-deg conduction (6.4, 6.5.1, 6.5.2).
25. Single-pulse width modulation for the full-bridge inverter, (6.6.1). Examples.
26. Multiple and sinusoidal-pulse-width modulation unipolar output (6.6.2, 3).
27. Three-phase half-bridge inverters, square pulse and PWM schemes (6.8.1-3)
28. Examples—three-phase inverters.
29. AC Power Supplies: Switched-mode supplies; multistage conversions (14.3-14.4).
30. Three-phase supplies. Control and protection issues (notes).
31. Examples
32. Drives: DC Drives, control of the shunt dc motor (15.1-15.3 and notes).
33. Single-phase dc drives (15.4)
34. Examples
35. AC Drives: Induction motor performance characteristics, model equations (16.1-16.2).
36. Induction motor control: Stator voltage control (16.2).
37. Frequency and voltage-frequency control (16.2).
38. Rotor voltage control, static Kramer drive (16.2).
39. Closed-Loop Control: overview of scalar and vector control methods (16.3-16.4).
40. Examples
41. Exam Review
42. Final Exam (May 7)