

## ECE 483/583 TOPICS by LECTURE

Text: "Power Electronics: circuits devices and applications" by M. Rashid, Pearson Prentice Hall, third edition.

**(There will be 44 regular class meetings in the Spring 2009)**

### UNIT 1

1. Introduction to the Class; Course overview (**January 12**).
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. 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).
12. DC-DC Converters: Step-down operation, duty cycle, converter with RL load (5.1-5.3).
13. Step-up operation: converter with R load, performance (5.4-5.6).
14. DC-DC Converters: Converter classification (5.7).
15. Switching mode regulators: Buck regulators, boost regulators (5.8). Examples.
16. Buck-boost regulator (5.8). Example.
17. Cuk regulator; multi-output boost converters, rectifier-fed boost converters (5.9-5.11).
18. Chopper circuit design (5.12), examples.
19. Exam Review
20. **MID-TERM EXAM (Friday Feb 20<sup>th</sup>)**

### UNIT 2

21. DC Power Supplies fly-back converter (14.1-14.2).
22. DC power supplies: forward converter, push-pool converter (14.2).
23. DC power supplies: Half-bridge, full-bridge and bidirectional power supplies (14.2).

24. DC-AC Conversion: The half-bridge inverter, principle of operation, resistive, lagging and leading load, harmonics (6.1-6.3).
25. The full-bridge inverters, single and three-phase, 180- and 120-deg conduction (6.4, 6.5.1, 6.5.2).
26. Examples.
27. Voltage Control of Single-Phase Inverters: Single-pulse width modulation for the full-bridge inverter, unipolar scheme (6.6.1). **(Project Assignment, March 16<sup>th</sup>)**
28. Multiple-pulse-width modulation (6.6.2).
29. Examples.
30. Sinusoidal pulse-width modulation unipolar scheme (6.6.3).
31. Sinusoidal PWM for three-phase inverters bipolar schemes (half-bridge) (6.8.1-3).
32. Selective Harmonic Reduction bipolar and unipolar schemes (6.9).
33. Examples.
34. AC Power Supplies: Switched-mode supplies; multistage conversions (14.3-14.4).
35. Three-phase supplies. Control and protection issues (notes).
36. Drives: DC Drives, control of the shunt dc motor (15.1-15.3 and notes).
37. Single-phase drives (15.4)
38. AC Drives: Induction motor performance characteristics, model equations (16.1-16.2).
39. Induction motor control: Stator voltage control (16.2).
40. Frequency and voltage-frequency control (16.2).
41. Rotor voltage control, static Kramer drive (16.2).
42. Closed-Loop Control: overview of scalar and vector control methods (16.3-16.4).
43. Examples **(Projects are due, April 29<sup>th</sup>)**
44. **Exam Review (May 1<sup>st</sup>)**