

BITS, PILANI – DUBAI CAMPUS
Knowledge Village, Dubai
Year III – Semester II 2003 – 2004
Comprehensive Exam (Closed Book)

Course No.: EEE UC 461 / INSTR UC 461 Course: Power Electronics
09 - 06 - 04 Time: 3Hrs. M.M. = 60 Weightage = 40 %

(Answer all questions from Part A , any five from Part B and any five from Part C)

Part A : Each question carries one mark

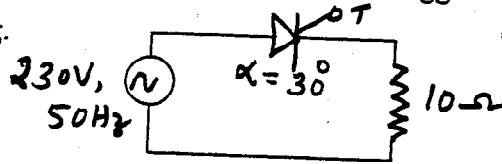
- A1. A Schottky diode is used for
- a) high voltage rectification
 - b) low reverse current
 - c) low current application
 - d) high frequency low voltage application
- A2. A MOSFET has
- a) high switching speed, low drive power and low on state drop
 - b) high switching speed, low drive power and high on state drop
 - c) low switching speed, low drive power and low on state drop
 - d) low switching speed, high drive power and high on state drop
- A3. Draw the two transistor model representation of a thyristor with terminal markings.
- A4. What is a controlled rectifier?
- A5. What is a cycloconverter drive?
- A6. What do you mean by servo drives?
- A7. What is a dc chopper?
- A8. The regulation of the output in switched mode regulators are normally achieved by _____
- A9. A series resonant converter behaves like a _____ and at resonant frequency, the converter gain is _____
- A10. Harmonic elimination in the PWM inverters can be done by _____ and _____

Part B : All Questions carry 2 marks each

- B1. Briefly explain the performance characteristics of IGBTs
- B2. What is a buck converter? What are its advantages and disadvantages?
- B3. Explain the basic principle of Sine-PWM inverter using bipolar switching.
- B4. Explain the methods used for the controlled rectification in a single phase full bridge AC to DC converter with constant output current.
- B5. Explain the performance characteristics of a series resonant converter.
- B6. With the help of an appropriate block diagram, explain the operation of an uninterruptible power supply system.

Part C : All questions carry 8 marks each

- C1. A line commutated thyristor shown in the figure below is triggered at an angle α of 30° with respect to zero crossing.



Sketch the output current, voltage and thyristor voltage waveforms. Also calculate the average output voltage and average output current.

- C2. In a step up / boost converter, the duty ratio is adjusted to regulate the output voltage V_o at 48V. The input voltage varies in a wide range from 12V to 36V. The maximum power output is 120W. For stability reasons, it is required that the converter always operate in a discontinuous conduction mode. The switching frequency is 50 kHz. Assuming ideal components and 'C' as very large, calculate the maximum value of 'L' that can be used.
- C3. Draw the circuit and explain the mode operation of a single phase full bridge voltage source Inverter. *with square wave switching -* Also derive its performance characteristics (T_{vv} , T_{ii})
- C4. A three phase fully controlled bridge converter is fed by a supply voltage of 230V, 50 Hz. Assuming continuous load current and a thyristor voltage drop of 1V determine the average load voltage at firing angles of 30° and 45° . Plot the waveform of the thyristor voltages at a firing angle of 60° .
- C5. What is a resonant converter? Draw and explain the different modes of operation of a series resonant DC-DC converter with voltage sink in the discontinuous conduction mode.
- C6. a) Explain the general requirements of a power supply. With a block diagram, explain the operation of a DC power supply system.
b) Explain the adjustable speed control of Induction motor drives. Why do you need soft start in Induction motor drives?

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Test II (Closed Book)

Course No.: EEE UC 461 / INSTR UC 461 Course: Power Electronics
23 - 05 - 04 Time: 50 Minutes M.M. = 20 Weightage = 15 %

(Each question carries 5 Marks)

1. Show that the state plane trajectory of the steady state response of a series resonant tank circuit under voltage excitation is a circle with center as $(-1, 0)$
2. Explain the continuous conduction mode of operation of parallel resonant converters with neat circuit diagrams and their equivalent simplified circuit models. Explain the waveform also for a single switching period.
3. Explain the different modes of operation of an Induction motor speed control drive system. With the help of a block diagram, explain the control algorithm used in servo drives using Induction motors.
4. Explain the switching characteristics of a power diode

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Test I (Closed Book)

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11 - 04 - 04 Time: 50 Minutes M.M. = 40 Weightage = 20 %

- 1(a). Explain the various basic topologies of switched mode power converters.
- (b). A Buck-Boost converter operating in CCM has following parameters
 $V_s = 12 \text{ V}$, $L = 250 \text{ uH}$, $R_L = 20 \text{ ohms}$, $C = 470 \text{ uF}$, $f_s = 20\text{kHz}$, $D = 0.7$
- i) Determine v_o
 - ii) sketch the inductor current i_L
 - iii) Determine the peak-peak voltage ripple in the output
 - iv) Find the minimum L for which the converter would move to DCM operation (4+6)
2. What is a fly-back converter? With the help of a neat circuit diagram, explain the operation of a fly-back converter and draw the waveforms of magnetizing current and voltage across the magnetizing inductance. (2 + 2 + 4 + 1 + 1)
3. What are the methods of harmonic elimination used in inverters. Explain how notching can be used to eliminate third harmonic from the output? (3 + 7)
- 4(a). Briefly explain the methods by which the output voltage of a controlled AC – DC converter can be varied.
- (b). Draw the output voltage waveform of a three phase AC-DC full wave controlled rectifier with $\alpha = 90^\circ$ supplied from a star connected three wire source. (3 + 7)
