BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BE
BRANCH: EEE

SEMESTER : VII/BL
SESSION : MO/13

SUBJECT: EE7101 APPLIED POWER ELECTRONICS

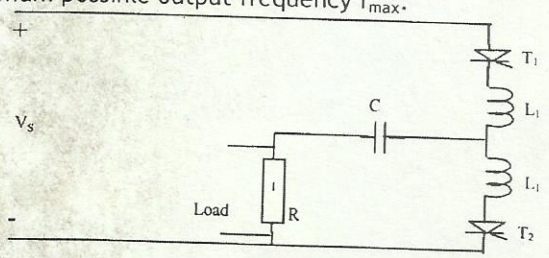
TIME: 3.00 HOURS

FULL MARKS: 60

INSTRUCTIONS:
1. The question paper contains 7 questions each of 12 marks and total 84 marks.
2. Candidates may attempt any 5 questions maximum of 60 marks.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q1. (a) Name a few devices from gate triggered (Thyristor) family and gate commutating devices. [2]
(b) Draw the switching equivalent circuit of a power MOSFET and explain the turn-on and turn-off operations with the help of waveforms. [4]
(c) Draw the simplified gate drive circuit of a GTO and briefly explain how its turn-on and turn-off operations take place. What is the direction and approximate magnitude of the gate current during turn-off w.r.t. its anode current? [6]

Q2. (a) Explain how resonant converters overcome the problem of switching losses in inverters. [2]
(b) Draw and briefly explain the operation of a full bridge series resonant inverter with bi-directional switches. Show the current waveform through the load and indicate which devices are carrying the current in different time segments. [4]
(c) For the basic series resonant inverter circuit shown below L1 = L2 = L = 50 μH, C = 6μF, R = 2Ω, V_S = 220V, frequency of output voltage f_0 = 7kHZ and turn-off time of thyristor t_q = 10μs. Write expressions and find values of (i) resonant frequency - fr, (ii) available turn-off time (dead time) t_{off} and (iii) maximum possinle output frequency f_{max}. [6]



Q3. (a) Explain why pulse transformers/opto-isolators are required to drive power semiconductor devices used in converter/inverter circuits? [2]
(b) Draw the diagram of a synchronized UJT gate triggering circuit for phase control of a Thyristor and explain how the delay angle is controlled. [4]
(c) Explain the principle of ideal dual converter with the help of simplified equivalent diagram and derive the relationship between the firing angles of two converters. [6]

Q4. (a) What are the advantages and disadvantages of Pulse Width Modulation (PWM) technique? [2]
(b) Write a short note on advanced modulation techniques. [4]
(c) With the help of a neat diagram show how Sinusoidal PWM technique generates variable pulse width, proportional to amplitude of a sine wave, at the output of an inverter. Write expressions for amplitude modulation index and frequency modulation ratio. [6]

Q5. (a) What are the applications of Current Source Inverters (CSI)? [2]
(b) What are the different modes of operation of a CSI for synchronous and induction motors? What are ranges of firing angle for these modes of operation? [4]
(c) Compare the advantages and disadvantages of Current Source Inverter (CSI) with respect to Voltage Source Inverter (VSI). [6]

Q6. (a) What is the role of Flexible AC Transmission Systems (FACTS)? [2]
(b) Explain the principle of Thyristor Switched Capacitor (TSC) in a transmission line. [4]
(c) Draw the schematic diagram and explain the operation of a series static VAR compensator (SSVC). [6]

Q7. (a) What is MEMS (Micro-Electro-Mechanical System)? What is the lateral dimension range of a classical MEMS? [2]

PTO

(b) What are the advantages of MEMS as a manufacturing technology? List some of the important technological discipline whose design, engineering and manufacturing expertise are utilized in MEMS. [4]

(c) Write short notes on application of MEMS for the following: [6]
- Automotive airbag sensor
- Inkjet printer head
- New MEMS applications

::::: 12.11.2013 :::::M