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

CLASS: MTECH **SEMESTER : III**
BRANCH: EEE **SESSION : MO/19**

SUBJECT: EE603 POWER ELECTRONICS SYSTEM DESIGN

TIME: 3 HOURS **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
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.

Q.1(a) Define volt -second balance law. Explain with proper waveforms and mathematical expression of the law for design of an inductor in case of an SMPS. [5]

Q.1(b) Derive the expression for Inductor (L) for a Buck-Converter feeding a resistive load (R) such that per unit ripple current $\Delta I0I0 \ll 1$where I_0 is average output current. Consider switching period of 'T_S' seconds and duty cycle of 'D'. [5]

Q.2(a) Compute area product, number of turns, cross section of wire, and air gap for design of an E-Core inductor of 20μH capable of conducting 5Amp average DC current. Assume maximum flux density of the core to be 0.2 Tesla, current density of wire to be 3Amp/mm^2, permeability of the air-gap to be $4\pi \times 10^{-7} H/m$. [5]

Q.2(b) Derive relationship between input and output voltage of a Boost Converter for Discontinuous Conduction Mode. [5]

Q.3(a) Apply concepts of basic DC-DC converters to design a topology for non-isolated bidirectional DC-DC converter. Explain its operation in bidirectional power flow. [5]

Q.3(b) Draw a power circuit for bidirectional DC-DC converter with isolation between input and output side. Explain its operation in bidirectional power flow. [5]

Q.4(a) Draw a voltage waveform, load current waveform and firing pulses for a three phase controlled rectifier, with firing angle of $\frac{\pi}{6}$ Rad. [5]

Q.4(b) Evaluate harmonic contents present in output voltage of a three phase controlled rectifier under continuous load current. [5]

Q.5(a) Design a closed loop control of three phase inverter using block diagram in order to maintain a desired output RMS voltage and desired line frequency. Explain its operation. [5]

Q.5(b) Design an analogue electrical circuit in order to explain heat dissipation in power semiconductor devices. [5]

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