Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

II SEMESTER M.TECH. (ELECTRIC VEHICLE TECHNOLOGY)

MAKE UP EXAMINATIONS, JUNE 2024

POWER CONVERTERS FOR ELECTRIC VEHICLES [ELE 5415]

Time: 3 Hours **Date: 21 June 2024** **Max. Marks: 50**

1A. With the help of circuit topology, switching sequence, and output voltage waveforms, explain the working of an H bridge inverter selecting a simple square wave switching scheme. **(05)**

1B. A single phase fully controlled rectifier is supplied with 230V 50Hz AC supply. Considering a DC motor armature as the load, and enough filter inductance is added for continuous conduction,

a) Calculate the average output voltage of the rectifier at a firing angle of 45 degrees.
b) Draw the waveforms of output voltage and current.
c) Suggest few methods to ensure continuous conduction **(05)**

2A Consider the listed single phase converters. Differenciate them based on the devices used and the possible quadrants of operation. Also draw the output voltage waveform in each case at a suitable firing angle with RLE load.

a) Uncontrolled rectifier c) Fully controlled rectifier. **(05)**

2B. Does interleaved DC-DC converter is able to achieve bidirectional feature? Justify your answer. Also explain the circuit topology and working. **(05)**

3A. What is the concept behind inductive charging? Explain each stage of the converter configuration with an inductive charging system with suitable schematic diagram. **(05)**

3B. Consider a single-phase fully controlled bridge rectifier feeding the armature of a separately excited DC motor. The power supply to the rectifier is 240 V, 50Hz. The motor needs to be operated at the rated speed. At what firing angle, the rated speed can be achieved?

Motor ratings: 220V, 16A, 1000rpm, Armature winding resistance is 1.1 Ω. Assume continuous conduction. **(05)**

4A. Consider a three-phase H bridge inverter configuration.

a) Explain the working of the converter with sinusoidal PWM switching scheme.
b) Also draw and explain the harmonic spectrum of the output voltage. **(05)**

4B. What is the input-output voltage relationship of a boost DC-DC converter. Derive the expression for the same.

A DC link voltage needs to be maintained at 220 V for an application where the battery bank can provide 80V. What should be the duty cycle of operation of a boost converter which is used for this conversion. **(05)**

5A. Demonstrate the need of powerfactor correction, in electric vehicle charging system, with the help of suitable block schematic diagrams. Also differentiate the terms, distortion power factor & displacement power factor. **(05)**

5B. Write a technical note on Matrix converter and its application in electric vehicles **(05)**