Reg. No.



(A constituent unit of MAHE, Manipal)

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

II SEMESTER M.TECH. (ELECTRIC VEHICLE TECHNOLOGY) END SEMESTER EXAMINATIONS, APRIL -MAY 2024

POWER CONVERTERS FOR ELECTRIC VEHICLES [ELE 5415]

Time: 3 I	Hours Date: 05 May 2024	Max. Marks: 50
Instructions to Candidates:		
*	Answer ALL the questions.	
*	Sine graph may be used	
1A.	'A multilevel inverter is a good choice for high voltage vehicle d where lesser total harmonic distortion is required.' Justify statement with the help of circuit topology, switching sequence,	rives this and
	output voltage waveforms of multilevel inverters.	(05)
1B.	A three phase fully controlled rectifier is supplied with 415V 50H supply. Considering a DC motor armature as the load, and enough inductance is added for continuous conduction,	z AC filter
	 a) Calculate the average output voltage of the rectifier at a firing a of 30 degrees. b) D and the manufacture for the device and a second secon	ingle
	c) Draw the waveforms of output voltage and current.c) Analyse the factors that can affect the continuity in conduction	? (05)
2A	Differenciate the listed converters based on the devices used and possible quadrants of operation. Also draw the output voltage wave in each case at a suitable firing angle with RL load.	the form
	a) Uncontrolled rectifierb) Half controlled rectifierc) Fully controlled rectifier.	(05)
2B.	Analyze the operation of an interleaved DC-DC converter circuit w bidirectional feature and discuss how it is suitable for Electric Ve	ith a hicle
	applications.	(05)
3A.	Suggest any converter configurations for an electric vehicle cha with power factor correction. Explain each stage of the system suitable schematic diagram.	arger with
	Is the true power factor less than displacement power factor of 0.8 with a THD of 2%? Justify your answer	lag, (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 230 V, 50Hz. The motor needs to be operated in a range of speed more than half of the rated speed to rated speed at full load. Suggest the range of firing angle of the converter to achieve this speed range.

Motor ratings: 200V, 18A, 1200rpm, Armature winding resistance of 1.1 Ω , Back emf constant 1.8 V/(rad/sec). Assume continuous conduction.

Also, draw and analyze the waveforms of armature voltage and current at this condition.

(05)

- **4A.** A single-phase H bridge inverter needs to operate with minimum total harmonic distortion.
 - a) Suggest a suitable switching scheme which results in less amount of harmonics in the output voltage?
 - b) Explain the working of the converter with suggested scheme using the waveforms of the control signals and input-output voltages.
 - c) Also draw and explain the harmonic spectrum of the suggested method.

(05)

(05)

(05)

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

A DC link voltage needs to be maintained at 110 V for an application where the battery bank can provide 80V. What should be the duty cycle of operation of a buck-boost converter which is used for this conversion. **(05)**

- **5A.** Demonstrate the use of SEPIC converter topology in electric vehicles. Discuss the features, circuit schematic and working.
- **5B.** Can Matrix Converter topology help in providing bidirectional contactless interfaces between Electric Vehicle and Grid?

Justify your answer with the help of circuit schematic diagram of the topology.