Registration No: | | | | | | | | | | |

Total Number of Pages: 02 **M.TECH**
P2PRCC11

2nd Semester Regular Examination 2016-17
ELECTRIC DRIVES IN HYBRID VEHICLE

BRANCH: ELECTRIC& ELECTRONIC ENGG (POWER SYSTEM ENGG), ELECTRICAL AND ELECTRO ENGG, ELECTRICAL ENGG., ELECTRICAL POWER SYSTEM, ENERGY SYSTEMS ENGG, INDUS. POWER CONTROL AND DRIVES (PT), POWER AND ENERGY ENGG, POWER ELECTRONIC, POWER ELECTRONIC & DRIVES, POWER ELECTRO AND ELECTRICAL DRIVES, POWER ELECTRONIC AND POWER SYSTEMS, POWER ENGG AND ENERGY SYSTEMS, POWER SYSTEM ENGG, POWER SYSTEMS

Time: 3 Hours
Max Marks: 100
Q.CODE: Z962

Answer Question No.1 which is compulsory and any FOUR from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: ***Short answer type*** **(2 x 10)**

a) Why the cost of Hybrid Electric Vehicles (HEVs) and Plugged-in Hybrid Vehicles (PHEVs) is significantly more as compared to their gasoline counterparts? Give any two reasons.

b) What is the CAFÉ standard average fuel economy set by the US government, in its announcement in 2009, for all the car manufacturers to achieve?

c) What will be the fuel consumption for travelling a distance of 100 km in MPG (MPG= Miles Per Gallon) for a car that consumes 1.5 litres of gasoline while travelling 64 km distance?

d) What will be the hybridization ratio of a hybrid electric vehicle with a motor rated at 50 kW and an engine rated at 75 kW?

e) Name any four non- propulsion loads in an electric vehicle.

f) What percentage of rms AC input voltage in magnitude will be available as average output voltage at the output terminals of a single-phase bridge rectifier using ideal diodes?

g) Write down the expression for the output voltage V_o of a buck converter with an input DC voltage V_d and a duty cycle D.

h) By what percentage the average output voltage in case of a three-phase bridge rectifier using ideal diodes will be more than the rms value of its line-to-line input voltage?

i) The energy- contents of 1 gallon of gasoline is equal to 33.7 kWh. The efficiency of electricity generation equals to 30.3%. Calculate the Well-to-Wheel Efficiency of an Electric Vehicle that consumes energy of 240 Wh per mile.

j) The induction motor used in driving a battery vehicle will develop no electromagnet torque on its own when the rotor speed becomes equal to the synchronous speed. Justify the statement with brief explanation.

Q2 **a)** Discuss the various factors responsible for the development of the Electric Vehicles (EVs). **(10)**

b) Discuss in detail how a Hybrid Electric Vehicle (HEV) differs from an Electric Vehicle (EV) as far as its working principle is concerned. **(10)**

Q3 **a)** Discuss the various reasons responsible for the commercial failure of the Electric Vehicles (EVs). **(10)**

b) Discuss the series and parallel architectures of Hybrid Electric Vehicles (HEVs) with the help of block diagrams and make a comparison between them. **(10)**

Q4 **a)** A 250 V, 15 kWh battery pack has an internal impedance of 0.25 ohm. The motor-inverter combination has an overall efficiency of 92% and rated output of 110 kW. The rated current is 250 A on the DC side of the inverter. Calculate the (i) the battery terminal voltage, (ii) battery output power and (iii) the power lost in the battery pack, while the battery pack is delivering the rated current of 250 A. **(10)**

b) Explain the terms 'Well-to-Wheel Efficiency' and 'Utility Factor' as defined in case of Plug-in Hybrid Electric Vehicles (PHEVs). **(10)**

Q5 **a)** Describe the operating principle of a Buck Converter used in Hybrid Electric Vehicles (HEVs). Show the circuit diagram and explain. Write down the expression for the voltage ripple assuming constant load current. **(10)**

b) Differentiate between the continuous and discontinuous modes of operation of a single-phase practical bridge rectifier used in a Hybrid Electric Vehicle (HEV). Write down the expression for the AC side current in the continuous mode. **(10)**

Q6 **a)** Describe the operating principle of a Non-isolated Bidirectional DC-DC Converter used in Hybrid Electric Vehicles (HEVs). Show the circuit diagram and explain both the (i) Buck operation and (ii) Boost operation. **(10)**

b) Derive the expression for the output voltage obtained from a 3-phase ideal bridge rectifier using simple power diodes. Draw the input and output voltage waveforms associated with this rectifier. **(10)**

Q7 **a)** Derive the equivalent circuit of a three phase induction motor. Write down the expression for stator input current and the electromagnetic torque developed in terms of its equivalent circuit parameters. Draw its speed-torque characteristic. **(10)**

b) Describe the principle of operation of a Switched Reluctance Motor (SRM). Write down the expression for the 'Torque developed' in this SRM fed with sinusoidal supply. **(10)**