Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOV 2019

SUBJECT: HYBRID and ELECTRIC VEHICLES [MTE 4004]

(28/11/2019)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed
- Graph sheets will be provided

1A.	Mention various power plants used in conventional vehicles and discuss their advantages and disadvantages. Describe the effect of "τ" and "υ" product on torque and power characteristics of IC Engine.	**04**	**CO2**
1B.	Discuss the working, advantages and disadvantages of fuel cell based and solar based vehicles. List out few EV and HEV available in present day market.	**06**	**CO4**
2A.	A open convertible vehicle is having following coefficients (Rolling resistance coefficient = 0.01, air density = 1.27 kg/m^3, rotational inertial constant = 0.04, Mass of vehicle 1500kg). Calculate the following: a) Grading and rolling resistive forces when vehicle has the gradeability to cover vertical elevation of 3.411m with the horizontal distance of 20m. b) Aerodynamic drag when vehicle is at 100km/hr. c) Calculate the accelerating force by the vehicle to accelerate from 30kmph to 60kmph.	**03**	**CO2**
2B.	Discuss how an Induction motor can achieve EV characteristics.	**04**	**CO3**
2C.	In an Electric Vehicle Wheel, PMDC motor running at a velocity of 60 km/hr as shown in **Fig.2c**. The wheel has a maximum Mass of 11.42 kg on shaft and has efficiency of 85% running at rated 1500rpm. Estimate the max torque & shaft power of the motor. Find the torque, if the motor is operated in constant power region and is operated with maximum cruising speed for PMDC motor.	**03**	**CO3**

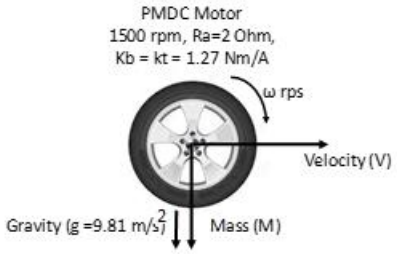

Fig. 2c

3A.	Describe the advantages of switched reluctance machine with a neat constructional diagram. Also explain the switching for motoring and generating modes in EV.	**05**	**CO3**
3B.	Compare the economic and environmental aspects of conventional and hybrid vehicles. Justify the statement "Energy within the vehicle is the key need in EV technologies".	**05**	**CO1**
4A.	Sketch the basic configurations of HEV systems and depict the power flow in the block diagrams.	**04**	**CO1**
4B.	Discuss the energy requirements of conventional and HEV in combined, urban and highway driving.	**03**	**CO3**
4C.	Explain the complete closed loop control of EV and illustrate why we need drive cycles.	**03**	**CO4**
5A.	A pure EV is redesigned to extend the range of the vehicle as depicted in **Fig.5a** with the total vehicle propulsion power of 106.66 kW. i) Identify the type of vehicle and estimate the power rating of the motor, peak output and intermittent output. ii) If the vehicle motor has to be designed with the desired volume specification as shown in **Fig.5b**, magnetic flux density of 1.5 Tesla, 480 Ampere turns, proportional constant of 19.64, Calculate the rated speed of the Motor. iii) The vehicle is designed for maximum cruising speed of 62.1371 miles per hour, gear ratio of 3.393 and vehicle tyre radius on 11.81 inches. Evaluate the maximum speed of the motor and recognize suitable motor, converter and voltage rating of the devices and select suitable power device for the converter ratings.	**07**	**CO4, CO2**

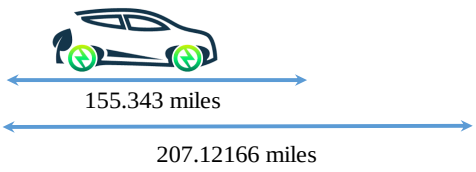

Fig.5a

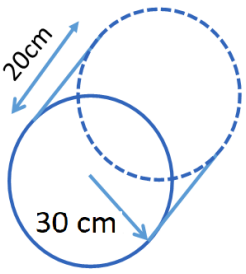

Fig.5b

5B.	Sketch the block diagram of the series & mixed hybrid vehicle and mention various vehicle configurations using Hybridness plot.	**03**	**CO4**