Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: E cars technology **Semester: V**

Program: B.Tech. Electrical Engineering **Time : 03 hrs.**

Course Code: EPEG 3024 **Max. Marks: 100**

Instructions: Assume any missing data

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What is tractive effort. List down different tractive efforts required to pull an EV.	**4**	**CO1**
Q 2	Write down the advantage and limitation of PMSM motor over induction motor.	**4**	**CO2**
Q 3	Enlist the motors being used in EV with their limitations.	**4**	**CO2**
Q 4	Sketch the block diagram depicting the power train components of an EV.	**4**	**CO1**
Q 5	Brief the methods for SOC estimation of EV battery pack.	**4**	**CO2**
SECTION B **(4Qx10M= 40 Marks)**			
Q 6	Describe the Battery Management System (BMS) for electric vehicles with its main components and functions. What are the key challenges faced by Battery Management Systems in electric vehicles?	**10**	**CO3**
Q 7	Interpret the working principle of BLDC motors and how it differs in employing commutation along with applications of two variants of BLDC motors.	**10**	**CO2**
Q 8	Adopt a case study of TATA Nexon EV available in India and derive the value of peak current can be drawn from battery pack and also cross check the total range claimed by the car.	**10**	**CO3**
Q 9	Explain the working principle of a DC chopper and how it is used to control the speed of a DC motor in an EV. What are the advantages of using a chopper to control motor speed? **OR** Explain the pulse-width modulation (PWM), and how it is used in a chopper to control the output voltage. Discuss the benefits of using PWM in a chopper.	**10**	**CO4**
SECTION-C **(2Qx20M=40 Marks)**			

Q 10	Design an electric vehicle that weighs 2,000 kg and needs to achieve a top speed of 80 km/h. The vehicle has four wheels, and each wheel has a radius of 0.3 meters. The vehicle will be powered by an electric motor that has a maximum power output of 150 kW and a maximum rotational speed of 12,000 RPM. The drivetrain has a gear ratio of 8:1. Assume air density of 1.2 kg/m^3, a frontal area of 2 m^2 and no road gradient with acceleration 7.5 m/s^2. (a) Calculate the maximum torque that the electric motor can produce. (b) Determine the total tractive effort required to propel the vehicle at a speed of 80 km/h on a level road. Assume a coefficient of rolling resistance of 0.01 and an aerodynamic drag coefficient of 0.3. (c) Calculate the total torque required to produce the necessary tractive effort at the wheels. (d) Determine whether the electric motor is capable of providing the necessary torque to propel the vehicle at a speed of 80 km/h. **OR** Design a battery pack for an electric vehicle that requires a range of 200 miles on a single charge. The battery pack voltage is 400V, and the total energy required is 60 kWh. The battery cells have a nominal voltage of 3.6V and a capacity of 3.5 Ah. (a) Calculate the total number of cells needed to achieve the required energy storage capacity of the battery pack. (b) Determine the configuration of the battery pack that will achieve the required voltage and energy capacity. Assume that the cells will be arranged in series and parallel combinations. (c) Calculate the total weight of the battery pack based on the weight of each individual cell, and assume a cell weight of 50 grams. (d) Determine the size of the battery pack, assuming a cell size of 18mm x 65mm.	**5*4**	**CO4**
Q 11	You are a design engineer at a leading automotive company tasked with designing a new battery electric vehicle (BEV). The company has decided to enter the BEV market to meet the increasing demand for environmentally friendly vehicles. Your team has been given a budget of $500 million and a timeline of two years to design and produce the new vehicle.	**20**	**CO3**

	Task: Design a BEV that meets the following specifications: A driving range of at least 300 miles on a single charge. A top speed of at least 100 mph. A 0-60 mph acceleration time of less than 6 seconds. A passenger capacity of at least 4 people. A cargo capacity of at least 15 cubic feet.		