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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

TEST 1

Winter Semester: 2021 - 22

Course Code: EEE 1005

Course Name: Electric Vehicles and Battery Technology

Program & Sem: B.Tech & IV Sem

Date: 27th April 2022

Time: 03:00 PM to 04:00PM

Max Marks: 30

Weightage: 15%

Instructions:

- (i) Read the all questions carefully and answer accordingly.
- (ii) Question paper consists of 3 parts.
- (iii) Scientific and Non-programmable calculators are permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries THREE marks.

(3Qx 3M= 9M)

1. A vehicle, consisting of thousands of components, is a complex system. To describe its behavior fully, sophisticated mechanical and mathematical knowledge is needed. List the parameters based on which the vehicle's driving performance is usually evaluated
(C.O.No.1) [Bloom's level: Knowledge]
2. If we have a vehicle which is normally driving at 100 kilometers per hour and if we increase the speed to 110 kilometer per hour, what will be its effect on the energy supplied by the battery?
(C.O.No.1) [Bloom's level: Knowledge]
3. Identify the statements that are true/false from the following statements.
 - A) If the vehicle speed is doubled, the aerodynamic power required goes up by a factor of four.
 - B) If the vehicle speed is doubled, the aerodynamic power required goes down by a factor of four.
 - C) Mud road has higher rolling resistance compared to tar road.

(C.O.No.1) [Bloom's level: Knowledge]

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries SIX marks.

(2Qx6M=12M)

4. There are a variety of possible EV configurations due to the variations in electric propulsion characteristics and energy sources. Distinguish the significance of those configurations.

(C.O.No.1) [Bloom's level: Comprehension]

5. Mr. Roy wants to convert his existing internal combustion engine vehicle (ICEV) into an electric vehicle (EV) by replacing the internal combustion engine and fuel tank with an electric motor drive and battery pack while retaining all the other components. Mr. Roy asked you because you know about the electric vehicles. Explain the way you are going to respond to Mr. Roy with necessary discussion. (C.O.No.1) [Bloom's level: Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries NINE marks.

(1Qx9M=9M)

6. Mr. Mithun wants to select the power rating of a motor for a two wheeler electric vehicle design with the following specifications. He wants the electric vehicle to run at speed of 60 kilometer per hour with the drag coefficient of 0.3, frontal area of 5 meter square, air density of 1.25 kg per meter, weight of the vehicle during running condition is 200kg, gradient angle is 3 degrees and the wheel radius is 0.29m. State the parameters that are to be considered by Mr. Compute the minimum power rating of motor has to be selected by Mr. Mithun to have propulsion on flat roads and hill climbing according to the above specifications?

(C.O.No.2) [Bloom's level: Application]



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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

TEST 2

Winter Semester: 2021 - 22

Course Code: EEE 1005

Course Name: Electric Vehicles and Battery Technology

Program & Sem: B.Tech (EEE) & IV

Date: 2nd June 2022

Time: 03:00PM-04:00PM

Max Marks: 30

Weightage: 15%

Instructions:

- (i) *Read the all questions carefully and answer accordingly.*
- (ii) *Question paper consists of 3 parts.*
- (iii) *Scientific and Non-programmable calculators are permitted*

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks. (5Qx 2M= 10M)

1. In HEV one powertrain favours steady state operation, such as an ICE or fuel cell. The other powertrain in the HEV is used to supply the dynamic power. The-----drivetrain is used in heavy commercial vehicles, military vehicles and buses. (C.O.No.2) [Knowledge]
- a. Series Hybrid b. Series-Parallel Hybrid
- c. Parallel Hybrid d. Complex Hybrid
2. An Amp-hr is the amount of current a certain battery can supply for a certain period of time. Consider a battery of 36 V with a capacity of 5kWh, battery capacity can be defined by its ampere hour is----- (C.O.No.3) [Bloom's level: Knowledge]
- a. Capacity / voltage b. Voltage * capacity c. voltage / capacity d. all of the above
3. In Series HEV systems, both electric and IC drive trains are connected to the transmission system using electric motor. So during startup or acceleration. (C.O.No.2) [Knowledge]
- a. both the systems will be active b. Only IC engine is active
- c. Only electrical drive is active d. While IC engine is active and battery get charged
4. HEV is a vehicle in which propulsion energy is available from ----- or ----- types of energy sources and at least one of them can ----- electrical energy. (C.O.No.2) [Knowledge]
- a. one, two, deliver b. two, more, deliver c. two, more, dissipates d. two, one, deliver
5. The depth of discharge (DOD) is the fraction of battery capacity that can be used from the battery and will be specified by the manufacturer. If the SoC is 75%, it means

(C.O.No.3) [Knowledge]

- a. the battery is charged 1/4 and the depth of discharge is 25%
- b. the battery is discharge charged 3/4 and the State of charge is 25%
- c. the battery is charged 3/4 and the depth of discharge is 25%
- d. None of the above.

Part B [Thought Provoking Questions]

Answer both the Questions. Each question carries FIVE marks.

(2Qx5M=10M)

- 6. A hybrid vehicle combines any two power (energy) sources. The combination of two power sources may support two separate propulsion systems. Explain the power flow connection of hybrid bus which is travelling from hebbal to Doddaballapur with road constraints of traffic, flyover and highway. (C.O.No.2) [Comprehension]
- 7. A hybrid drivetrain can supply its power to the load by a selective power train. There are many available patterns of operating two power trains to meet the load requirement. Being put yourself as a control engineer and illustratrate the possible ways of combining the power flow to meet the driving requirements of Hybrid drive train system.

(C.O.No.2) [Comprehension]

Part C [Problem Solving Questions]

Answer the Question. The question carries TEN marks.

(1Qx10M=10M)

- 8. Mr. Mathew is working on go-kart project for participating in a competition. He worked out on chassis part, and designing part. Now he wanted to select a Lithium ion battery to drive a motor with power rating of 4.7kW. The battery specifications are: nominal voltage is 72V, Ah capacity is 48Ah, cell capacity of 1.5Ah, battery efficiency is 98%.
 - i. List the parameters that are to be computed in order to understand the requirement of cells and usage of battery.
 - ii. Compute the listed parameters and defend your answer. (C.O.No. 3) [Application]



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**PRESIDENCY UNIVERSITY
BENGALURU**

SCHOOL OF ENGINEERING

END TERM EXAMINATION

Winter Semester: 2021 - 22

Course Code: EEE 1005

Course Name: Electric Vehicles & Battery Technology

Program & Sem: B.Tech – IV Sem

Date: 1st July 2022

Time: 09:30 AM to 12:30 PM

Max Marks: 100

Weightage: 50%

Instructions:

(iv) Read the all questions carefully and answer accordingly.

(v) Question paper consists of 3 parts.

(vi) Scientific and Non-programmable calculators are permitted

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries TWO marks.

(10Qx 2M= 20M)

1.
 - i. A vehicle traveling at a particular speed in air encounters a force resisting its motion. This force is known as [CO2, Knowledge]
a. Tractive force b. Aerodynamic drag c. Rolling force d. Skin drag
 - ii. Higher C (capacity) rates adversely impact the battery life. Higher the charging rating lower will be the life of the battery. For a 10 kWh battery if we charge or discharge at 1C it takes 1 hour time. If we charge at 4C rate then..... (C.O.No.4) [Knowledge]
a. 40 kW charge in 60 min b. 40 kW charge in 30 min
c. 40 kW charge in 15 min d. 40 kW charge in 45 min
 - iii. There are various types of pollutants and greenhouse gases which are released as emission from vehicles and they are the reasons for smoke, and air pollution. (C.O.No.1) [Knowledge]
a. Carbon Monoxide and carbon dioxide b. NOx gases
c. Hydrocarbons d. All of the above
 - iv. The energy flow in EV is mainly via flexible electrical wires rather than bolted flanges or rigid shafts. Electric vehicles are generally powered by () (C.O.No.3) [Knowledge]
a. Aluminum batteries b. Lead acid batteries
c. sodium batteries d. None of the above

- v. An electric battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices. If a battery is wrongly connected on charge following will happen () (C.O.No.4) [Knowledge]
- a. Current delivered by the battery will be high b. Current drawing will be nil
c. Current drawing will be very small d. Current drawing will be very high
- vi. Fuel cells work like batteries, but they do not run down or need recharging. Water is decomposed into hydrogen and oxygen by means of an electric current by the method of (C.O.No.3) [Knowledge]
- a. Electric heating b. Electrolysis c. Electroplating d. None of the option
- vii. A fuel cell consists of two electrodes—a negative electrode (or anode) and a positive electrode (or cathode)—sandwiched around an electrolyte. What is the fuel for a fuel cell? (C.O.No.3) [Knowledge]
- a. Oxygen b. Hydrogen c. Ozone d. Water
- viii. A hybrid vehicle combines any two power (energy) sources. The combination of two power sources may support two separate propulsion systems. What purpose does a generator serve in a hybrid vehicle? (C.O.No.2) [Knowledge]
- a. It converts nuclear energy into more nuclear energy
b. It converts mechanical energy into electrical energy
c. It converts chemical energy into electrical energy
d. It converts electrical energy into mechanical energy
- ix. The capacity of a lead-acid cell does not depend on its (C.O.No.4) [Knowledge]
- a. Rate of charge b. Temperature
c. Rate of Discharge d. Quantity of active material
- x. A vehicle may have regeneration, which converts deceleration of vehicle while climbing down or otherwise applying brakes into regenerative energy. Thus the net energy consumed is $R \times \text{Energy}$, Where R is the regeneration efficiency. The typical range of regeneration factor is (C.O.No.2) [Knowledge]
- a. 15 to 30% b. 10 to 30% c. 85 to 70% d. 15 to 35%

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries TEN marks.

(5Qx10M=50M)

2. Mr. Mathew is working on go-kart project at Presidency University. He worked out on chassis part, and designing part. Now he wanted to select a battery with nominal voltage of 48V, Ah rating is 24Ah for his vehicle and he is not having any idea about batteries which he wanted to purchase. Mr. Mathew approached you regarding the selection of battery. Explain the way you are going to guide him, so that he will be able to choose a battery from variety of batteries. (C.O.No.3) [Comprehension]

3. A vehicle's driving performance is usually evaluated by its acceleration time, maximum speed, and grade ability. In EV drive train design, proper motor power rating and transmission parameters are the primary considerations to meet the performance specification. Suggest suitable motor characteristics for the above design of motor.

(C.O.No.1) [Comprehension]

4. The Road Transport Ministry has asked the Centre for Fire, Explosive and Environment Safety (CFEES) to investigate the fire instances which happened in some states of India in an Ola S1Pro and an Okinawa Praise Pro e-scooters. If you are the test engineer, identify the possible causes for explosion and report the possible measures for avoiding the issues.

(C.O.No.4) [Comprehension]

5. The following figure 1 represents the characteristics of a Li-ion battery which is used in Hero electric scooter. Summarize your observations and impact of these characteristics on the performance of battery.

(C.O.No.3) [Comprehension]

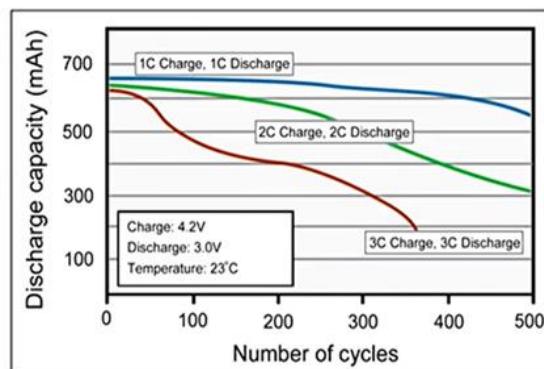


Fig. 1. Characteristics of a Li-ion battery

p Mr. Mathew is working on go-kart project for participating in a competition. He worked out on chassis part, and designing part. Now he wanted to select a Lithium ion battery to drive a motor with power rating of 4.7kW. The battery specifications are: nominal voltage is 72V, Ah capacity is 48Ah, cell capacity of 1.5Ah, battery efficiency is 98%.

i. List the parameters that are to be computed in order to understand the requirement of cells and usage of battery.

ii. Compute the listed parameters and defend your answer.

(C.O.No. 3) [Comprehension]

Part C [Problem Solving Questions]

Answer both the Questions. Each question carries FIFTEEN marks.

(2Qx15M=30M)

7. Mr. Mahendran wants to select the power rating of a motor for a two wheeler electric vehicle design with the following specifications. He wants the electric vehicle to run at speed of 65 kilometer per hour with the drag coefficient of 0.3, frontal area of 5 meter square, air density of 1.25 kg per meter cube, rolling coefficient is 0.02, weight of the vehicle during running condition is 180kg, gradient angle is 3 degrees and the wheel radius is 0.29m. State the parameters that are to be considered by Mr. Mahendran. Compute the minimum power and torque rating of motor which have to be selected by Mr. Mahendran to have propulsion according to the above specifications? (C.O.No. 2) [Application]
8. In lithium batteries, the key to longevity, efficiency and reliability lies in the permanently optimal interaction of the individual cells, modules and packs. A better choice of battery cells and battery design is quite imperative now for all electric vehicles. Illustrate the complete architecture and interfacing of a system which will monitor and control the current, voltage, temperature and isolation conditions of a battery pack in such a way that the life of battery and safety can be achieved. (C.O.No. 4) [Application]