University of Mumbai

Electric and Hybrid Electric Vehicle

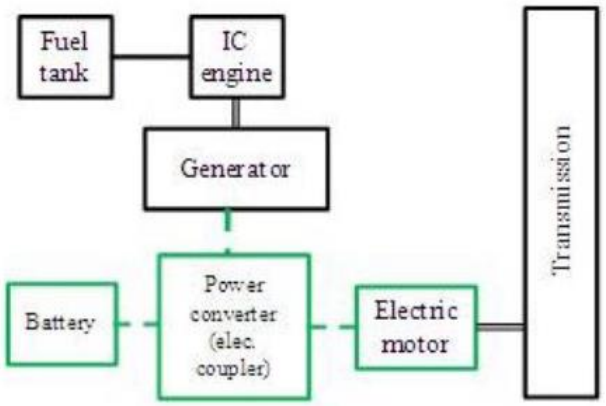
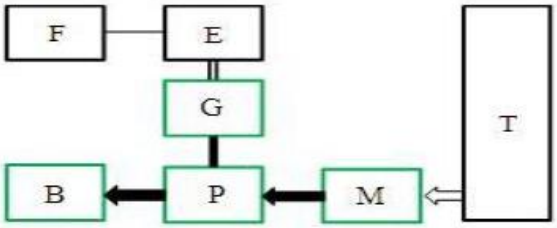
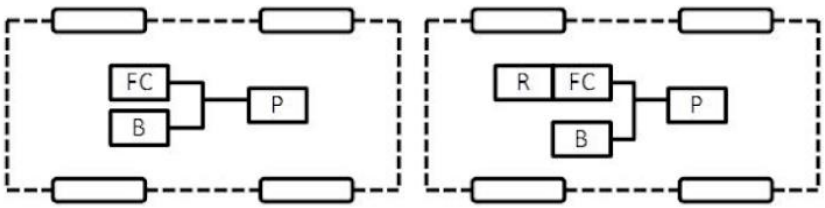
MCQ

Q1. **(20 Marks)**	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	From where tractive effort is generated in EV
Option A:	Battery
Option B:	Converter
Option C:	Driving Shaft
Option D:	Motor
2.	It is difficult to use ultracapacitors alone as an energy storage for EVs and HEVs because of their
Option A:	high specific energy density and the dependence of voltage on the SOC
Option B:	low specific energy density and the dependence of voltage on the SOC
Option C:	low specific energy density and the independence of voltage on the SOC
Option D:	high specific energy density and the independence of voltage on the SOC
3.	In which year battery powered carriage was developed
Option A:	1874
Option B:	1889
Option C:	1857
Option D:	1850
4.	The Fuel Cell provides _____ energy but _____ power
Option A:	High, Low
Option B:	modest, modest
Option C:	modest, low
Option D:	low, low
5.	Gradeability is defined as the maximum _____ angle that the vehicle can overcome in the whole speed range
Option A:	grade
Option B:	raise
Option C:	slope
Option D:	plane
6.	When a vehicle goes up or down a slope, its weight produces a component of force that is always directed _____
Option A:	upwards
Option B:	downwards
Option C:	left ways
Option D:	right ways
7.	Permanent magnet motors with sinusoidal air gap flux distribution are called
Option A:	Permanent Magnet Synchronous Motors
Option B:	Brushless DC motors
Option C:	Brushless AC motors

Option D:	Permanent Magnet induction Motors
8.	The series parallel hybrid systems are classified into two categories _____& the_____
Option A:	Fuel Cell dominated; petrol engine dominated
Option B:	ICE dominated; Electrical Motor dominated
Option C:	Hydrogen cell dominated; petrol engine dominated
Option D:	Hydrogen cell dominated; gas engine dominated
9.	Which strategy is not used in Energy management strategy system
Option A:	Optimization based
Option B:	Rule based
Option C:	Global optimization strategy
Option D:	Regression method
10.	Which Battery are preferred for EV
Option A:	Lead-acid (Pb-acid)
Option B:	Lithium-ion (Li-ion)
Option C:	Sodium-sulphur (NaS)
Option D:	Nickel-cadmium (NiCd)
11.	The rolling resistance of tires on hard surfaces is due to _____ in the tire material
Option A:	Hysterisis
Option B:	Breakdown
Option C:	elasticity
Option D:	flexibility
12.	The Field Oriented Control (FOC) enables the induction machine being controlled alike the
Option A:	separately excited DC Machine
Option B:	Permanent magnet DC machine
Option C:	Switched reluctance machine
Option D:	Stepper motor
13.	Energy Storage allocation on an EV, _____ is the first consideration since it limits the vehicle range.
Option A:	specific energy
Option B:	specific power
Option C:	specific power and specific energy
Option D:	none of these
14.	Which motor is suitable for high starting torque
Option A:	DC Series motor
Option B:	DC shunt Motor
Option C:	DC separately Excited Motor
Option D:	Synchronous Motor
15.	Fuel Cell use combination of
Option A:	Zinc Sulphur

Option B:	Sulphur oxygen
Option C:	Hydrogen Oxygen
Option D:	Sodium Sulphur
16.	Flywheel stores energy in...
Option A:	Chemical form
Option B:	Electrical form
Option C:	Mechanical form
Option D:	Static form
17.	High specific energy, high specific power, long cycle life, high-energy efficiency, quick recharge, maintenance free characteristics, cost effectiveness, and environmental friendliness are the features of_____
Option A:	ultracapacitor
Option B:	battery
Option C:	fuel cell
Option D:	flywheel
18.	Battery that cannot be charged again is called
Option A:	Primary Battery
Option B:	Secondary Battery
Option C:	Nor Primary Neither secondary
Option D:	Both primary and Secondary
19.	A battery labeled 200 Ah at C5 rate has a 200 amp-hour capacity at 5 hours discharge rate the discharging current will be _____.
Option A:	25 Amps
Option B:	22.5 Amps
Option C:	27.5 Amps
Option D:	40 Amps
20.	In Optimal control strategies, the main goal is to_____while respecting the system constraints and specifications.
Option A:	minimize the fuel cost
Option B:	minimize the emissions
Option C:	minimize fuel cost and emissions
Option D:	improve the vehicle performance
21.	Which of the following is not a power source combination for Hybrid electric Vehicles
Option A:	ICE and Battery
Option B:	Battery and Ultra capacitor
Option C:	Diesel and ICE
Option D:	Battery and Fuel Cell
22.	What is the unit of charge capacity in a battery
Option A:	Ahr
Option B:	W hr
Option C:	W/hr
Option D:	W/Ahr

23.	The batteries cannot be recharged simply by reversing the current
Option A:	Li-Ion Battery
Option B:	Lead Acid battery
Option C:	Li-poly Battery
Option D:	Aluminum Air battery
24.	Calculate the mass of the battery in series HEVs when battery power is 59600 kW and specific power of battery is 335 kW/kg
Option A:	177.91 Kg
Option B:	200 Kg
Option C:	229.3 Kg
Option D:	150 Kg
25.	For efficiency reasons_____ would have an optimal operating range in the middle (0.4–0.7) of SOC, and for limited voltage variation reasons, _____ would only have a very limited energy change range (0.8–1.0) of SOC.
Option A:	ultracapacitors, chemical batteries
Option B:	chemical batteries, ultracapacitors
Option C:	chemical batteries, flywheel
Option D:	flywheel, chemical batteries
26.	The ultra-capacitors are characterized by
Option A:	Low specific Energy
Option B:	High specific power and low specific energy
Option C:	High specific energy and high specific power
Option D:	Low specific power and Low specific Energy
27.	If the manufacturer of a 10-kWh battery recommends a maximum DoD of 60 percent, how much kWh we can use without recharging
Option A:	6 kwh
Option B:	60kwh
Option C:	600kwh
Option D:	0.6kwh
28.	_____vehicles are powered by battery only
Option A:	Conventional
Option B:	EV
Option C:	HEV
Option D:	PHEV
29.	First Electric Vehicle was built in
Option A:	1839
Option B:	1800
Option C:	1900
Option D:	1939

30.	The figure shown below indicates which of the following HEV configuration? 
Option A:	Series Parallel
Option B:	Series
Option C:	Parallel
Option D:	Complex
31.	The block diagram below represents which of the following modes of series HEV configuration 
Option A:	Normal Driving mode
Option B:	Light Load mode
Option C:	Braking/Deceleration mode
Option D:	Stop mode
32.	The EV drivetrain shown in the figure represents what type of configuration 
Option A:	Alternatives based on Drivetrain configuration
Option B:	Alternatives based on Power source configuration
Option C:	Alternatives based on Power source and drive train configuration both
Option D:	Independent of power source.
33.	Calculate hybridness of a light delivery van with the propulsion: Diesel engine: 110 kW, Electric motor: 23 kW

Option A:	82%
Option B:	17%
Option C:	21%
Option D:	47%
34.	Enhancing the_____ of the flywheel is the key method of increasing its energy capacity and reducing its weight and volume
Option A:	angular velocity
Option B:	power density
Option C:	characteristic
Option D:	current
35.	The region for a full hybrid is at _____
Option A:	H=25%
Option B:	H=50%
Option C:	H=0%
Option D:	H=100%
36.	For series HEV the relation between acceleration power requirement Pa grade-climbing power requirement Pg is
Option A:	Pa > Pg
Option B:	Pa < Pg
Option C:	Pa =Pg
Option D:	Not related
37.	Aerodynamic drag energy is directly proportional to
Option A:	$Velocity^2$
Option B:	$Velocity^3$
Option C:	Velocity
Option D:	constant
38.	Rolling resistance force is given by relation
Option A:	$F_{RR} = \mu_{rr}$ mg sin θ
Option B:	$F_{RR} = \mu_{rr}$ mg cos θ
Option C:	$F_{RR} = \mu_{rr}$ mg tan θ
Option D:	$F_{RR} = \mu_{rr}$ mg
39.	The _____ monitors and measures temperature and assures cooling is adequate for battery
Option A:	Hybrid ECU
Option B:	Transmission ECU
Option C:	ICE EMU
Option D:	Battery management system
40.	Defuzzification transforms the results of_____ to _____.
Option A:	rule base, inference
Option B:	inference, crisp output
Option C:	crisp output, inference
Option D:	inference, rule base

41.	In a hybrid electric vehicle one energy source is _____ & the other is a conversion of a_____
Option A:	combustion, energy to fuel
Option B:	storage, energy to fuel
Option C:	storage, energy to energy
Option D:	storage, Fuel to energy
42.	Over the years application of which motor to EV and HEV is limited
Option A:	Induction Motor
Option B:	BLDC
Option C:	PMSM
Option D:	SRM
43.	The Fuel Cell provides _____ energy but _____ power
Option A:	High, Low
Option B:	modest, modest
Option C:	modest, low
Option D:	low, low
44.	Gradeability is defined as the maximum _____ angle that the vehicle can overcome in the whole speed range
Option A:	grade
Option B:	raise
Option C:	slope
Option D:	plane
45.	When a vehicle goes up or down a slope, its weight produces a component of force that is always directed _____
Option A:	upwards
Option B:	downwards
Option C:	left ways
Option D:	right ways
46.	Electric motors are ideal for vehicular applications because of
Option A:	the torque speed characteristics
Option B:	the V I characteristics
Option C:	the Pd characteristics
Option D:	the alpha delta characteristics
47.	Permanent magnet motors with sinusoidal air gap flux distribution are called
Option A:	Permanent Magnet Synchronous Motors
Option B:	Brushless DC motors
Option C:	Brushless AC motors
Option D:	Permanent Magnet induction Motors
48.	Permanent magnet motors with trapezoidal air gap flux distribution are called
Option A:	Permanent Magnet Synchronous Motors
Option B:	Brushless DC motors

Option C:	Brushless AC motors
Option D:	Permanent Magnet induction Motors
49.	Advantages of steam powered cars
Option A:	high performance in terms of power and speed good fuel economy
Option B:	firing a boiler
Option C:	fresh feed water
Option D:	good fuel economy
50.	The golden age of electrical vehicles from 1890 to 1924 marked an end in 1924 because
Option A:	range of electrical vehicle was limited by energy storage in battery
Option B:	long battery life
Option C:	motor technology was not up to the mark
Option D:	motors were electrically inefficient
51.	The main causes of aerodynamic drag are _____ drag & _____ effect
Option A:	Shape, Skin
Option B:	skin, shape
Option C:	outer, inner
Option D:	inner, outer
52.	The series parallel hybrid systems are classified into two categories _____& the_____
Option A:	Fuel Cell dominated; petrol engine dominated
Option B:	ICE dominated; Electrical Motor dominated
Option C:	Hydrogen cell dominated; petrol engine dominated
Option D:	Hydrogen cell dominated; gas engine dominated
53.	In series hybrid vehicle _____ is coupled with the Internal combustion engine to produce electricity for propulsion
Option A:	diesel engine
Option B:	gas engine
Option C:	hydrogen engine
Option D:	generator
54.	The load power can be decomposed into _____ power & _____ power
Option A:	super-fast, dynamic
Option B:	ultrasonic, fast,
Option C:	fast, slow
Option D:	steady, dynamic
55.	The rolling resistance of tires on hard surfaces is due to _____ in the tire material
Option A:	Hysterisis
Option B:	Breakdown
Option C:	elasticity
Option D:	flexibility

56.	Vehicle-to-grid (V2G) describes a system in which plug-in electric vehicles (PEV), communicate with the _____ to sell demand response services by either returning electricity to the grid or by throttling their charging rate
Option A:	PEV
Option B:	ICE vehicles
Option C:	Power grid
Option D:	Battery scooters
57.	For Hybridness H=100% the vehicle is a pure _____ Vehicle
Option A:	Electrical
Option B:	Mechanical
Option C:	Gasoline
Option D:	Hybrid
58.	Which of the following vehicle produces zero emissions
Option A:	gasoline vehicle
Option B:	Electrical vehicle
Option C:	hybrid vehicle
Option D:	Diesel vehicle
59.	Which vehicle has the smallest number of principle components?
Option A:	gasoline vehicle
Option B:	electrical vehicle
Option C:	hybrid vehicle
Option D:	Diesel vehicle
60.	The Field Oriented Control (FOC) enables the induction machine being controlled alike the
Option A:	separately excited DC Machine
Option B:	Permanent magnet DC machine
Option C:	Switched reluctance machine
Option D:	Stepper motor

DESCRIPTIVE QUESTIONS

1.	Elaborate on and compare the energy sources for EV and HEV.
2.	Draw and explain the configurational block diagram of EV.
3.	Draw and explain the architecture of Series and Series -Parallel hybrid electric drive train and explain any one of them.
4.	Compare EV, HEV and PHEV technologies.
5.	Describe the power flow control in electric drive train topologies for HEV for parallel configuration.
6.	Calculate Peukert capacity of a battery of 130Ah with C10(10hr) rating and Peukert coefficient=1.2
7.	Describe the concept of “Hybridness” and Classify HEV on basis of hybridness.

8.	What are the different charging methods used in EV? Elaborate on standards adopted for same worldwide.
9.	What is tractive effort? Explain aerodynamic drag in detail.
10.	Compare various types of DC and AC machines used for EV applications.
11.	What is the need of electric vehicle and hybrid electric vehicle?
12.	State and define any five key battery parameters.
13.	What are the different types of energy storage devices? Explain any one in detail.
14.	A lead acid battery of 240V,120 Ah capacity is used for EV drive, provides average of 240wh/km to motor. Calculate distance covered in single charge. Assume efficiency as 90% and DOD as 50%.
15.	Classify energy management strategies used in hybrid electric vehicle.
16.	Draw the schematic of general configuration of electrical subsystem of an Electric Vehicle (EV) and a Hybrid Electric Vehicle (HEV).
17.	State and define the key battery parameters (i) Battery capacity (ii) C rate (iii) SoC (iv) DoD (v) Specific Energy (vi) Energy Density.
18.	Describe the concept of "Hybridness" and classify the HEV based on hybridness.
19.	Describe in detail all modes of operation of a series hybrid vehicle
20.	Explain the terms rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals
21.	What is the need and importance of EV and HEV?
22.	Explain energy management system in short.
23.	Explain how the fuel efficiency analysis is carried out
24.	Write a short note on hybridization of different energy sources for EV/HEV.
25.	Classify the electric motor drives for EV and HEV applications.
26.	Explain basic EV AC and DC Chargers.
27.	What is the need and importance of EV and HEV?
28.	Explain energy management system in short.
29.	Explain how the fuel efficiency analysis is carried out
30.	Write a short note on hybridization of different energy sources for EV/HEV.
31.	Classify the electric motor drives for EV and HEV applications.
32.	Explain basic EV AC and DC Chargers.
33.	Explain fuel cell and flywheel as energy source elements in electric and hybrid electric vehicles
34.	State historical background of EV / HEV technology in brief. Describe the current state of the art of EV / HEV technology along with technology challenges associated with it
35.	Compare and differentiate between the battery electric vehicle (BEV), hybrid electric vehicle (HEV), and plug in HEV (PHEV) technologies.
36.	