



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

## ELECTRICAL ENGINEERING

### DEFINITIONS AND TERMINOLOGY QUESTION BANK

Course Name	:	<b>HYBRID ELECTRIC VEHICLES</b>
Course Code	:	<b>AEE019</b>
Program	:	<b>B.Tech</b>
Semester	:	<b>VIII</b>
Branch	:	<b>Electrical Engineering</b>
Section	:	<b>A</b>
Academic Year	:	<b>2019 - 2020</b>
Course Faculty	:	<b>Mrs.P.Sindhu, Assistant Professor</b>

#### COURSE OBJECTIVES:

<b>The course should enable the students to:</b>	
I	Interpret the social and environmental importance of hybrid and electrical vehicles
II	Discuss the concept of hybrid traction and electric traction with the help of hybrid drive train and electric drive train topologies.
III	Explain the electric propulsion unit of hybrid electric vehicles.
IV	Understand the configuration and control of different types of electric drives.
V	Demonstrate the concepts of energy storage and energy management in hybrid electric vehicles.

#### DEFINITIONS AND TERMINOLOGY QUESTION BANK

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
<b>UNIT-I</b>						
1	Define Hybrid?	A hybrid combines any two power (energy) sources.	Remember	CO 1	CLO 1	AEE019.1
2	Define Hybrid Electric Vehicles?	A hybrid vehicle combines any two power (energy) sources. HEVs are a combination of electrical and mechanical components.	Remember	CO 1	CLO 1	AEE019.1
3	What is Electric Vehicles?	Electric Vehicle is one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels or an electric generator to	Understand	CO 1	CLO 1	AEE019.1

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		convert fuel to electricity				
4	Define Conventional Vehicles?	Conventional vehicles are those that use an internal combustion engine (ICE) for propulsion, without assistance from an electric motor or other mechanism. However, they operate on a variety of fuels, use a variety of supporting technologies and, as a result, vary in efficiency and emissions levels.	Remember	CO 1	CLO 1	AEE019.1
5	Define Plug in Hybrid Electric Vehicles?	A plug in hybrid electric vehicle (PHEV) is a hybrid electric vehicle with the ability to recharge its energy storage with electricity from an off-board power source such as a grid.	Remember	CO 1	CLO 1	AEE019.1
6	What is ICE Engine?	An internal combustion engine (ICE) is a heat engine in which the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion applies direct force to some component of the engine. The force is applied typically to pistons, turbine blades, rotor or a nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy.	Understand	CO 1	CLO 1	AEE019.2
7	Define Regenerative Braking?	It is an energy recovery mechanism that slows a vehicle or object by converting its kinetic energy into a form that can be either used immediately or stored until needed	Remember	CO 1	CLO 2	AEE019.2
8	What is Conventional Gasoline Vehicle?	Gasoline and diesel vehicles are similar. They both use internal combustion engines. A gasoline car typically uses a spark-ignited internal combustion engine,	Understand	CO 1	CLO 2	AEE019.2

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		rather than the compression-ignited systems used in diesel vehicles. In a spark-ignited system, the fuel is injected into the combustion chamber and combined with air. The air/fuel mixture is ignited by a spark from the spark plug. Although gasoline is the most common transportation fuel, there are alternative fuel options that use similar components and engine systems.				
9	What is Hydrogen Fuel Cell Vehicle?	Fuel cell vehicles use hydrogen gas to power an electric motor. Unlike conventional vehicles which run on gasoline or diesel, fuel cell cars and trucks combine hydrogen and oxygen to produce electricity, which runs a motor. Since they're powered entirely by electricity, fuel cell vehicles are considered electric vehicles, but unlike other EVs, their range and refueling processes are comparable to conventional cars and trucks.	Understand	CO 1	CLO 2	AEE019.2
10	What is Hydrogen Internal Combustion Vehicles?	It is a type of hydrogen vehicle using an internal combustion engine. Hydrogen internal combustion engine vehicle is different from hydrogen fuel cell vehicles.	Understand	CO 1	CLO 2	AEE019.2
11	What is Ammonia Fuel Vehicle?	Fuel cells are pollution-free power sources that convert chemical energy to electricity with high efficiency and zero emissions. Fuel cell cars, trucks, and buses would allow people to travel long distances with convenient refueling and less of a carbon footprint.	Understand	CO 1	CLO 2	AEE019.2
12	What is the Drive Range of Hybrid Vehicles?	The Drive range of Hybrid Vehicle is 930Km.	Understand	CO 1	CLO 2	AEE019.2
13	What is the Drive Range of Electric Vehicles?	The Drive range of Hybrid Vehicle is 164km.	Remember	CO 1	CLO 2	AEE019.2
14	What is The Main Green House Gas Emission?	The Main Emissions of Green house Gas is CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, and SFC.	Remember	CO 1	CLO 1	AEE019.1
15	What are the Benefits of	an absence of emissions, high efficiency, independence from	Remember	CO 1	CLO 1	AEE019.1

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
	Hybrid Electric vehicles?	petroleum, and quiet and smooth operation.				
<b>UNIT-II</b>						
1	Define Traction?	the ability of a wheel or tire to hold the ground without sliding.	Remember	CO 2	CLO 5	AEE019.5
2	What is Hybrid Electric Drive Train?	Hybrid vehicle drive trains transmit power to the driving wheels for hybrid vehicles. A hybrid vehicle has multiple forms of motive power. Hybrids come in many configurations. For example, a hybrid may receive its energy by burning petroleum, but switch between an electric motor and a combustion engine.	Remember	CO 2	CLO 5	AEE019.4
3	What is Electric Drive Train?	The electric motor is the only means of providing power to the wheels. The motor receives electric power from either the battery pack or from a generator run by a gasoline engine. A computer determines how much of the power comes from the battery or the engine/generator.	Understand	CO 2	CLO 3	AEE019.4
4	Define Hybrid Traction?	the ability of a wheel or tire to hold the ground without sliding in Hybrid Electric Vehicle.	Understand	CO 2	CLO 4	AEE019.5
5	Define Electric Traction?	the ability of a wheel or tire to hold the ground without sliding in Electric Vehicle.	Understand	CO 2	CLO 4	AEE019.5
6	What is Series Hybrid Electric Vehicle Drive Train?	Series drive trains are the simplest hybrid configuration. In a series hybrid, the electric motor is the only means of providing power to the wheels. The motor receives electric power from either the battery pack or from a generator run by a gasoline engine. A computer determines how much of the power comes from the battery or the engine/generator. Both the engine/generator and the use of regenerative braking recharge the battery pack.	Remember	CO 2	CLO 5	AEE019.6
7	What is Parallel Hybrid Electric Vehicle Drive Train?	In vehicles with parallel hybrid drive trains, the engine and electric motor work in tandem to generate the power that drives the wheels. Parallel hybrids tend to use a smaller battery pack than series drive trains, relying on regenerative braking to keep it recharged. When power	Remember	CO 2	CLO 5	AEE019.6

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		demands are low, parallel hybrids also utilize the motor as a generator for supplemental recharging, much like an alternator in conventional cars.				
8	Define Power Flow in Hybrid Electric vehicle?	Hybrid vehicle drive trains transmit power to the driving wheels for hybrid vehicles. A hybrid vehicle has multiple forms of motive power. Hybrids come in many configurations. For example, a hybrid may receive its energy by burning petroleum, but switch between an electric motor and a combustion engine.	Remember	CO 2	CLO 5	AEE019.6
9	What is Torque Coupling in Hybrid Electric Vehicle?	A torque-coupling architecture for hybrid electric vehicles is proposed to exploit energy-reduction potential. ... A smooth shifting process without torque hole is also attained through a deliberately designed control scheme for the power sources and the sliding sleeves.	Remember	CO 2	CLO 6	AEE019.5
10	What is Series Parallel Configuration?	Power-split hybrid or series-parallel hybrid that incorporate power-split devices, allowing for power paths from the ICE to the wheels that can be either mechanical or electrical. The main principle is to decouple the power supplied by the primary source from the power demanded by the driver.	Remember	CO 2	CLO 6	AEE019.6
11	What is Complex Configuration?	In complex hybrid vehicle, the electric generator is used bidirectional power flow, whereas in case of series-parallel, it offers unidirectional power flow. However, both the configurations involve ICE, electric generator, and motor to propel the vehicle.	Remember	CO 2	CLO 6	AEE019.7
12	Define Power Flow in Hybrid Electric vehicle?	Hybrid vehicle drive trains transmit power to the driving wheels for hybrid vehicles. A hybrid vehicle has multiple forms of motive power. Hybrids come in many configurations. For example, a hybrid may receive its energy by burning petroleum, but switch between an electric motor and a combustion engine.	Remember	CO 2	CLO 5	AEE019.6
13	Define Hybrid Traction?	the ability of a wheel or tire to hold the ground without sliding in Hybrid Electric Vehicle.	Understand	CO 2	CLO 4	AEE019.5

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
14	Define Electric Traction?	the ability of a wheel or tire to hold the ground without sliding in Electric Vehicle.	Understand	CO 2	CLO 4	AEE019.5
15	What is Speed coupling in Parallel Hybrid Train?	Speed-coupled speed power train adds up the speeds from each power source, but the torques of both sources remains equal. Additionally, coupling for the parallel vehicle can consist of either single single-shaft or double-shaft configuration.	Understand	CO 2	CLO 4	AEE019.5
<b>UNIT-III</b>						
1	Define Torque?	Torque is a twisting or turning force that tends to cause rotation around an axis, which might be a center of mass or a fixed point.	Understand	CO 3	CLO 13	AEE019.5
2	Write the Motor principle?	A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force.	Remember	CO 3	CLO 13	AEE019.5
3	Write the Induction Motor principle?	Basic working principle of an Induction Motor. In a DC motor, supply is needed to be given for the stator winding as well as the rotor winding. But in an induction motor only the stator winding is fed with an AC supply. Alternating flux is produced around the stator winding due to AC supply.	Remember	CO 3	CLO 11	AEE019.5
4	Define Flux Weakening of motors?	specific applications such as propulsion purpose, the induction motor has to operate at speeds higher than the rated one, the field (flux) weakening is required which denotes the strategy by which the motor's speed can be increased above the rated speed.	Remember	CO 3	CLO 13	AEE019.5
5	Define Regenerative Mode?	Regenerative braking is an energy recovery mechanism that slows a vehicle or object by converting its kinetic energy into a form that can be either used immediately or stored until needed.	Remember	CO 3	CLO 11	AEE019.5
6	Write the PMMC Motor principle?	The instruments which use the permanent magnet for creating the stationary magnetic field between which the coil moves is known as the permanent magnet moving coil or PMMC instrument. It operates on the principle that the torque is	Understand	CO 3	CLO 13	AEE019.5

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		exerted on the moving coil placed in the field of the permanent magnet.				
7	Write the Switch Reluctance Motor Principle?	Switched Reluctance Motor (SRM) is also known as Variable Reluctance Motor. This motor works on the principle of variable reluctance. This means, the rotor always tries to align along the lowest reluctance path. As the name suggests, a switching inverter is required for the operation of Switched Reluctance Motor.	Remember	CO 3	CLO 15	AEE019.6
8	What is Field Orientation Control?	In an Electric Vehicle, it is required that the traction motor is able to deliver the required torque almost instantaneously. In an induction motor (IM) drive, such performance can be achieved using a class of algorithms known as Field Orientation Control.	Understand	CO 3	CLO 13	AEE019.6
9	Define Voltage Source Inverter?	An inverter circuit which creates an ac voltage (and current) from a dc voltage source is called a voltage source inverter (VSI)	Remember	CO 3	CLO 15	AEE019.6
10	Define Rotor Action?	The rotor circuit is shorted and current flows in the rotor conductors. The action of the rotating flux and the current produces a force that generates a torque to start the motor. ... As currents travel through the wire coil a magnetic field is created around the core, which is referred to as field current.	Remember	CO 3	CLO 13	AEE019.6
11	What is Speed control of Induction Motor?	speed of an induction motor is controlled by injecting a voltage in rotor circuit. It is necessary that voltage (emf) being injected must have same frequency as of the slip frequency. However, there is no restriction to the phase of injected emf.	Remember	CO 3	CLO 13	AEE019.6
12	What is Voltage Regulation Of Induction Motor?	Induction voltage regulator is a type of an electrical machine in which the output voltage may be varied from zero to a certain maximum value depending upon the ratio of turns in the primary and secondary windings.	Remember	CO 3	CLO 15	AEE019.6
13	What are types of Motors used in Hybrid Electric Vehicles?	DC Motors, Induction Motor, PMMC Motor, Switch Reluctance motor	Remember	CO 3	CLO 15	AEE019.6
14	State Direct Rotor Oriented FOC Control?	In direct FOC, the position of the synchronous reference frame is determined based on the	Remember	CO 3	CLO 15	

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		values of $q$ -axis and $d$ -axis rotor flux linkages in the stationary reference frame.				
15	State In Direct Rotor Oriented FOC Control?	The indirect FOC methods are more sensitive to knowledge of the machine parameters but do not require direct sensing of the rotor flux linkages.	Remember	CO 3	CLO 11	
<b>UNIT-IV</b>						
1	Define Energy Storages System in Hybrid Electric Vehicles?	Hybrid energy storage systems (HESS) are used to optimize the energy management for electric vehicles. These solutions use separate energy and power sources in order to use their characteristics at their best, what allows a reduction of the size, efficiency or cost of the embedded source.	Remember	CO 4	CLO 11	AEE019.11
2	What is the Principle of Electrochemical Battery?	Electrochemical cells are devices based on the principle that when a chemical oxidation-reduction reaction takes place, electrons are being transferred from one chemical species to another.	Remember	CO 4	CLO 11	AEE019.11
3	What is Energy Efficiency of Battery?	Energy Efficiency = $(87\%)(90\%) = 78\%$	Remember	CO 4	CLO 12	AEE019.12
4	Define Super Capacitor?	Super capacitor is a type of capacitor that can store a large amount of energy, typically 10 to 100 times more energy per unit mass or volume compared to electrolytic capacitors.	Remember	CO 4	CLO 13	AEE019.13
5	What is the Principle of Super Capacitor?	Positive charges form on one plate and negative charges on the other, creating an electric field between them. The field polarizes the dielectric, so its molecules line up in the opposite direction to the field and reduce its strength.	Remember	CO 4	CLO 13	AEE019.13
6	What is Battery?	A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, mobile phones, and electric cars.	Remember	CO 4	CLO 12	AEE019.12
7	Define Hybridization	Hybrid energy storage systems (HESS) are used to optimize the energy management for electric	Remember	CO 4	CLO 14	AEE019.14



S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
	storage system?	vehicles. These solutions use separate energy and power sources in order to use their characteristics at their best, what allows a reduction of the size, efficiency or cost of the embedded source				
8	Define Charge Equalization?	An equalizing charge is nothing more than a deliberate overcharge to remove sulfate crystals that build up on the plates over time.	Remember	CO 4	CLO 12	AEE019.12
9	What is Series Hybridization Storage Based System?	The series hybrid has motor power approximately equal to engine power; hence, the series hybrid exists in a band near H = 50%. Outside that band, the series hybrid changes into either mixed hybrid or plug-in hybrid.	Remember	CO 4	CLO 14	AEE019.14
10	Define Charge capacity?	The electric charge that a battery can supply is clearly a most crucial parameter. The SI unit for this is the Coulomb, the charge when one Amp flows for one second. The capacity of a battery might be, say, 10Amphours. This means it can provide 1Amp for 10 hours.				
11	What is the Principle of Fly Wheel Based Energy Storage Based System?	A flywheel stores energy that is based on the rotating mass principle. It is a mechanical storage device which emulates the storage of electrical energy by converting it to mechanical energy. The energy in a flywheel is stored in the form of rotational kinetic energy.	Remember	CO 4	CLO 14	AEE019.14
12	What is Fuel Cell Energy Storage Based System?	Essentially it takes the chemical energy that is stored within whatever energy source you have such as hydrogen, gasoline or methane and then through two electrochemical reactions it converts it directly to electricity.	Remember	CO 4	CLO 13	AEE019.13
13						
14						
15	Define Lithium battery?	Lithium batteries are primary batteries that have metallic lithium as an anode. These types of batteries are also referred to as lithium-metal batteries.	Remember	CO 4	CLO 12	AEE019.12
<b>UNIT-V</b>						
1	Write the Definition of Energy	Energy management includes planning and operation of energy production and energy	Remember	CO 5	CLO 21	AEE019.15

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
	Management Strategies?	consumption units. Objectives are resource conservation, climate protection and cost savings, while the users have permanent access to the energy they need.				
2	Define Rule Based Strategy?	a rule-based system is used to store and manipulate knowledge to interpret information in a useful way. It is often used in artificial intelligence applications and research. Normally, the term rule-based system is applied to systems involving human-crafted or curated rule sets	Remember	CO 5	CLO 15	AEE019.15
3	Define Optimization Strategy?	Finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones. In comparison, maximization means trying to attain the highest or maximum result or outcome without regard to cost or expense	Remember	CO 5	CLO 15	AEE019.15
4	Define Real Time Optimization Strategy?	Real-time optimization (RTO) is a category of closed-loop process control that aims at optimizing process performance in real time for systems. Compared to traditional process controllers, they are different as they are normally built upon model-based optimization systems and are usually large scale.	Remember	CO 5	CLO 15	AEE019.15
5	Define Transmission ECU or Energy Management System?	A transmission control unit or TCU is a device that controls modern electronic automatic transmissions.	Understand	CO 5	CLO 15	AEE019.16
6	Define Fuzzy Logic?	Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which the modern computer is based.	Understand	CO 5	CLO 15	AEE019.17

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
7	What is Battery ECU or Energy Management System?	The battery ECU or the battery management system (BMS) monitors and measures temperature and assures cooling is adequate. The BMS avoids the stress of heat and over-temperature and the effects of excessive charging or discharging are eliminated or lessened. The BMS is essentially for long battery life and optimum fuel efficiency.	Understand	CO 5	CLO 16	AEE019.16
8	What is Power Electronics ECU or Energy Management System?	The function of the power electronic ECU is to receive commands from hybrid ECU, to control inverter energy flow both ways, that is, charge and discharge, to control switching of EM between motor and generator modes and to control switching of EM between motor and generator modes.	Understand	CO 5	CLO 16	AEE019.16
9	What is Hybrid ECU or Energy Management System?	The Hybrid ECU is in command of all other ECUs and selects the operational mode based on the driver's input. The hybrid ECU is responsible for system wide energy management.	Understand	CO 5	CLO 16	AEE019.16
10	Define CAN(Control Area Network)	The CAN is a fast high rate network encourages communication between ECU's. In CAN most data can be updated every 10ms and the data is checked to assure data reliability.	Understand	CO 5	CLO 17	AEE019.17
11	Define Factor $K_{target}$ ?	The Ratio of max of time averaged vehicle to performance target performance.	Remember	CO 5	CLO 17	AEE019.17
12	What is Acceleration pedal stroke?	One Pedal Driving is all about applying a positive or negative torque to the wheels with respect to the accelerator pedal position. The pedal position is indicated by the variable p, which is expressed as a percentage of the maximum accelerator pedal stroke.	Remember	CO 5	CLO 17	AEE019.17
13	What is Modified power follower?	In order to improve the power follower controller a cost function is introduced. The role of this cost function is to strike a balance between fuel consumption and emissions at all operating points of HEV.	Understand	CO 5	CLO 16	AEE019.16
14	What is Deterministic rule?	Deterministic system is a system in which no randomness is involved in the development of future states of the system. A deterministic model will thus	Remember	CO 5	CLO 17	AEE019.17

S.No	QUESTION	ANSWER	Blooms Level	CO	CLO	CLO Code
		always produce the same output from a given starting condition or initial state.				
15	What is Global Optimization Technique?	Global optimization is a branch of applied mathematics and numerical analysis that attempts to find the global minima or maxima of a function or a set of functions on a given set.	Remember	CO 5	CLO 17	AEE019.17

Signature of the Faculty

P.Sindhu, Assistant professor

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