ELG2336 Case Study: Electric and Hybrid Cars (Midterm 2)

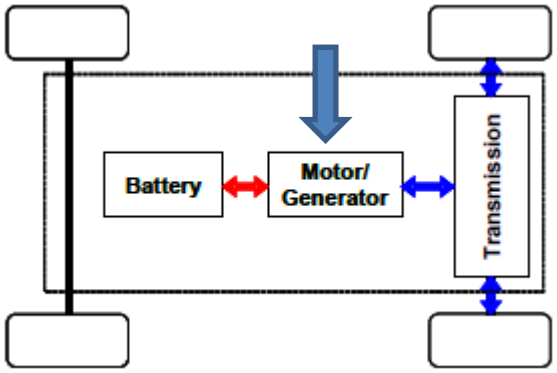
Battery Electric Car: A battery electric vehicle (BEV) is a vehicle that is powered entirely on electric energy, typically a large electric motor and a large battery pack.

Consider a 60-Hz, 208-V, 15-hp (rated), three-phase, 2-pole, Y-connected wound-rotor induction motor. Its equivalent circuit has the following values:

$R_s + jX_s = 0.22 + j0.43\ \Omega$; $jX_m = j15.0\ \Omega$; $R_r + jX_r = 0.127 + j0.43\ \Omega$

The motor has mechanical losses of 300 W and core losses of 300 W, and a slip (S) of 0.05.

Find I_s, Efficiency, and Torque.



Tesla, for example, uses induction machine.

Solution:

Answer YES or NO

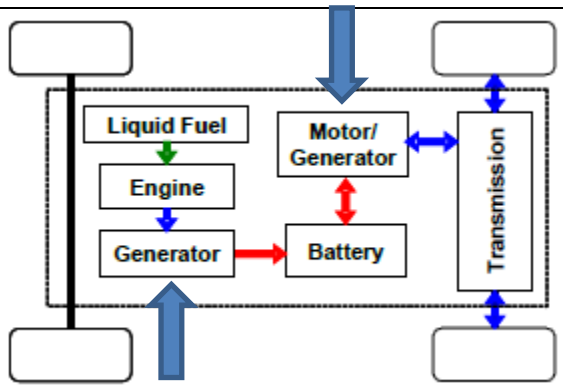
The Induction motor is a an AC motor and is the most widely used machine. Its characteristic features are: Simple and rugged construction; Low cost and minimum maintenance; High reliability and sufficiently high efficiency; Needs no extra starting motor and need not be synchronized.	
The induction rotor has no magnets; just stacked steel laminations with buried peripheral conductors that form a "shorted structure." Currents flowing in the stator windings produce a rotating magnetic field that enters the rotor. In turn, the frequency of this magnetic field as "seen" by the rotor is equal to the difference between the applied electrical frequency and the rotational "frequency" of the rotor itself.	
The stator of an induction motor consists of a number of overlapping windings offset by an electrical angle of 120°. When the primary winding or stator is connected to a three phase alternating current supply, it establishes a rotating magnetic field which rotates at a synchronous speed.	
The number of poles and the frequency of the applied voltage determine the synchronous speed of rotation in the motor's stator. Motors are commonly configured to have 2, 4, 6 or 8 poles. The synchronous speed, a term given to the speed at which the field produced by primary currents will rotate = (120 × Supply Frequency) / Number of poles on the stator.	
Draw the equivalent circuit of induction motor	

Series Hybrid Electric Vehicles

In a series hybrid there is one path to power the vehicle wheels, but two energy sources. The fuel tank feeds an ICE engine which is coupled to a generator to charge the battery which provides electrical energy to a motor/generator to power the wheels through a transmission. The motor/generator is also used to recharge the battery during deceleration and braking.

A shunt DC motor rotating at 1500 r/min is fed by a 220 V source. The input current is 61 A and the shunt-field resistance is 220 Ω. If the armature resistance is 0.15 Ω.

Find E_b and the toque.



Other manufacturers use DC machines.

Answer YES or NO

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, carbon brushes, stationary magnets (permanent or electromagnets), and rotating electrical magnets.	
Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed. Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the carbon brushes and springs which carry the electric current, as well as cleaning or replacing the commutator.	
Typical brushless DC motors use one or more permanent magnets in the rotor and electromagnets on the motor housing for the stator. A motor controller converts DC to AC. This design is mechanically simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor.	
A permanent magnet motor does not have a field winding on the stator frame, instead relying on PMs to provide the magnetic field against which the rotor field interacts to produce torque. Compensating windings in series with the armature may be used on large motors to improve commutation under load.	
Draw the equivalent circuit of a DC shunt motor.	