ELIZADE UNIVERSITY, ILARA-MOKIN,
ONDO STATE, NIGERIA

DEPARTMENT OF AUTOMOTIVE ENGINEERING

FIRST SEMESTER EXAMINATIONS
2020/2021 ACADEMIC SESSION

COURSE: ATE 407 –Dynamics and Control II (3 Units)
CLASS: 400 Level Automotive Engineering
TIME ALLOWED: 3 Hours
INSTRUCTIONS: Answer Any Five Questions

Date: March, 2021

HOD'S SIGNATURE

Question 1 (12 Marks)

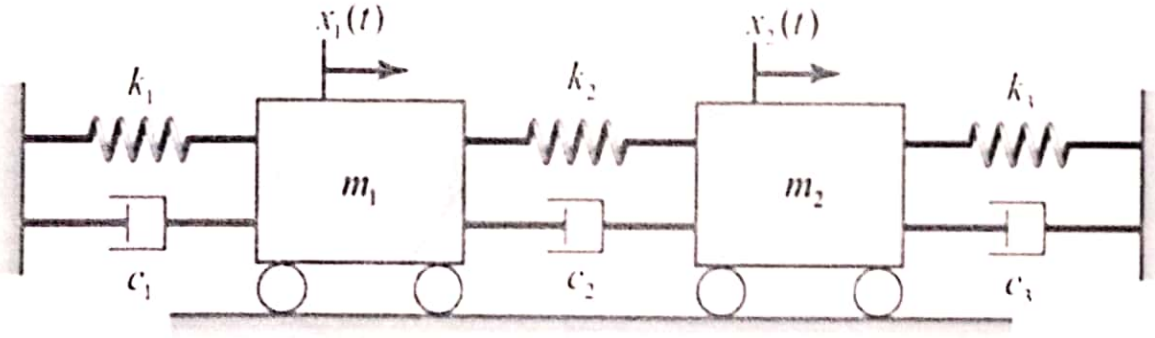
a. Differentiate between an electric vehicle and a hybrid electric vehicle
b. Distinguish between the parallel and the series-parallel architectures for hybrid-electric vehicles.

Question 2 (12 Marks)

a. What are the functions of gears? illustrate pictorially the difference between a simple and a complex gear train.
b. In modelling the performance of hybrid electric vehicles, differentiate between torque and speed coupling architectures.
c. Describe a framework for the combination of both torque and speed coupling.

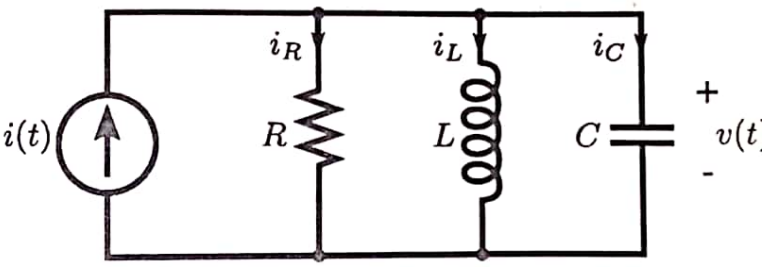
Question 3 (12 Marks)

a. Describe the basic elements of a mechanical system and illustrate their associated functionalities.
b. Describe the basic elements of an electrical system and illustrate their associated functionalities
c. Derive an equation of motion for the system shown. The system consists of two masses (m1 and m2) connected by linear springs (k1, k2 and k3) and viscous dampers (c1, c2, and c3)



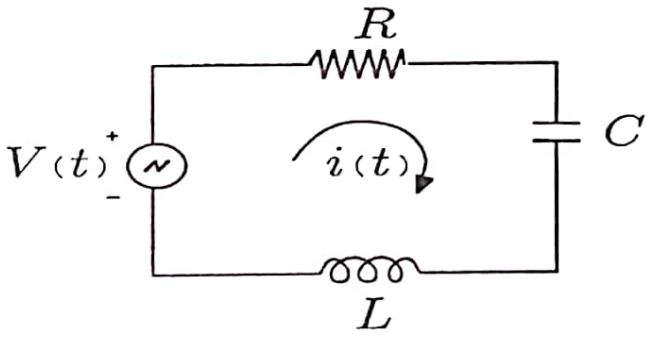
Question 4 (12 Marks)

The electronic controller system for charging the battery of a hybrid electric vehicle operates by RLC circuit design shown in the figure. if the current i(t) = 4A, is released at time at time t = 0 determine the voltage v (t) across the circuit given that the resistor R = 1Ω, the inductor L = 1H and the capacitor C = 0.5F. All initial conditions are zero.



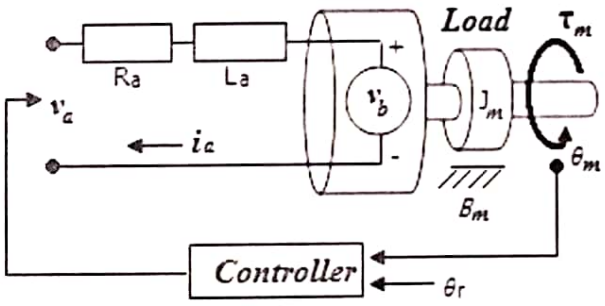
Question 5 (12 Marks)

The regenerative braking system of a Tesla is controlled by the circuit shown in the Figure, Find the current i(t) connected to an emf source V(t) = -220 sin (87t) that is required to charge the battery after deceleration, given that L= 5H, R = 25Ω and C = 0.014285F. Assume the current and capacitor charge are zero when t= 0.



Question 6 (12 Marks)

Determine the transfer function $G(s) = \frac{W_m(s)}{E_a(s)}$ for a DC motor supplying power transmission of a model electric car. $W_m(s)$ is the speed of the shaft and $E_a(s)$ is the input voltage. The given circuit parameters are R = 0.25Ω, the inductor L = 0.1H, motor constants K_t and back e.m.f constant K_b are 0.05 N.m/A and 0.08 respectively. The moment of inertia of load $J_m = 6 \times 10^{-5} kg.m^2$ and the viscous damping coefficient B_m = 0.003 Nm.s.



Question 7 (12 Marks)

a. State 3 features of the traction battery for an electric vehicle.
b. State two types of valve regulated lead acid (VRLA) battery.
c. Differentiate between voltage and current.
d. Name four physical laws that are important to the field of electromechanical modelling.