EE4001 Study Questions – ED Chapter 2

1. A 10 kg mass is hung from the tip of a lever. The lever is 1 m long and is at a 60^o angle to the ground. Calculate the holding torque required to keep the lever from turning. [Ans. 49.05 Nm] **2003A,B**

2. Given that a solid metal cylinder has radius r_I = 10 cm, length l = 20 cm, and material density $\rho = 10 \times 10^3$ kg m^{-3}, calculate its moment of inertia. [Ans. 0.314 kg m^2] **2003A**

3. If the moment of inertia of a solid cylinder is $\frac{\pi}{2}\rho l r^4$, what is the moment of inertia of a hollow cylinder of inner radius r_I and outer radius r_O? **2004**

4. A motor is rigidly coupled to a load and each structure has an inertia of 0.05 kgm^2. Calculate the required electromagnetic torque and peak power if the speed is to increase linearly from rest to 600 rpm in 10 s. [Ans. 0.628 Nm, 39.5 W] **2004**

5. An electric vehicle has the following attributes: drag co-efficient C_W = 0.2, vehicle cross section A = 3 m^2. Use density of air ρ_{air} = 1.202 kg m^{-3}. Instantaneously at a vehicle speed of 36 km/hr, calculate the aerodynamic drag when driving into a 3.6 km/hr headwind. [Ans. 43.96 N] **2003A**

6. An electric vehicle has the following attributes: mass M = 500 kg, wheel diameter d_W = 1m, gear ratio from rotor to drive axle n = 10, and a nominal gear efficiency of 95%. The vehicle is required to accelerate from 0 to 36 km/hr in 10 s on a flat road surface under calm wind conditions. Neglecting load forces, instantaneously at 36 km/hr calculate the

electromagnetic torque, rotor speed, and horse power of the electric motor to achieve this acceleration. [Ans. 26.3 Nm, 1910 rpm, 7.06 hp] **2004**

7. A vehicle experiences a drag force of 400 N at 36 km/h. If the wheel diameter is 0.6 m. Calculate the torque required at the axle to overcome the drag. [Ans. 120 Nm] **2003A,B**

8. At highway speed, the power generated by car engines is mostly used to overcome aerodynamic drag, and thus the fuel consumption is nearly proportional to the drag force on a level road. Determine the percentage increase in fuel consumption of a car per unit time when a person who normally drives at 55 mph now starts driving at 70 mph. Calculate the approximate percentage increase in energy consumption to travel a 55 mile distance at a constant speed of 70 mph compared to 55 mph. [Ans. 106 %, 62 %,] **2003A, 2004**

9. What are the principal load forces associated with a moving vehicle? **2002A**

10. What are some of the advantages of using a gearing system in an application?

11. Sketch a plot of torque vs. speed for a squared-power load. **2003B**

12. A motor developing a torque T_{EM} is coupled with a shaft of torsional coefficient K to a structure of load torque T_L and each structure has an inertia J. Sketch the analogous electrical circuit. **2004**