Q4. SET A

It is required to develop a differential mobile robot as shown in Fig. Q4a. It uses two similar DC geared motors with speed-reduction ratio of gear box is 4. The mass of theses wheels is 100gm each, with radius of 20 cm, and it can be assumed as a ring element. To achieve desired motion, two solid caster wheel (spherical) assemblies are provided as the opposite end, each having 180gm mass & 20 cm radius. The whole assembly is mounted on a circular platform. The total mass of this robot is equal to 1 Kg and their combined CG is maintained at the center of the platform. The overall moment of inertia (MOI) of the gearbox and motor can be neglected. It is required to run this robot carrying a mass of 1.5 Kg, in a trapezoidal velocity profile as shown in Fig. Q4b, on a linear path. For this application, compute the followings, [MOI for ring=mass×radius^2, MOI for sphere=2/5×mass×radius^2]

(i) MOI of both wheels, reflected on motors side [2]

(ii) MOI of both caster wheels, reflected on motors side [2]

(iii) Total MOI, reflected on motors side. [1]

(iv) Maximum Torque required for given velocity profile (Fig. Q4b). Neglect the frictional torques. [1]

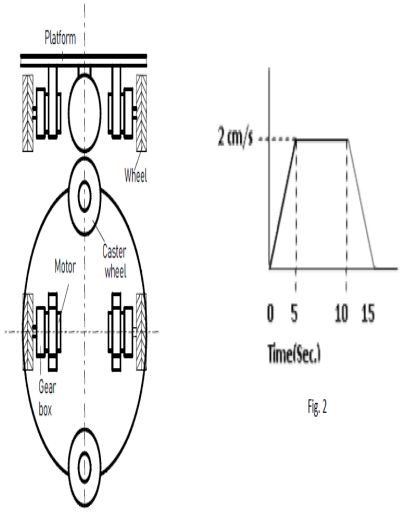

Fig. Q4a

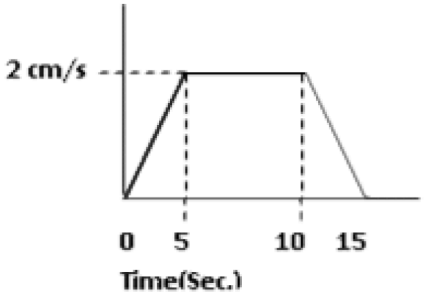

Fig. Q4b