Solutions to Assignment 6

Question 1

1. A 120 V 60 Hz induction motor would run at a fixed speed and would be a reliable long-lasting motor capable of supplying from a few hundred watts up. The most appropriate of the applications listed would be the dishwasher pump motor.

2. A "universal" motor can run from DC or AC because it uses a commutator. These motors are typically low-power and suitable for intermittent duty. The most suitlable application would probably be the kitchen mixer.

3. A series-field DC motor will have a high starting torque. This motor is often used for traction applications such as in an electric car.

4. A permanent-magnet (PM) motor driven by an electronic circuit that switches the direction of the armature current at the desired frequency can be very efficient because there will be no field current losses and the armature supply electronics can be designed to operate efficiently. The most likely application is (d).

5. A stepper motor provides accurate positioning without requiring position feedback. A possible application would be in a pen plotter (although using a position sensor together with a servo motor might be a better idea).

Question 2

A 100 kg load will exert a force of about 980 kN. If the load has to be raised at a constant speed of 0.314 m/s the power required is about 310 Watts.

The torque on the shaft (not required) will be $r \times F = 1 \times 100 \times 9.8 = 980$ N-m.

We can also compute the power required from the torque using the equation $P = T\omega$. Since the pulley raises the load πD m per revolution it must turn at $0.314/6.28 = 1/20$ Hz and $\omega = 2\pi f = \pi/10$. The power required is again $980 \times \pi/10 = 310$W.

If the efficiency of the motor is 80%, then $310/0.8 = 380$W must be supplied.