A 230V dc shunt machine has armature resistance of 0.5Ω and field circuit resistance of 100Ω. If this machine is connected to 230V supply mains, find ratio of speed as a generator to the speed as a motor. The line current in each case is 30A. The voltage drop across brushes is 2V.

$I_L = 30A$; $I_{sh} = 2.3A$, $r_a = 0.5\Omega$.

$I_a = 27.7A$

Motor operation:

$$V_t = E_b + I_a r_a + 2$$

$$230 = E_b + \frac{27.7}{} \times 0.5 + 2$$

$$\Rightarrow E_b = 214.15$$

Generator operation:

$$E_a = V_t + I_a r_a + 2$$

$$= 230 + \frac{27.7}{} \times 0.5 + 2$$

$$= 245.85$$

$E \propto \phi N$

$$\therefore \frac{E_a}{E_b} = \frac{N_g}{N_m} = \frac{245.85}{214.15} = 1.148$$

$\therefore$ $\frac{N_g}{N_m}$ 1.16

$\frac{N_g}{N_M} = 1.148$

A 20KW, 220V, 1500rpm separately excited dc generator has armature resistance of 0.1Ω. The machine is first run at rated speed and its field current is adjusted to give an open circuit voltage of 260V. Now, when the generator is loaded to deliver rated current, the speed of the driving motor is found to be 1400rpm. Compute the terminal voltage of the generator under these conditions. Assume that field flux remains unaltered.

$$E_g = \frac{\phi Z N P}{60 a} \Rightarrow E_g \propto N.$$

$$\Rightarrow \frac{260}{Ea_2} = \frac{1500}{1400}$$

$$\Rightarrow Ea_2 = \frac{260 \times 1400}{1500} = 242.667.V$$

For generator $E_{a_2} = V_t + I_a r_a$

$$= V_t + \frac{20000}{220} \times 0.1$$

$$\Rightarrow V_t = 242.67 - 9.09$$

$$= 233.57 V.$$

A 4 pole dc machine has 300 conductors and each conductor is capable of carrying 80A without excessive temperature rise. The flux per pole is 0.03 wb and the machine is driven at 1500rpm.

Compute the total current, emf, power developed in the armature and electromagnetic torque, if the armature conductors are:

(a) Wave connected (b) Lap connected.

(a) Wave connected: Parallel paths = 2

$\Rightarrow a = 2$

$$E = \frac{\phi Z N P}{60 a} = \frac{0.03 \times 300 \times 1500 \times 4}{60 \times 2}$$

$$= 450V$$

Total current = 160A.

$\therefore$ Power developed in armature = $E_a \cdot I_a$

$= 450 \times 160$

$= 72kW.$

Electromagnetic torque = $\frac{72000 \times 60}{2.\pi \times 1500} = 458.36 Nm$

(b) Parallel paths = poles = 4

$$\Rightarrow E = \frac{0.03 \times 300 \times 1500 \times 4}{60 \times 4} = 225V$$

$I_a = 4 \times 80 = 320A$

$\therefore P = 72kw, \quad T = 458.36 Nm.$