Uppgift 1. a)

$$P_1 = U_F I_1 \cos\varphi$$
$$I_1 = \frac{1000}{230 \cdot 0.80} = 5.43A$$
$$\varphi_1 = \cos^{-1}(0.80) = 37^\circ$$
$$\bar{I}_1 = 5.43e^{-j37^\circ} A$$
$$I_2 = \frac{75 \cdot 10}{230 \cdot 1.0} = 3.26A$$
$$\bar{I}_2 = 3.26e^{-j120^\circ} A$$
$$I_3 = \frac{1500}{230 \cdot 1.0} = 6.52A$$
$$\bar{I}_3 = 6.52e^{-j240^\circ} A$$
$$\bar{I}_N = \bar{I}_1 + \bar{I}_2 + \bar{I}_3 = 0.7e^{-j141^\circ} A$$

b)

$$P = P_I + P_{II} = 1870W$$
$$Q = \sqrt{3}(P_{II} - P_I) = 1420.3VAr$$

Fullständig faskompensering ger $Q_{tot} = 0$.

$$Q_C = -Q$$
$$Q_C = -6\pi \cdot 50 \cdot C \cdot 230^2 = -1420.3 \Rightarrow$$
$$C = 28.5\mu F$$

Uppgift 2. a)

$$I_{2M} = \frac{S_M}{\sqrt{3}U_{2M}} = 1804A$$

b)

$$P_{FKM} = 3R_{2k}I_{2M}^2 \Rightarrow R_{2k} = \frac{P_{FKM}}{3I_{2M}^2} = \frac{9190}{3 \cdot 1804^2} = 0.94m\Omega$$
$$U_{2k} = U_{1k}\frac{U_{2M}}{U_{1M}} = 570 \cdot \frac{400}{10000} = 22.8V$$
$$Z_{2k} = \frac{U_{2k}}{\sqrt{3}I_{2k}} = /I_{2k} = I_{2M}/ = \frac{22.8}{\sqrt{3} \cdot 1804} = 7.3m\Omega$$
$$X_{2k} = \sqrt{Z_{2k}^2 - R_{2k}^2} = \sqrt{0.0073^2 - 0.00094^2} = 7.2m\Omega$$

c)

$$\cos\varphi = 0.8 \Rightarrow \sin\varphi = 0.6$$
$$\frac{U_2}{\sqrt{3}} = \frac{U_{20}}{\sqrt{3}} - I_2(R_{2k}\cos\varphi + X_{2k}\sin\varphi) \Rightarrow$$
$$U_2 = 400 - \sqrt{3} \cdot 1804 \cdot (0.00094 \cdot 0.8 + 0.0072 \cdot 0.6) = 389.9V$$

d)

$$P_{ut} = \sqrt{3}U_H I_L \cos\varphi = \sqrt{3} \cdot 389.9 \cdot 1804 \cdot 0.8 = 974.6kW$$
$$P_{in} = P_{ut} + P_{F0} + P_{FKM} = 974.6 + 1.5 + 9.2 = 985.3kW$$
$$\eta = \frac{P_{in}}{P_{ut}} = 98.9\%$$

e) Se labb-PM.

Uppgift 3. a) Se boken. Pådraget påverkar endast ankarkretsen, dvs inte magnetiseringskretsen.

b) Magnetiseringsströmmen oberoende av ankarströmmen

$$I_m = \frac{220}{400} = 0.55A$$

Vi start är $E = 0V$

$$U - R_a I_a - E = 0 \Rightarrow I_a = 220/2 = 110A$$

Totala strömmen till motorn

$$I = I_m + I_a = 110.55A$$

c) Vid märkbelatsning:

$$I_{a,M} = I_M - I_m = 9.55 - 0.55 = 9.0A$$
$$I_{a,start} = I_{a,M} \cdot 1.60 = 14.4A$$
$$U - R_a I_{a,start} - E - R_p I_{a,start} = 0 \Rightarrow R_p = \frac{220 - 0 - 2 \cdot 14.4}{14.4} = 13.3\Omega$$

d)

$$\eta = \frac{P_2}{P_1} = \frac{M\frac{2\pi n}{60}}{U \cdot I} = \frac{12.4 \cdot \frac{2\pi \cdot n}{60}}{220 \cdot 9.55} = 86.5\%$$

e) Vid märkdrift:

$$220 - 2 \cdot 9.0 - k_1\phi \cdot 1400 - 0 \cdot 9.0 = 0 \Rightarrow k_1\phi = \frac{202}{1400}$$

$M = k_2\phi I_a$. Halva momentet ger $I_a = \frac{9.0}{2} = 4.5A$.

$$220 - 2 \cdot 4.5 - k_1\phi n - 0 \cdot 4.5 \Rightarrow 1462rpm$$

Uppgift 4. a)

$$n_1 = \frac{120}{f}p$$

Poltal 4 ger $n_1 = 1500$. Därför har maskinen 4 poler.

b)

$$P_{2a} \approx P_2 = \frac{n_2 \cdot 2\pi}{60} M = \frac{1450 \cdot 2\pi \cdot 1235}{60} = 187.5kW$$

c)

$$P_1 = \frac{P_2}{\eta} = \frac{187500}{0.94} = 199.5kW$$
$$P_L = P_1 - P_2 = 199.5 - 187.5 = 12kW$$

d) Se föreläsningsanteckningar

e)

$$M = k_1 U^2 \frac{s}{R_2}$$
$$\frac{M_I}{M_{II}} = \frac{k_1 U^2 \frac{s_I}{R_2}}{k_1 U^2 \frac{s_{II}}{R_2}} \Rightarrow \frac{M_I}{M_{II}} = \frac{s_I}{s_{II}}$$
$$s_{II} = s_{II} \frac{M_{II}}{M_I} = \frac{n_s - n_I}{n_s} \frac{M_{II}}{M_I} = \frac{1500 - 1450}{1500} frac8901235 = 0.024$$
$$n_{II} = n_s - s_{II} n_{II} = 1464rpm$$

f) Se boken eller föreläsningsanteckningar.

Uppgift 5. b)

$$U_L = \frac{6}{T} \int_{\frac{5T}{36}}^{\frac{17T}{36}} u(t)dt = \frac{6\omega}{2\pi} \int_{\frac{5\pi}{18\omega}}^{\frac{17\pi}{18\omega}} u(t)dt = \frac{3\omega}{\pi} \int_{\frac{5\pi}{18\omega}}^{\frac{17\pi}{18\omega}} \hat{u} \sin(\omega t)dt =$$
$$= \frac{3\omega}{\pi} \hat{u} \left[-\frac{\cos(\omega t)}{\omega} \right]_{\frac{5\pi}{18\omega}}^{\frac{17\pi}{18\omega}} = \frac{3}{\pi} \hat{u} \left(-\cos\left(\frac{17\pi}{18}\right) + \cos\left(\frac{5\pi}{18}\right) \right)$$
$$= \frac{3}{\pi} \cdot \frac{400}{\sqrt{3}} \cdot \sqrt{2} \cdot (0.984 + 0.643) = 507.4V$$

c) Dewn likriktade spänningen är identisk oavsetty om en induktiv eller en resistiv last används.