

EE_Exam_By_KM_ID1804424

by Krzysztof Sylwester Matela

FILE	13223_KRZYSZTOF_SYLWESTER_MATELA_EE_EXAM_BY_KM_ID1804424_325 225_1636347066.DOCX (4.32M)		
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Electrical Engineering Exam Jan

Q1.

a) $Z_1 = 20 + j37.6991$

$$Z_2 = 1/(52 + j31.4159)$$

$$Z_3 = 15 + j24.7177$$

b) $I_1 = 6.7172 \angle 62.05^\circ \text{ A}$

$$I_2 = 4.27 \angle 3.58^\circ \text{ A}$$

$$I_3 = 16.9405 \angle 23.55^\circ \text{ A}$$

Q4.

$$I = 0.1625 \text{ A}$$



Attachments:

Q1. a)

$$Z_1 = \cancel{R_1 + X_{L1}} ? , R_1 = 20 \Omega , L_1 = 120 \text{ mH}$$

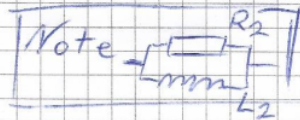
$$X_{L1} = 2\pi fL = 2 \times \pi \times 50 \times 120 \times 10^{-3} = 37.6991 \Omega$$

$$Z_1 = R_1 + X_{L1} = 20 \Omega + j37.6991 \Omega$$

$$Z_2 = ?$$

$$R_2 = 52 \Omega$$

$$L_2 = 100 \text{ mH}$$



$$Z_2 = \frac{1}{\frac{1}{R_2} + \frac{1}{L_2}}$$

$$X_{L2} = 2\pi fL = 2 \times \pi \times 50 \times 100 \times 10^{-3} = 31.4159 \Omega$$

$$Z_2 = \frac{1}{52 + j31.4159 \Omega}$$

$$Z_3 = ?$$

$$R_3 = 15 \Omega$$

$$L_3 = 180 \text{ mH}$$

$$C_3 = 100 \mu\text{F}$$

$$X_{L3} = 2\pi fL = 2 \times \pi \times 50 \times 180 \times 10^{-3} = 56.5487 \Omega$$

$$X_{C3} = \frac{1}{2\pi fC} = \frac{1}{2 \times \pi \times 50 \times 100 \times 10^{-6}} = 31.831 \Omega$$

$$X_{+3} = X_L - X_C = 56.5487 - 31.831 = 24.7177 \Omega$$

$$Z_3 = R_3 + X_{+3} = 15 \Omega + j24.7177 \Omega$$

01

$$b) \quad \underline{I}_1 = \frac{V_{L1}}{Z_1} = \frac{230 \angle 0^\circ}{20 + j37.6991} = \frac{230 + j0}{20 + j37.6991}$$

$$= \frac{230 + j0}{20 + j37.6991} \times \frac{20 - j37.6991}{20 - j37.6991}$$

$$= \frac{4600 - j8670.793}{40 - j753.982 + j753.982 - j^2 1421.2221}$$

$$= \frac{4600 - j8670.793}{40 - (-1421.2221)}$$

$$= \frac{4600 - j8670.793}{40 + 1421.2221} = \frac{4600 - j8670.793}{1461.2221}$$

$$= 3.148 - j5.9339 \text{ A}$$

$$|I_1| = \sqrt{3.148^2 + 5.9339^2} = 6.7172 \text{ A}$$

$$\theta = \tan^{-1}\left(\frac{5.9339}{3.148}\right) = 62.05^\circ$$

$$\underline{I}_1 = 6.7172 \angle 62.05^\circ \text{ A}$$

$$\underline{I}_2 = \frac{V_{L2}}{Z_2} = \frac{230 \angle 120^\circ}{0.019 + j0} = \frac{230 \angle 120^\circ}{52 + j31.4159} =$$

$$= \frac{230 + j120}{52 + j31.4159} = \frac{230 + j120}{52 + j31.4159} \times \frac{52 - j31.4159}{52 - j31.4159}$$

$$= \frac{11960 - j7225.657 + j6240 - (-)3769.908}{2704 - j1633.6268 + j1633.6268 - (-)986.9588}$$

$$= \frac{11960 - j985.657 + 3769.908}{2704 + 986.9588} =$$

$$= \frac{15729.908 - j985.657}{3690.9588} = 4.2617 - j0.267$$

$$= 4.2617 - j0.267$$

Q1 b) cont...

$$|I_2| = \sqrt{4.2617^2 + 0.267^2} = 4.27 \text{ A}$$

$$\theta = \tan^{-1}\left(\frac{0.267}{4.2617}\right) = 3.58^\circ$$

$$I_2 = 4.27 \angle 3.58^\circ \text{ A}$$

$$I_3 = \frac{V_{L3}}{Z_3} = \frac{230 \angle 240^\circ}{15 + j24.7177} = \frac{230 + j240}{15 + j24.7177}$$

$$\Rightarrow \frac{230 + j240}{15 + j24.7177} \times \frac{15 - j24.7177}{15 - j24.7177} =$$

$$= \frac{3450 - j5685.071 + 2650 - \cancel{6^2} 5932.248}{225 - j370.7655 + j370.7655 - \cancel{6^2} 610.9647}$$

$$= \frac{7050 + 5932.248 - j5685.071}{225 + 610.9647}$$

$$= \frac{12982.248 - j5685.071}{835.9647}$$

$$= 15.5297 - j6.7683$$

$$|I_3| = \sqrt{15.5297^2 + 6.7683^2} = 16.9405 \text{ A}$$

$$\theta = \tan^{-1}\left(\frac{6.7683}{15.5297}\right) = 23.55^\circ$$

$$I_3 = 16.9405 \angle 23.55^\circ \text{ A}$$

Q4.

~~$B_{core} = \frac{\Phi}{A}$~~

$$N = 1200$$

$$L_1 = 650 \text{ mm}$$

$$\text{air gap} = 560 \mu\text{m} \quad a = 90 \text{ mm}$$

$$A = 40 \text{ mm} \times 100 \text{ mm}$$

$$\Phi B_{core} = \frac{\Phi}{A} = \frac{560 \times 10^{-6}}{40 \times 10^{-3} \times 100 \times 10^{-3}} = 0.14 \text{ T}$$

$$\text{BH Curve, } H = 300 \frac{\text{A.t}}{\text{m}}$$

$$\text{mmf}_{core} = H \times L = 300 \times 650 \times 10^{-3} = 195 \text{ A.t}$$

$$\text{mmf}_{gap} = \frac{0.14}{2142.857} \times 90 \times 10^{-3} = 5.88 \mu\text{A.t}$$

$$\text{mmf}_{total} = \text{mmf}_{core} + \text{mmf}_{gap} =$$

$$= 195 + 5.88 \times 10^{-6} = 195.0000059 \text{ A.t}$$

$$I = \frac{\text{mmf}_{total}}{N} = \frac{195.0000059}{1200} = 0.1625 \text{ A}$$

FINAL GRADE

22/100

GENERAL COMMENTS

Instructor

Q1a) $2+1+2 = 5$ Marks

Q1b) $2+2+2 = 6$ Marks

Q4) 9 Marks

Total 20/90 = 22.2%

PAGE 1



Comment 1

Q1a) $2+1+2 = 5$ Marks

Q1b) $2+2+2 = 6$ Marks

Q4) 9 Marks

Total 20/90 = 22.2%

PAGE 2

PAGE 3



Comment 2

$20 \times 20 = 400$ not 40



Comment 3

Q1b)

Phase 1 - arithmetic error. 2 Marks

Phase 2- arithmetic error 2 Marks - error carried forward from Q1a)

Phase 3 - arithmetic errors 2 Marks

Q1b total 6 Marks



Comment 4

230 at angle 120 is not the same as $230+j120$.

PAGE 4



Comment 5

230 angle 240 is not the same as $230+j240$



Comment 6

missing "j" from 3600

PAGE 5



Comment 7

should be $\mu 0$ not μCore



Comment 8

right method, arithmetic errors.

9/10