

EEE102 Power Networks

Solutions to Mid-Term test 2010

1. Note: Important to include Ω in response – if missed deduct ½ from overall mark, i.e. 1 ½ out of 2 for correct calculations but with no Ω

i)

| A | B | C | D |
|---------------------------------|--------------------------------|--------------------------------|--------------------------------|
| $17.7 \angle 73.6^\circ \Omega$ | $9.5 \angle 71.6^\circ \Omega$ | $2.0 \angle 72.5^\circ \Omega$ | $1.2 \angle 82.9^\circ \Omega$ |

ii)

| A | B | C | D |
|-------------------|-------------------|-------------------|-------------------|
| $3.6+j2.6 \Omega$ | $0.1+j0.3 \Omega$ | $4.8+j8.3 \Omega$ | $0.3+j0.5 \Omega$ |

2. The flux in the core is given by $\phi = BA$

| A | B | C | D |
|-------------|-------------|-------------|-------------|
| 0.000182 Wb | 0.000156 Wb | 0.000140 Wb | 0.000108 Wb |

Reluctance S given by: $S = \frac{NI}{\phi}$

| A | B | C | D |
|----------|----------|----------|----------|
| 1.28E+07 | 1.43E+07 | 2.39E+07 | 1.21E+07 |

Reluctance of core given by: $S = \frac{L_{core}}{A\mu_0\mu_r}$

| A | B | C | D |
|----------|----------|----------|----------|
| 4.26E+06 | 2.07E+06 | 5.57E+06 | 8.62E+05 |

Hence reluctance of gap is given by difference:

| A | B | C | D |
|----------|----------|----------|----------|
| 8.53E+06 | 1.22E+07 | 1.83E+07 | 1.13E+07 |

Hence, length of airgap is given by: $l_g = \mu_0 AS_{gap}$

| A | B | C | D |
|-------|-------|-------|-------|
| 1.5mm | 2.0mm | 2.3mm | 1.7mm |

Inductance is given by $L = \frac{N^2}{S}$

| A | B | C | D |
|--------|--------|--------|--------|
| 3.13mH | 17.5mH | 5.13mH | 7.42mH |

3. Deduct half marks if units not included in any answers

i) Impedance

| A | B | C | D |
|-------------------|-------------------|-------------------|-------------------|
| $6 + j15.7\Omega$ | $3 + j28.3\Omega$ | $5 + j37.7\Omega$ | $7 + j15.7\Omega$ |

ii) Current (Permissible to exclude rms in terms of marks deduction) but zero marks for just magnitude

| A | B | C | D |
|----------------------------------|---------------------------------|---------------------------------|----------------------------------|
| 13.68 $\angle -69.1^\circ$ A rms | 8.09 $\angle -83.9^\circ$ A rms | 6.05 $\angle -82.4^\circ$ A rms | 13.37 $\angle -66.0^\circ$ A rms |

iii) VA

| A | B | C | D |
|---------|---------|---------|---------|
| 3146 VA | 1861 VA | 1391 VA | 3076 VA |

iv) VAr

| A | B | C | D |
|----------|----------|----------|----------|
| 2939 VAr | 1850 VAr | 1379 VAr | 2810 VAr |

v) Real power

| A | B | C | D |
|--------|-------|-------|--------|
| 1123 W | 196 W | 183 W | 1252 W |

vi) Peak energy stored in inductor

| A | B | C | D |
|-------|-------|-------|-------|
| 9.35J | 5.89J | 4.39J | 8.94J |

4. 1 mark each for Watts, VA, VAr, current magnitude and current phase

i) Watts

| A | B | C | D |
|-------|-------|-------|-------|
| 5250W | 5610W | 7760W | 7250W |

ii) VA

| A | B | C | D |
|---------|---------|---------|---------|
| 6032 VA | 6963 VA | 8859 VA | 8238 VA |

iii) VAr

| A | B | C | D |
|----------|----------|----------|----------|
| 2970 VAr | 4125 VAr | 4274 VAr | 3912 VAr |

iv) Current

| A | B | C | D |
|----------------------------|----------------------------|----------------------------|----------------------------|
| 26.2 \angle -29.5° A rms | 30.3 \angle -36.3° A rms | 38.5 \angle -28.8° A rms | 35.8 \angle -28.4° A rms |

G.W Jewell
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