EET 350 Test #2 (3:00 PM Section) 11/16/2023

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This is an open-notes, open-book test. Each question has a corresponding box in which you should place your answer. There is ample room provided to complete the calculations for each question. Conventional calculators are allowed, however no other personal electronics may be used during the test other than those needed for accessing the uploading the test. A formula sheet is located on the last page of the test for your use. Cell phones must not be used during the taking of this test. You must show your work demonstrating how you arrived at the solution. Answers that are unsupported will be given less than full credit. Remember, proper units are required as part of your answer. **The test that you wish to have graded must be uploaded to Blackboard no later than 4:30 PM on 11/16/23. You are also required to email the instructor (iflory@odu.edu) the same document that you just uploaded to Blackboard no later than 4:30 PM on 11/16/23. Make certain that your submission is complete since the late submission of any test solutions will not be accepted for grading.** Good luck.

Please sign: As stated in the University Code of Student Conduct, subsection 8A, I have neither given nor received information pertaining to this examination.

Signature and Date: [signature]

1. A sinusoidal voltage with a peak value of 294.2 V_{pk} is applied to a 125 Ω resistor. What is the RMS current flowing through the resistor, and the power absorbed by the resistor? [6 points]

$V_{RMS} = \frac{V_{PK}}{\sqrt{2}} = \frac{294.2}{\sqrt{2}} = 208.03\ V_{rms}$

$I_{rms} = \frac{208.03\ V_{rms}}{125\ \Omega} = 1.66\ A$

$P = VI\cos\theta = 208.03 \cdot 1.66 = 346\ W$

I_{rms} =	1.66 A_{rms}
P =	346 W

2. The following measurements were made on an AC circuit. Determine the apparent power, the real power, and the power factor. [10 points]

$V = 240\ V_{rms}$, $I = 7\ A_{rms}$, $Q = 1000$ VAR

$S = V \cdot I = 240 \cdot 7 = 1680$ VA

$Q = \sqrt{S^2 - P^2}$

$P = \sqrt{S^2 - Q^2} = \sqrt{1680^2 - 1000^2} = 1349.96\ W$

$P.F. = \frac{1349.96}{1680} = .8035$

S =	1680 VA
P =	1350 W
P.F. =	.8035

3. If a three-phase, four-wire wye power system has a line voltage of 480V, and a phase current of 17A, answer the following:

$V_L = 480$ $I_\rho = 17A$ wye

a.) What is the phase voltage? [5 points]

$V_\rho = \frac{480}{\sqrt{3}} = 277.1\,V$

b.) What is the line current? [5 points]

$V_\phi = 277\,V$

$I_L = I_\rho$

$I_L = 17A$

$I_L = 17\,A$

c.) If the power factor of the system is 0.82 leading, what is the total real power being delivered by the power system? [5 points]

$P = \sqrt{3}\, V_L I_L PF = \sqrt{3} \cdot 480 \cdot 17 \cdot .82 =$

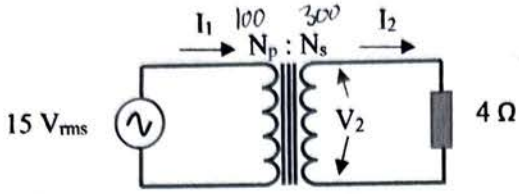
$P_{total} = 11589\,W$

4. A balanced delta-connected resistive load dissipates a total power of 225W. What is the power dissipated by each phase of the load? [4 points]

$P_{dis} = \frac{225}{3} = 75W$

$P_\phi = 75W$

5. For the following ideal transformer circuit the primary has 100 turns and the secondary has 300 turns. Identify V_2, I_2, I_1 and power delivered by the voltage source. [10 points]



$V_2 = 15 \cdot \left(\frac{300}{100}\right) = 45$ ✓

$I_2 = \frac{V_2}{R} = \frac{45}{4} = 11.25\ A$

$I_1 = 11.25 \cdot \left(\frac{300}{100}\right) = 33.75\ A$

$P = VI = 45 \cdot 11.25 = 506.25$

$V_2 =$ 45 ✓
$I_2 =$ 11.25 A
$I_1 =$ 33.75 A
P = 506.25W

6. A self-excited DC motor delivers 5.7 ft-lbs of torque at a speed of 1500 rpm. If the supply voltage is 200Vdc, and the current drawn is 9.5A, what is the efficiency of the motor? [10 points]

$\eta = \frac{P_{out}}{P_{in}} = \frac{5.7 \cdot 1500 \cdot \frac{1}{7.04}}{200 \cdot 9.5} = .6392$

$\eta =$ 63.9 %

7. A three-phase AC *motor* rotates at 1135 RPM when powered by a 60 Hz source. How many poles does this machine likely have and is the motor and induction motor or a synchronous motor? [5 points]

$n_r = n_s \cdot .95$ $\quad P = \frac{120(60)}{1194} = 6.03$

$n_s = \frac{1135}{.95} = 1194$

P = 6
(Induction) or Synchronous (circle choice)

8. A three-phase ***motor*** nameplate has the following ratings:

7.5 Hp, 480 V, 60 Hz, 3450 RPM

If the efficiency under rated conditions is 0.89, what is the output power (watts), input power (watts) and the shaft torque under rated conditions? [10 points]

$P_{out} = 7.5\,hp \cdot 746 = 5595\ W$

$\eta = \frac{P_{out}}{P_{in}} \quad P_{in} = \frac{5595}{.89} = 6286.5\ W$

$\eta = \frac{T_{nr} \cdot \frac{1}{7.04}}{P_{in}}$

$T = \frac{\eta \cdot P_{in} \cdot 7.04}{n_r} = \frac{.89 \cdot 6286.5 \cdot 7.04}{3450} = 11.4\ ft \cdot lb$

$P_{out} =$ 5595W
$P_{in} =$ 6286.5W
T = 11.4 ft·lb

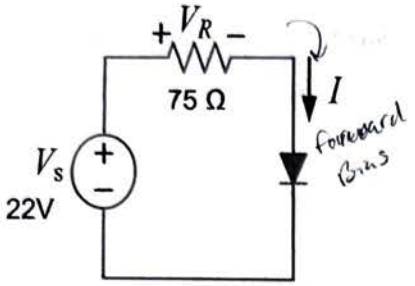
9. A self-excited DC shunt ***generator*** is operating at 800 RPM and is 73% efficient when delivering 2kW of electrical power. What is the shaft torque supplied by the prime mover under these conditions? [10 points]

$P_{out} = 2000\ W$

$\eta = \frac{2000}{T n_r / 7.04} \quad T = \frac{2000}{.73 \cdot 800 \cdot \frac{1}{7.04}} = 24.1\ ft \cdot lb$

$T_{shaft} =$ 24.1 ft·lb

10. For the following circuit, what is the voltage across the resistor and the current flowing in the circuit (a.) using the ideal diode model and (b.) using the 0.7 V constant voltage diode model? [10 points]



A) $I = \frac{22}{75} = 293\,mA$

B) $V_r = 22 - .7 = 21.3\,V$

$I = \frac{22-.7}{75} = 284\,mA$

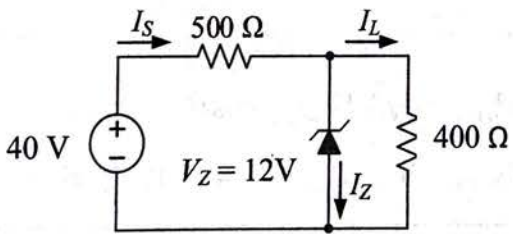
(a.)	V_R = 22 V
	I = 293 mA

(b.)	V_R = 21.3 V
	I = 284 mA

11. In the following circuit, what is the load current (I_L), the source current (I_S), and the current (I_Z) flowing through the Zener diode? [10 points]

$\frac{400}{500+400} \cdot 40 = 17.7$ $V_L = V_Z$

$V_L = 12\,V$



$I_L = \frac{V_L}{R_L} = \frac{12\,V}{400\,\Omega} = .03\,A$

$V_{RS} = 40 - 12 = 28\,V$

$I_S = \frac{28\,V}{500\,\Omega} = .056\,A$

$I_Z = I_S - I_L = 56 - 30 = 26\,mA$

I_L = 30 mA
I_S = 56 mA
I_Z = 26 mA