

Review: \_\_\_\_\_ day, \_\_\_\_\_ pm on zoom

Final Exam: Tuesday, 12/10, 1:00 pm in regular classroom (another class starts at 3:30)

First part of Exam is **Closed book, Closed notes, No calculator**, ~ 0 - 90 points. Could be a very large part.

The second part will be **Closed book**, except for the note sheets handed out in class for exams 1, 2, 3 and Final. You may add to these sheets. The second part will be problems. Total: 180 points, both parts.

### The exam will cover

1. Material from Exam 1, 2, & 3

2. HW 1 AC steady-state review, used extensively throughout class

3. HW 2 RMS & **Single-phase AC power**. Possibly part of 3 $\phi$  problem

$P$   $Q$   $S$   $|S|$  pf correction of pf

4. HW 3 Energy sources, plant efficiencies

5. **HW 4 & 5 3-phase AC power.**

$$\begin{array}{ccccccc} V_L & V_{LL} & V_{LN} & I_L & I_{LL} & I_Y & S_{3\phi} & S_{1\phi} \\ Z_Y = \frac{Z_{\Delta}}{3} & & & Z_{\Delta} = 3 \cdot Z_Y & & & & \text{pf correction of pf} \end{array}$$

6. HW 6 Magnetic circuits

$$B = \mu \cdot H \quad H = \frac{N \cdot i}{l_m}$$

7. HW 7 - 9 Transformers

Calculations

Impedance transformation

OC & SC Tests --> model

$\eta$  & VR

Autotransformers

3 $\phi$  Transformers  $\Delta$  & 3rd harmonic

8. One-Line Diagrams, variations and Per-Unit analysis

Base Values  $S_{base}$   $V_{base}$   $I_{base}$   $Z_{base}$

Basic per-unit modeling and calculations

9. Motor Basics

10. HW SG1 & SG2 Synchronous generators and motors

Know the phasor diagram!

### Possible questions

Study the questions from midterms

Basic relationships and units

Lots possible

Basic magnitude and phase relationships

Flux density, Field intensity, Permeability, B-H curve. effects of nonlinearity on some currents (3rd harmonic).

Basic relationships

losses, ideal/non construction, ratings, magnetization reactance, core losses, winding losses, leakage reactance.

Autotransformers

Y or  $\Delta$

Common symbols, why PU

Bases, why and when do they change

Why per-unit?

Terms, Stator, Rotor, etc. Armature, Field, back EMF Torque, Speed, Power Friction, Windage Slip rings, brushes

Basic relationships

losses, construction, limits, operation

11. HW Ind1 - Ind3 Induction motors

Know the model!

Powers  $P_{AG}$   $P_{conv}$   $P_{out}$  etc.  $\eta$

Torque & speeds

Types & effect of  $R_2$

Basic relationships

Poles, slip, why, how

Typ torque-speed curves

12. Single phase induction motors

Types of starting methods

Centrifugal switches

Phase modification for start winding

Calculation of Impedances and Capacitors

Single phase starting

Magnetic fields

Starting direction

Optimal Phase difference

13. DC motors

Know the model!

Powers  $P_{conv}$   $P_{out}$  etc.  $\eta$

Torque & speeds

Series-wound & universal motors

Basic relationships

Torque-speed curves

14. Motor Load types & Torque-speed curves

Especially in relation to DC motors

Not covered in previous exams

15 **Transmission Lines**

Short, **Med**, Long  $Z_C$

Series impedance  $Z_{series}$  Shunt admittance &  $\frac{Y_{shunt}}{2}$   
Shunt impedance &  $2 \cdot Z_{shunt}$

**Models and calculations**

Basic relationships

Common line voltages

Short, Med, Long mi, km

What is & why use bundling

16. **Power Flow**

Possibly a simple admittance matrix or part of one

See notes that were handed out,  
many possible questions

System requirements

Assumptions

Bus types

17. **Transmission line Faults**

Know the component sequences and how they are used to analyze unbalanced systems. I May give the basic matrix equations and then ask how one of the four faults is reduced to series and/or parallel component circuits (see Transmission Line Faults notes, p.3 - 9). May ask for some detail from those notes (say why something can be neglected in some case).

Also review how the impedances differ for the 3 sequences.

Types of faults

18. **Protection**

**questions**

19. All homeworks, but especially **TL2 through Prot**

20. All Labs

questions

21. All Field trips

questions