INEL 5408 - ELECTRIC MOTORS CONTROL

Fall Semester 2002 (REVISED)

Catalog Data: Three credit hours. Electric motor drive systems; selection criteria for AC and DC machines; characteristics, braking, heating and duty cycle; analysis and design of converter fed open loop and closed loop drive systems.

Prerequisites: INEL 4405, INEL 4416 and INEL 4505

Textbook: Required: R. Krishnan, **Electric Motor Drives**, Prentice Hall, 2001.

References:

1. N. Mohan, **Electric Drives: An Integrative Approach**, MNPERE Press, 2000
2. S.E. Lyshevski, **Electromechanical Systems, Electric Machines and Applied Mechatronics**, CRC Press 1999.
3. N. Mohan, **Power Electronics: Computer Simulation, Analysis and Education using PSPICE (Release 9)**, MNPERE, 2000.
4. M.A. El-Sharkawi, **Fundamentals of Electric Drives**, Brooks/Cole Publishing Company, 2000.
5. D.W. Novotny and T.A. Lipo, **Vector Control and Dynamics of AC Drives**, Oxford University Press, 1998.
6. Ion Boldea, Aon Boldea, Syed A. Nasar, **Electric Drives: CD-ROM Interactive**, CRC Press, 1998.
7. D.M. Dawson, J. Hu, and T.C. Burg, **Nonlinear Control of Electric Machinery**, Marcel Dekker, 1998.
8. R. Crowder, **Electric Drives and their Controls**, Oxford University Press, 1998.
9. C.H. Ong, **Dynamic Symulation of Electric Machinery using MATLAB**, Prentice Hall, 1998.
10. P.Vas, **Sensorless Vector and Direct Torque Control**, Oxford University Press, 1998.
11. B.K. Bose, **Power Electronics and Variable Frequency Drives Technology and Applications**, IEEE Press, 1997.
12. K. Rajashekara, **Speed Sensorless Control of AC Motor Drives**, IEEE Press, 1996.
13. V. Subrahmanyam, **Electric Drives: Concepts and Applications**, McGraw-Hill, 1996.
14. W. Leonhard, **Control of Electrical Drives**, 2nd Ed., Springer-Verlag, 1996.
15. K. Rajashekara, **Speed Sensorless Control of AC Motor Drives**, IEEE Press, 1996.
16. I. Boldea and S.A. Nasar, **Vector Control of AC Drives**, CRC Press, 1992.

Instructor: Dr. Miguel Vélez-Reyes, Professor of Electrical and Computer Engineering

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Office Hours: **Mon & Wed, 8:30 to 9:00 am and 11:30 am to 12:00 noon, and by appointment**.

I can also answer your questions via e-mail.

YOU HAVE TO READ YOUR E-MAIL FOR CLASS ANNOUNCEMENTS !!

Class e-mail list: inel5408@ece.uprm.edu

You have to subscribe!!!!!!!!!!!!!!

Attendance Attendance to classes and quizzes (including the final exam) is compulsory according to university policy. Also, you are required to attend classes to receive financial assistance from the university and professors have to notify the registrar about students who are not attending classes and who do not attend the final exam.

Grading policy: Your final grade will be based on four exams, 70 %, homework 10 %, and a project 20 %.

Grades:

At least 90	A
At least 80	B
At least 70	C
At least 60	D
59 or less	F

There will be a "gray area" between each two-letter grades in the final distribution, so that two people getting the same weighted average grade could get different letter grades. If you are in one of these gray areas, whether your get a higher or lower grade depends on two factors: (a) class and participation, and (b) whether your performance has been improving (your grade goes up) or declining (it does not change).

Athletes please inform of any activities ahead of time. Your coaches distribute your activities schedule to you early in the term. Last minute arrangements are not acceptable.

An **incomplete** grade is given **only** for a valid reason when arrangements have been made with me and, in that case, only if the student was passing the course.

Group homework: Required homework will be due at the beginning of each class period. **Unless otherwise instructed, you must work in-groups of two on the homework, handing in one solution per assignment.**

If a student name appears on a solution set, it certifies that he/she has participated in solving the problems. Students whose names do not appear on a solution set will receive zero.

No homework after due date will be accepted. Homework solutions will not be posted. The burden is on you to make sure you find out how to solve the problems before or after they are due.

Computer Homework: This course will have a significant use of computers for problem sets and projects. Two software packages will be used in the course: MATLAB and PSPICE.

MATLAB Info: A student version of MATLAB is available from mathworks (www.mathwork.com). MATLAB Student Version Highlights:

- Full-featured MATLAB (Same as expensive professional version)
- Includes Simulink (with model sizes up to 300 blocks) &
- the Symbolic Math Toolbox
- Available on PC & Linux platforms
- Add-on products also available

Do not purchase the prentice hall version. Students in the U.S. or Canada can purchase the MATLAB Student Version direct from The MathWorks for $99 or at UPRM bookstore. Students who own the MATLAB Student Version can purchase add-on products to extend its capabilities and they are available for download only. (Will not work with the Student Edition of MATLAB from Prentice Hall.) Each add-on product costs $59 except for the Signal Processing Toolbox and the Control Systems Toolbox which are specially priced at $29. (http://www.mathworks.com/products/studentversion/index.shtml)

PSPICE Info: There is a demo version of PSPICE that can be either loaded from the Web or you can request a CD.
(http://www.orcad.com/products/pspice/pspice_f.htm)

Prerequisites by Topic:

1- AC and DC machines characteristics
2- Power electronic converters
3- Analysis and design of feedback control systems
4- Dynamics of mechanical systems

Topic:

1- Introduction to Electric Drive Systems
2- Review of converters for electric drive systems
3- Understanding mechanical system requirements
4- DC motor modeling
5- Phase controlled DC Motor
6- Chopper controlled DC Motor
7- Feedback Control of DC Motors
8- Induction machines: Steady state analysis
9- Phase controlled induction motors
10- Variable frequency induction motor drives.
11- Permanent magnet and DC brushless motor drives
12- Energy efficiency and economics of drives
13- Power quality issues
14- Tests

Computer Usage:

Use of MATLAB/SIMULINK and SPICE for performance analysis and design of electric drives.

Laboratory projects:

Demonstrations and short experiments in motor control using the Electric Energy Processing Systems Laboratory.

ABET category content:

Engineering Science: 1 credit
Engineering Design : 2 credits

Prepared by: Miguel Vélez-Reyes, September 4, 2002.