COURSE OUTLINE
2017-2018 Sem 1

Subject & Code: Electrical Drives (MKEP 1523)
Total Lecture Hours: 3 hours x 14 weeks

Lecturer	:	Associate Professor Dr Nik Rumzi Nik Idris
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Synopsis:

The course introduces students to the fundamentals of electrical drives. The basics of electrical drives, such as the fundamental torque equations, main components of electrical drives, various T-ω characteristics of load and motors as well as multi-quadrant operations of electrical drives are covered in the introduction section of the course. The analysis and controller design of typical power electronic converters used in the electrical drives are studied with the help of MATLAB/SIMULINK simulation package. Specific examples of controller design for DC drives are presented. The scalar control using the constant V/Hz for induction motor drives based on steady-state per-phase equivalent circuit is discussed. These include the slip-compensation, current controlled, open loop and closed loop structures of constant V/Hz scheme. Finally, the dynamic modeling of induction machine is introduced. Using the dynamic model, the high-performance induction motor control schemes such as the field-oriented control and the direct torque control are presented and analyse using MATLAB/SIMULINK

No	Course Learning Outcome	PO	Assessment Method
1	Able to describe the principle and the dynamics of electrical drive systems	PO1	T, F
2	Able to explain the principles of vector control drives.	PO1, PO2	T, F
3	Able to analyse the operation and control of power converters used for electrical drives.	PO2	A, F
4	Able to simulate, design and evaluate controllers for electrical drive systems with the help of Matlab/SIMULINK.	PO3, PO5	A, F, Ps

T – Test, A – Assignments, Q – Quizzes, Ps – Presentation, Pr – Project, F – Final

Weeks 1-3 **Introduction**

Elements of Modern Electrical Drives
Dynamics of Motor-Load System
Load and Motor torque-speed characteristics,
Quadrant of operations

Weeks 4-6 **Power Electronic Converters in Electrical Drives**

Controlled rectifier: modelling, control and simulation
Switched-mode converters: modelling, control and simulation
Current ripple in current controlled converters
Current Control Converters:
-hysteresis
-ramp comparison in stationary and rotating frames
Space Vector Modulation
Simulation of PE Converters

Weeks 7-8 **DC motor drives**

Construction, modelling and transfer function of the DC machine
Converters for DC drives: quadrant of operations
Closed-loop control of DC drives: MATLAB/SIMULINK
Simulation and experiment of DC motor drives

Weeks 9-10 **Induction motor drives**

Steady state/scalar control
Induction motor: Steady state equivalent circuit
Operation with non-sinusoidal supply
Scalar control: open loop constant V/Hz control: Current control constant V/Hz

Weeks 11-13 Vector control
Dynamic modelling of IM
Field oriented control: rotor flux, stator flux
Direct torque control
Simulation of AC motor drives

Weeks 13-14 **Presentations/Revision**

References

[1] Ned Mohan , "Electric Drives: An integrative approach', MNPERE, Minneapolis, USA, 2001
[2] G.K. Dubey, -Fundamental of Electrical Drives", Narosa, 1994.
[3] R. Krishnan, -Electric motor drives", Prentice-Hall, 2001
[4] N. Mohan, -Power Electronics: Converters, applications and design" , 3e, John Wiley and Sons, 2003.
[5] W. Leonhard, -Control of electrical drives", Springer-Verlag, 2001.
[6] J. M. D. Murphy and F.G. Turnbull, -Power electronic control of AC motor", Pergamon press, 1988.
[7] B.K. Bose, -Power electronics and AC drives", Prentice-Hall, 2002
[8] D.W. Novotny &T.A. Lipo, -Vector control and dynamics of AC drives", Oxford Science Publicatios, 1996.
[9] M.A. El-Sharkawi, -Fundamentals of Electric Drives", Brooks/Cole, 2000

Assessment

Assignments	:	20%
Test 1	:	15%
Test 2	:	15%
Final Examination	:	50%