Exam Drive Systems Oral

Neighbours

Lecturer: Daniel T. McGuiness, Ph.D

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SEMESTER: SS 2025
DATE:
TIME: 09:00 - 10:30

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First and Last Name

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Student Registration Number

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Grading Scheme	$\geq$ 90%	1
	$\leq$ 80% and $\geq$ 90%	2
	$\leq$ 70% and $\geq$ 80%	3
	$\leq$ 60% and $\geq$ 70%	4
	$\leq$ 60%	5

Result:

___/ max. 100 points

Grade:

Student Cohort	
Study Programme	M.Sc Smart Technologies
Permitted Tools	Nothing is allowed.

Important Notes

Unnecessary Items

Place all items not relevant to the test (including mobile phones, smartwatches, etc.) out of your reach.

Identification (ID)

Lay your student ID or an official ID visibly on the table in front of you.

Examination Sheets

Use only the provided examination sheets and label each sheet with your name and your student registration number. The sheets be labelled on the front. Do not tear up the examination sheets.

Writing materials

Do not use a pencil or red pen and write legibly.

Good Luck!

Question	Maximum Point	Result
Oral Exam Questions	100	
Sum	100	

[Q1] Oral Exam Questions — 100

1. A PMSM can also be realised with PMs on the stator and armature windings on the rotor.

   Discuss its merits and demerits compared ot a PMSM with magnets on the rotor.

2. A cage rotor with PMs (called line-start PMSM) can be used to start the motor as an IM and run it as a synchronous machine at utility frequency. Such an arrangement will improve the efficiency of the motor in comparison to IM.

   Discuss its construction, detailed operation, and possible applications.

3. Synchronous machines with surface-mount magnets have very little difference between direct-axis and quadrature-axis inductance. Explain why.

4. Torque pulsation is one of the measures for evaluating the suitability of a motor drive for an application. For a critical application requiring minimum torque pulsation, which is a suitable candidate between PMSM and BLDC drive?

5. Besides core and copper losses, what other losses need to be considered in the performance evaluation of IMs?

6. Can the **d** and **q** models be used for supply-voltage-unbalance studies?

7. Is it possible to operate the IM as a generator? What is the polarity of slip in that mode of operation?

8. During free acceleration, the electromagnetic torque has large oscillations. What are the consequences of such oscillations?

9. A separately-excited DC motor has a non-linear characteristic between the field current and field flux due to the saturation of the iron core in the stator and rotor.

   How will this saturation affect the derived model of the DC motor?

10. The armature resistance of the DC motor is sensitive to temperature variations. Will this adversely affect the stability of the DC motor?

11. What is the maximum speed achievable using the North American grid with a pole value of 2p=2 in terms of rpm?

12. What are the major types of induction motor rotor types? Briefly explain them and compare the following criteria:

    a. Construction,

b. Rotor resistance,

c. Starting torque,

d. Maintenance,

e. Build cost, and

f. Industrial Use.

13. Please explain the types of reference frames available for use in the dynamic modelling of an IM, explain what value does θ_c takes in these reference frames and explain briefly their use-cases.

14. Please explain the types of vector control methods which can be employed to an induction motor and their implementation and their requirements.

15. What is flux-weakening? What is its principle of operation and for which machine it is applied to and why is it needed?

16. Drawing diagrams, please show the different type of rotor configurations used by PMSMs and BLDCs and give brief explanations to each one.

17. Please explain the concept of vector control. Why is it used? what are its advantages and its principle of operation.

18. Please explain the types of DC connections used by industry and give brief explanation to each one including drawing their circuit diagram.

19. What type of magnets are used in industry in the construction of PM motors? please explain each one including their advantages and disadvantages.

20. What is the main reason for the use of **dq0** transform ? Why do we use it? what benefits do we have from its application?

21. Please explain using block diagram/flowchart on how the IM dynamics is modelled?

22. Please draw a block diagram for a vector controlled IM and explain all its relevant components.

Glossary

BLDC Brush-less DC motor

DC Direct Current

IM Induction Motor

PMSM Permanent Magnet Synchronous Motor