

คณะวิศวกรรมศาสตร์
มหาวิทยาลัยสงขลานครินทร์

สอบกลางภาค ประจำปีการศึกษาที่ 1

ประจำปีการศึกษา 2550

วันที่ 4 สิงหาคม 2550

เวลา 09:00 – 12:00 น.

วิชา 217 - 471 Mechanical and Electrical Components and Systems ห้อง EE213

คำสั่ง

1. ข้อสอบมีทั้งหมด 4 ข้อ ให้ทำทุกข้อ
2. ไม่อนุญาตให้นำ โน้ต ตำรา หรือเอกสารใดๆ เข้าห้องสอบ
3. อนุญาตให้นำพจนานุกรมคำศัพท์ภาษาอังกฤษเข้าห้องสอบได้

ชื่อ.....นามสกุล..... รหัส.....

ข้อ	คะแนนเต็ม	คะแนนที่ได้
1	25	
2	25	
3	25	
4	25	
รวม	100	

อ.ชลิตา หิรัญสุข

ผู้ออกข้อสอบ

217-471: Mechanical and Electrical Components and Systems

Tutor: *Chalita Hiransoog*

Note: Only dictionaries (both paper copies and electronic dictionaries) are allowed into this examination. Answers are expected in English and show all working when possible.

Question 1: Steam Turbine

Axial flow steam turbines consist of circularly distributed stationary blades called nozzles which direct steam on to rotating blades or buckets mounted radially on a rotating wheel. Typically, the blades are short in proportion to the radius of the wheel, and the nozzles are approximately rectangular in cross section. Several stages of expansions are obtained by using a series of nozzles and buckets, with the exhaust from the buckets of one stage flowing directly into the nozzles of the following stage. A compact machine can be built economically with ten or more stages for optimum use of high pressure steam and vacuum exhaust by mounting the wheels of a number of stages on a single shaft, and supporting the nozzles of all stages from a continuous housing. Large axial turbines must be operated under such conditions that the exhaust steam does not contain more than 10 to 13% of liquid since condensate droplets could seriously erode the high velocity nozzles and blades. The moisture content of the exhaust is dependent upon the inlet steam pressure/temperature combination. Special moisture removal stages may be incorporated in the design when the steam superheat temperature is limited.

- 1.1 Draw a systematic diagram of an axial flow steam turbine. (15 marks)

- 1.2 Explain in your own words or with diagram how the axial steam turbine can be built economically? (5 marks)

- 1.3 Why the axial turbine has to operate at the condition where the exhaust steam contains less than 10 - 13% of liquid? (5 marks)

Question 2: DC Machine

A shunt-wound DC motor has an armature resistance of 0.1Ω . The motor operates from a 220V DC supply taking an armature current of 100 A and running at 500 rev/min. An external resistance of 2Ω is then connected in series with the armature winding, while the field current remains unaltered.

- 2.1 Draw the circuit diagram of the shunt-wound DC motor in the above question. (5 marks)
- 2.2 Calculate the armature input power of the motor when with and without external resistance. (5 marks)
- 2.3 Obtain the speed of this motor. Note that $N \propto E/\Phi$. (5 marks)
- 2.4 Calculate the output power. (5 marks)
- 2.5 Explain briefly the characteristic of speed control using armature resistance. (5 marks)

Question 3: AC Machine

Two of the speed control techniques for AC motors are changing the rotor resistance and reducing stator voltage.

Changing the rotor resistance:

- 3.1 Draw graph showing the torque – speed characteristics of a slip-ring induction motor for a range of different resistances connected in series with the rotor windings. (10 marks)
- 3.2 What happens to the speed at any particular torque as the external resistance is increased? (3 marks)
- 3.3 How does the speed range change at the higher torque? (2 marks)

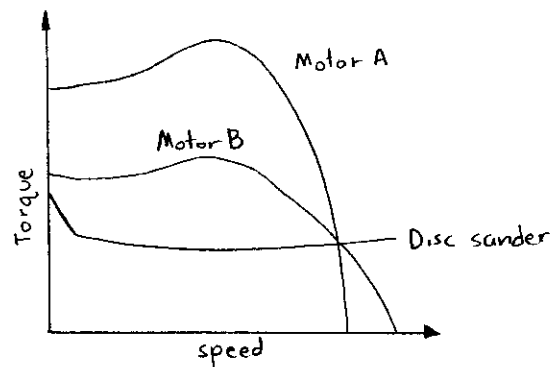
Reducing stator voltage:

3.4 Draw graph showing the torque – speed characteristics as the stator voltage is reduced. (8 marks)

3.5 At any particular torque, will the speed increase or reduce as a result of the stator voltage reduction? (2 marks)

Question 4: Motor Selection

The figure below shows the torque-speed characteristics for a disc sander and the torque-speed characteristics for two motors which are being considered for the drive.



4.1 Discuss the starting and running conditions to be expected for each motor. (20 marks)

4.2 Which of the two motors is more suitable for a disc sander and why? (5 marks)
