คณะวิศวกรรมศาสตร์

มหาวิทยาลัยสงขลานครินทร์

สอบกลางภาค ประจำภาคการศึกษาที่ 1 ประจำปีการศึกษา 2551

วันที่ 2 สิงหาคม 2551 เวลา 09:00 – 12:00 น.

วิชา 217 - 471 Mechanical and Electrical Components and Systems ห้อง A300

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***

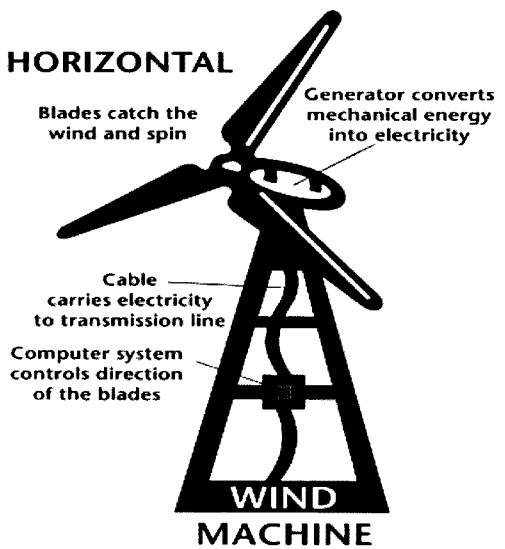
Note: Only dictionaries (both paper copies and electronic dictionaries) are allowed into this examination. Answers are expected in English and show all working when possible.

Question 1: Renewable Energy (Wind Machines)

There are two types of wind machines (turbines) used today based on the direction of the rotating shaft (axis): horizontal–axis wind machines and vertical-axis wind machines. The size of wind machines varies widely. Small turbines used to power a single home or business may have a capacity of less than 100 kilowatts. Some large commercial sized turbines may have a capacity of 5 million watts, or 5 megawatts. Larger turbines are often grouped together into wind farms that provide power to the electrical grid.

Horizontal-axis

Most wind machines being used today are the horizontal-axis type. Horizontal-axis wind machines have blades like airplane propellers. A typical horizontal wind machine stands as tall as a 20-story building and has three blades that span 200 feet across. The largest wind machines in the world have blades longer than a football field! Wind machines stand tall and wide to capture more wind.



Vertical-axis

Vertical–axis wind machines have blades that go from top to bottom and the most common type (Darrieus wind turbine) looks like a giant two-bladed egg beaters. The type of vertical wind machine typically stands 100 feet tall and 50 feet wide. Vertical-axis wind machines make up only a very small percent of the wind machines used today.

The Wind Amplified Rotor Platform (WARP) is a different kind of wind system that is designed to be more efficient and use less land than wind machines in use today. The WARP does not use large blades; instead, it looks like a stack of wheel rims. Each module has a pair of small, high capacity turbines mounted to both of its concave wind amplifier module channel surfaces. The concave surfaces channel wind toward the turbines, amplifying wind speeds by 50 percent or more.

1.1 What are wind farms? (5 marks)

1.2 What is the typical size of the horizontal-axis wind machine (height and blade span)? (5 marks)

1.3 Draw box diagram showing how the horizontal-axis wind machine operates. (10 marks)

1.4 Is the Wind Amplified Rotor Platform (WARP) wind machine? (5 marks)

Question 2: DC Machine

A series-wound DC motor runs at 500 rev/min when the terminal voltage is 120 V and the current drawn is 20 A. The armature and field resistances are 0.3 Ω and 0.2 Ω respectively. Then a 0.8 Ω resistor is connected in parallel with the field winding causing the flux to drop to 80% of the original circuit (i.e. without 0.8 Ω resistor).

2.1 Draw the circuit diagram of the series-wound DC motor in the above question with 0.8 Ω connected. (5 marks)

2.2 Calculate total resistance of the circuit without a 0.8 Ω connected in parallel to the field winding. Then calculate induced e.m.f (E). (5 marks)

2.3 Calculate total resistance of the circuit when a 0.8 Ω is now connected in parallel with the field winding. Then calculate induced e.m.f (E) of the new circuit if the total current is still at 20A. (5 marks)

2.4 Obtain the speed of this motor if the total current is still at 20A. Note that $N \propto E/\Phi$. (5 marks)

2.5 Explain briefly the characteristic of speed control using field regulator. (5 marks)

Question 3: AC Machine

3.1 In order to brake induction motors (i.e. bring the motor to a standstill), two techniques are used: 'plugging' and 'dynamic braking'. Explain briefly what those two techniques are. (10 marks)

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

Increasing the rotor resistance:

3.2 What happens to the speed at any particular torque as the external resistance is increased? (5 marks)

Reducing stator voltage:

3.3 At any particular torque, will the speed increase or reduce as a result of the stator voltage reduction? (5 marks)

3.4 According to your answers for question 3.2 and 3.3, explain why the speed of the motor behaves in those ways. (5 marks)

Question 4: Motor Selection

A power assisted lifting mechanism for 'up-and-over' type garage doors

4.1 Which of the following is the driven machine characteristic for a power assisted lifting mechanism for 'up-and-over' type garage doors: friction device; fans and blowers; reciprocating compressor; or high inertia device? (5 marks)

4.2 Draw torque-speed characteristic for your chosen driven load from question 4.1. (10 marks)

4.3 On the same graph drawn for question 4.2, draw the torque-speed characteristic of the motor that you believe to be suitable for the driven load above and explain any drawback and advantage associated with using such motor. (10 marks)