คณะวิศวกรรมศาสตร์

มหาวิทยาลัยสงขลานครินทร์

สอบปลายภาค ประจำภาคการศึกษาที่ 1 ประจำปีการศึกษา 2550

วันที่ 11 ตุลาคม 2550 เวลา 09:00 – 12:00 น.

วิชา 217 - 471 Mechanical and Electrical Components and Systems ห้อง R200

คำสั่ง

1. ข้อสอบมีทั้งหมด 5 ข้อ ให้ทำทุกข้อ
2. ไม่อนุญาตให้นำ โน้ต ตำรา หรือเอกสารใดๆ เข้าห้องสอบ
3. อนุญาตให้นำพจนานุกรมคำศัพท์ภาษาอังกฤษเข้าห้องสอบได้

ชื่อ.....นามสกุล..... รหัส.....

ข้อ	คะแนนเต็ม	คะแนนที่ได้
1	20	
2	20	
3	20	
4	20	
5	20	
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: Control Valves

General

1.1 Valves in pneumatic and hydraulic circuits are usually used to control three things. What are they? (3 marks)

Directional Control Valves

1.2 What are the two possible 'internal valving arrangement' for directional control valves? (2 marks)

1.3 What is the difference between the four-way directional control valve and the five-way directional control valve? (2 marks)

1.4 Give three examples of the methods for activating the directional control valves. (3 marks)

Flow Control Valves

1.5 What is the main function of the flow control valve? (2 marks)

1.6 In pneumatic actuator, what is a parallel flow design of the flow control? (3 marks)

Pressure Control Valves

1.7 What is the 'cracking pressure'? (1 marks)

1.8 What is the 'full flow pressure'? (1 marks)

1.9 What is different in the mechanism of a relief valve and a regulator valve? (3 marks)

Question 2: Pneumatic / Hydraulic Circuits

In a manufacturing process, components are to be clamped using a pneumatically operated clamping device. By operating an electrical switch, the moveable clamping jaw is pushed forward and the component is clamped. By deactivating the switch, the clamping jaw is returned to its start position.

Design this pneumatic clamping device and draw the pneumatic circuit associated with the design device. (20 marks)

Question 3: Capacitors and Resistors

Capacitors

3.1 What is dielectric in capacitors and give a few examples of what could be made as dielectric? (3 marks)

3.2 Could you explain what happens inside a capacitor when connecting to a battery? (4 marks)

3.3 What is the crucial difference between a capacitor and a battery? (3 marks)

Resistors

3.4 The amount of which material effect the value of resistance in fixed value resistors?? (3 marks)

3.5 What are the main functions of resistors? (4 marks)

3.6 Why are some resistors cased or put in aluminium with fins? (3 marks)

Question 4: Springs and Dampers

Damping

Damping is the control of motion or oscillation, as seen with the use of hydraulic gates and valves in a vehicles shock absorber. This may also vary, intentionally or unintentionally. Like spring rate, the optimal damping for comfort may be less than for control.

Damping controls the travel speed and resistance of the vehicles suspension. An undamped car will oscillate up and down. With proper damping levels, the car will settle back to a normal state in a minimal amount of time. Most damping in modern vehicles can be controlled by increasing or decreasing the resistance to fluid flow in the shock absorber.

Springs and Dampers

Most suspensions use springs to absorb impacts and dampers (or shock absorbers) to control spring motions. Some notable exceptions are the hydropneumatic systems, which can be treated as an integrated unit of gas spring and damping components, used by the French manufacturer Citroën and the hydrolastic, hydragas and rubber cone systems used by the British Motor Corporation, most notably on the Mini. A number of different types of each have been used:

Conventional Passive, Semi-Active/Active, and Interconnected Suspensions

Traditional springs and dampers are referred to as passive suspensions. If the suspension is externally controlled then it is a semi-active or active suspension.

Semi-active suspensions include devices such as air springs and switchable shock absorbers, various self-levelling solutions, as well as systems like Hydropneumatic, Hydrolastic, and Hydragas suspensions. Delphi currently sells shock absorbers filled with a magneto-rheological fluid, whose viscosity can be changed electromagnetically, thereby giving variable control without switching valves, which is faster and thus more effective.

For example, a hydropneumatic Citroën will "know" how far off the ground the car is supposed to be and constantly reset to achieve that level, regardless of load. It will *not* instantly compensate for body roll due to cornering however. Citroën's system adds about 1% to the cost of the car versus passive steel springs.

Fully active suspensions use electronic monitoring of vehicle conditions, coupled with the means to impact vehicle suspension and behavior in real time to directly control the motion of the car. Lotus Cars developed several prototypes, and introduced them to F1, where they have been fairly effective, but have now been banned. Nissan introduced a low bandwidth active suspension in circa 1990 as an option that added an extra 20% to the price of luxury models. Citroën has also developed several active suspension models. A recently publicised fully active system from Bose Corporation uses linear electric motors, ie solenoids, in place of hydraulic or pneumatic actuators that have generally been used up until recently. The most advanced suspension system is Active Body Control, introduced in 1999 on the top-of-the-line Mercedes-Benz CL-Class.

With the help of control system, various semi-active/active suspensions could realize an improved design compromise among different vibrations modes of the vehicle, namely bounce, roll, pitch and warp modes. However, the applications of these advanced suspensions are constrained by the cost, packaging, weight, reliability, and/or the other challenges.

Interconnected suspension, unlike semi-active/active suspensions, could easily decouple different vehicle vibration modes in a passive manner. The interconnections can be realized by various means, such as mechanical, hydraulic and pneumatic. Anti-roll bars are one of the typical examples of mechanical interconnections, while it has been stated that fluidic interconnections offer greater potential and flexibility in improving both the stiffness and damping properties. Considering the considerable commercial potentials of hydropneumatic technology (Crolla, 1996), interconnected hydropneumatic suspenisons have also been explored in some recent studies, and their potnetial benefits in enhancing vehicle ride and handling have been demonstrated. The control system can also be used for further improving performance of interconnected suspensions. Apart from academic research, an Australian company, Kinetic, is having some success (WRC: 3 Championships, Dakar Rally: 2 Championships, Lexus GX470 2004 4x4 of the year with KDSS, 2005 PACE award) with various passive or semi-active systems, which generally decouple at least two vehicle modes (roll, warp (articulation), pitch and/or heave (bounce)) to simultaneous control each mode's stiffness and damping, by using interconnected shock absorbers, and other methods. In 1999 Kinetic was bought out by Tenneco.

Historically, the first mass production car with front to rear mechanical interconnected suspension was the 1948 Citroen 2cv. The suspension of the 2CV was extremely soft — it had low roll stiffness, but its pitch stiffness was

increased by using an interconnected suspension. The leading arm / trailing arm swinging arm, fore-aft linked suspension system together with inboard front brakes had a much smaller unsprung weight than existing coil spring or leaf designs. The interconnection transmitted some of the force deflecting a front wheel up over a bump, to push the rear wheel down on the same side. When the rear wheel met that bump a moment later, it did the same in reverse, keeping the car level front to rear. The 2CV had a design brief to be able to be driven at speed over a ploughed field. It originally featured friction dampers and tuned mass dampers. Later models had tuned mass dampers at the front with telescopic dampers / shock absorbers front and rear.

Some of the last post war Packard models also featured interconnected suspension. The original Mini and some more recent British Leyland models also featured interlinking, when fitted with Moulton's Hydrolastic or Hydragas suspensions.

Find the crucial differences between the three different types of suspension (i.e. passive, semi-active / active, and interconnected). (20 marks)

Question 5: Heat Exchanger

Explain briefly how each of these heat exchangers works? You can use the following keywords if required: flow arrangement, parallel flow, counter flow, cross flow, mixing, heating and cooling.

5.1 Shell and Tube heat exchanger	(3 marks)
5.2 Plate heat exchanger	(3 marks)
5.3 Regenerative heat exchanger	(5 marks)
5.4 Adiabatic Wheel heat exchanger	(3 marks)
5.5 Fluid heat exchanger	(3 marks)
5.6 Dynamic Scraped surface heat exchanger	(3 marks)
