

OLLSCOIL NA hÉIREANN
The National University of Ireland

National University of Ireland, Galway.

Hilary Examinations, 2000/01
Third Year Mechanical and Biomedical Engineering Examination

AUTOMATED SYSTEMS

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Attempt Five Questions.
Time Allowed: 3 Hrs.

- 1(a) Explain why it is necessary to dry air after compression and write what you know about after cooling, absorption, refrigeration and adsorption drying of compressed air. (10)
- (b) Show examples of electro-pneumatic circuits which use at least three different types of non-contact sensor and explain how each sensor functions. (10)
2. Product can arrive to a central dispatch area on any one of four conveyors. If product is detected on any one of those conveyors by capacitive proximity switches, a light is lit to alert the operator and that conveyor is stopped. The operator may then press the relevant switch to align the unloading section of the conveyor with the section holding product. The operating panel thus has four indicator lights and four electrical switches. The switching section actuator uses two cylinders in series, one twice the length of the other, to effect conveyor selection. The speed at which the cylinders move must be controllable. The switching section should remain in the last selected position until a new track is selected.

Design an electro-pneumatic system, showing both pneumatic and electrical circuits, which can be used to control this handling system. (20)

3. A press tool is pneumatically operated and uses a cylinder as the actuator. An adjustable pressure switch disables the press until such time as air pressure to the control valve reaches a minimum level. When this pressure level is obtained the simultaneous operation of two push-button-switches is required to advance the form tool. The tool must retract if either push-button is released. The advance and return speeds of the mechanism are to be easily adjustable.

Design an electro-pneumatic system, showing both pneumatic and electrical circuits which can be used to control the machine. As the machine is located in an environment where there may be atmospheric pollution, arcing across contacts is to be avoided as far as possible. (20)

4. Design a pneumatic circuit that activates a cylinder five seconds after an operator activates a switch. The circuit should use roller limit and reed switches to detect piston position. Ten seconds after the piston end position is reached the cylinder should retract. The cylinder cannot extend until the initial position has been reached and proven. The return stroke cannot occur until forward end position has been reached and proven. A new start cycle may only become effective after the push button has first been released and depressed again. Explain how you use timed-on and timed-off relays to control the circuit delays and also how both limit and reed switches operate. (15)

Redraw the circuit having replaced the limit and reed switch with three-wire inductive and capacitive sensors respectively. Explain how these sensors function. (5)

5. What is the difference between an open loop and a closed loop hydraulic circuit? (2)

Show schematics of both and clearly label each component used in the circuit and describe its function. (12)

Show example of a closed loop hydraulic circuit with leakage oil compensation. (6)

- 6(a) Explain how any two of the following hydraulic circuit components operate:

- (i) poppet and spool valves when used as pressure relief valves
- (ii) bent axis piston pumps,
- (iii) axial and radial piston motors.

(8)

- (b) Design a simple electro-hydraulic press. The press uses two hydraulic cylinders - one to clamp the workpiece and the other to create the impression. Clamp and press operation are activated by manual operation of electric switches which in turn activate solenoid valves. Pressure is supplied by a gear pump driven by an electric motor.

Show both hydraulic and electrical circuits and indicate what each component in your circuit is and what function it performs. (12)

- 7(a) Draw a block diagram showing the main functional units of a programmable controller. (5)
- (b) What is an opti-isolator? (5)
- (c) What are the basic ladder logic symbols? (5)
- (d) Draw a simple ladder logic circuit to control three outputs, a motor and two solenoids. Each output is controlled by two switches which must be simultaneously activated for there to be a response. All three outputs may be cut off by an emergency stop or override. (5)