2. FIGURE 5 shows a public address system.

FIG. 5

(a) Represent the P.A. system as an 'information system' block diagram.

(b) It is found that if the microphone is brought into the proximity of the loudspeaker, the system will 'howl'. Carefully explain, making reference to feedback theory, why this is so.

(c) Suggest two actions that could be adopted to remedy the 'howling'.

(d) Represent the 'howling' system by a block diagram.

(e) Measurements show that for a particular arrangement of the equipment and at a particular amplifier setting, the system will howl if 1% of the output power is fed back to the microphone. Estimate the power gain of the P.A. amplifier in decibels.

(f) Analysis shows that the frequency at which the system 'howls' is 16 kHz and it is proposed to use a filter to attenuate all frequencies above 14 kHz. This is to be done using a simple RC filter.

(i) Redraw the 'information system' block diagram of (a) to show the filter.

(ii) If the resistor in the filter has a value of 10 kΩ calculate a suitable value for the capacitor.

3. A set of digital scales is required to measure a load of 1000 N with an accuracy of ±1 N. Determine the minimum output resolution of the required ADC.

4. 'Integral cycle control' is used to control the power delivered to an electric heating system. The supply frequency is 50 Hz and the system has a cycle time of one second. If the number of cycles the supply is switched on for is 20, calculate the power delivered to the heating system as a percentage of full power.

5. For the thyristor circuit of FIGURE 6, calculate the power in the load as a percentage of maximum power for a firing angle of 45°. Ignore any losses in the thyristor.

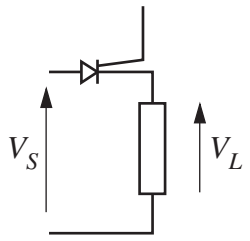

FIG. 6

6. FIGURE 7 (overleaf) shows a hydraulic press that is controlled by a solenoid-operated control valve. To meet safety requirements a guard is to be placed over the press so that operators are unable to put their hands in the vicinity of moving parts. For access to the press the guard is hinged at it base so that it can be swung up out of the way.

A reliable form of interlock is now required so that when the guard is opened it actuates a separate hydraulic valve. This valve will, when the guard is lifted, immediately shut off the hydraulic pressure flow from the pump to the press and at the same time open the extending side of the cylinder to exhaust. The valve to be used is the normally closed[1], three-way valve shown in the diagram. It is to be connected in the extend end of the main hydraulic pipeline to the cylinder. The valve will shut off hydraulic fluid from entering the extend end of the cylinder and divert the hydraulic fluid from this side of the cylinder back to the tank when the guard is opened. The closing of the guard closes the exhaust of the three-way valve and allows pressure to pass through to close the ram of the press.

Copy and complete the diagram to show the interlock connected into the hydraulic circuit and explain briefly how it will operate.

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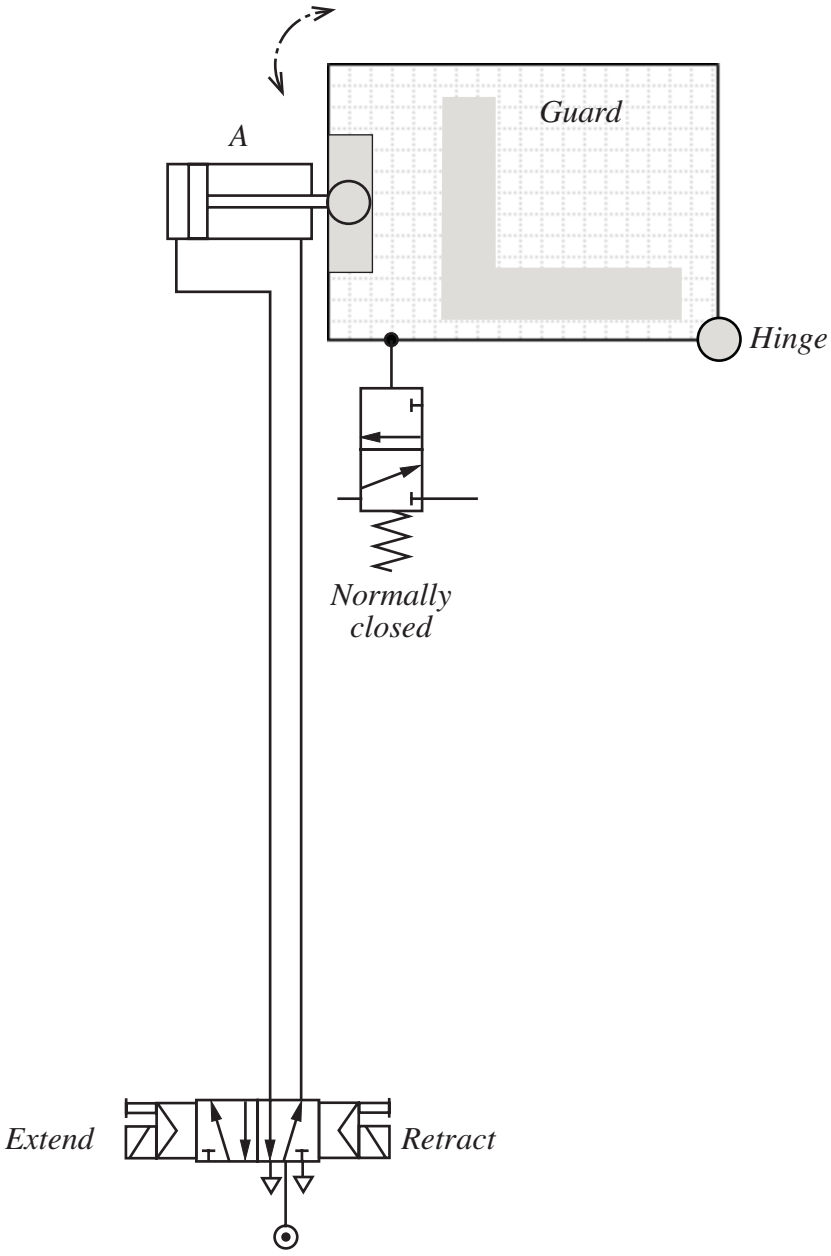
[1]'Normally closed' – note that in hydraulic circuits the meaning of this term is the exact opposite to that used in electric circuits! In hydraulics, think in terms of a water tap, the tap is 'closed' when the flow is off and 'open' when the flow is on.


Guard
A
Hinge
Normally
closed
Extend
Retract