PHASE 1 INSTRUMENTS

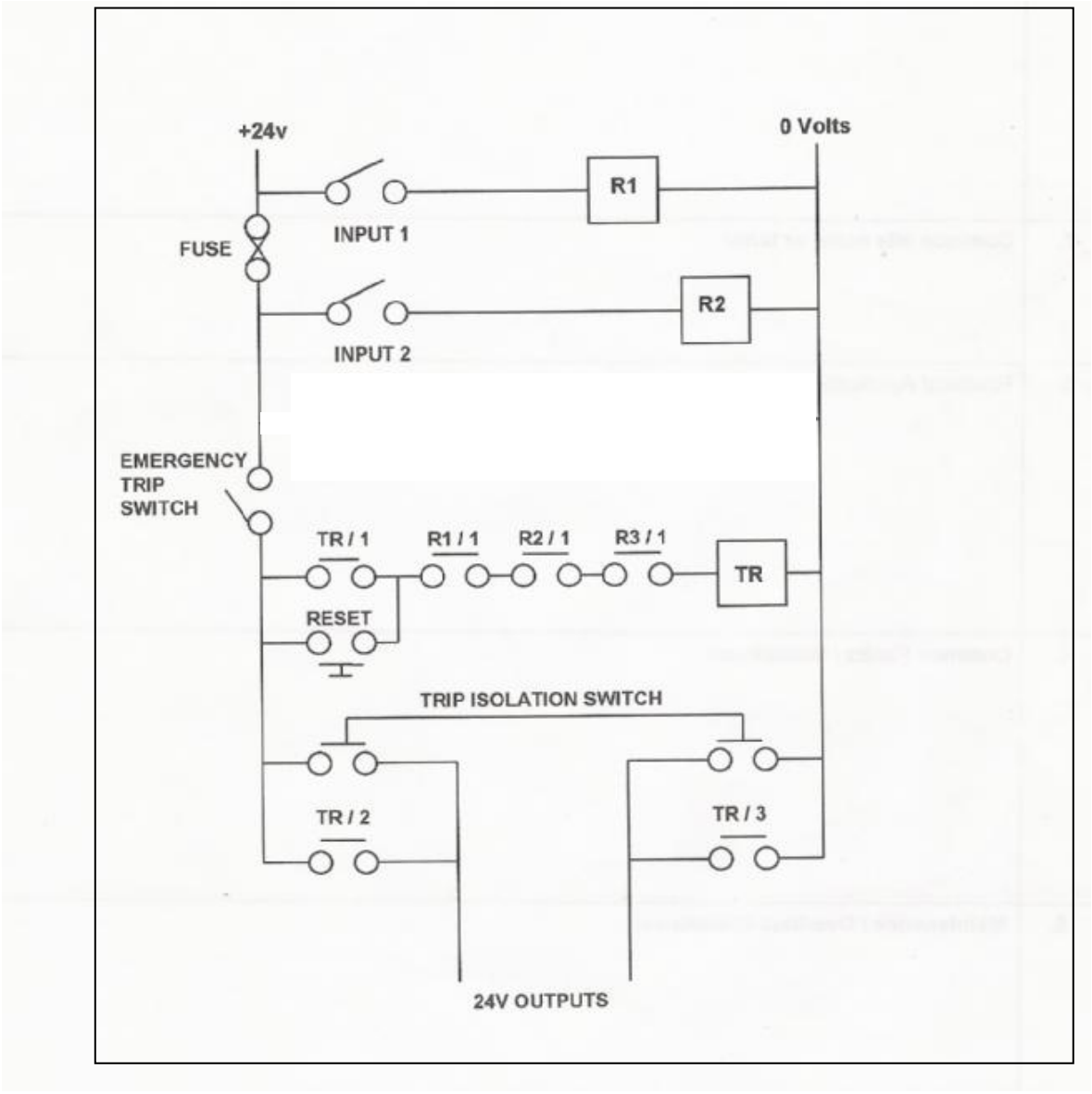
Project Write-up

Name:……Group……

Module Title: Shutdown Systems & Alarms Module No: I-11

Project Description: Shutdown Systems Theory and Design Project No: SD1

Objective Nos: 1,6,7



PROJECT WRITE UP SHEET

Principle/Theory of Operation

In reality what are wired in series?

What other device can be used instead of a relay to perform logic functions?

Why must shutdown systems be checked at regular intervals?

Name 3 alarm modes?

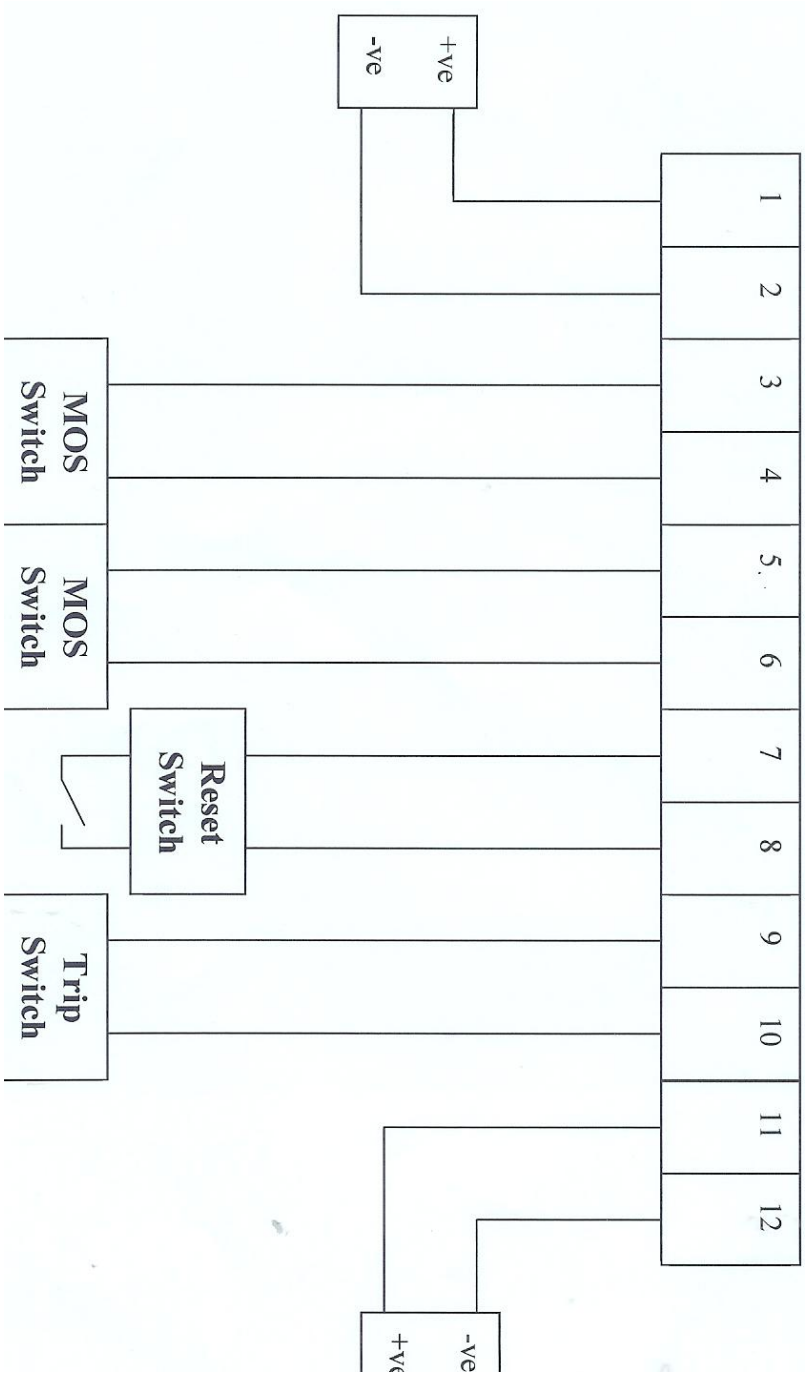
What are Interlock systems used for?

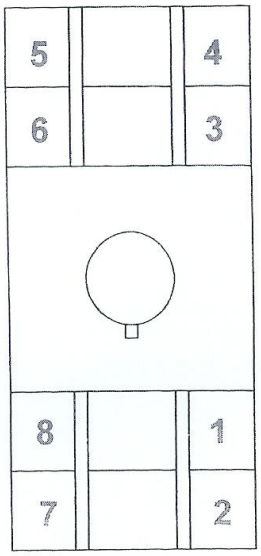
Project Description: Shutdown Systems Theory and Design

Objective No's: 1, 6, 7

2	**Common Faults/limitations:** Human intervention such as unauthorised use of trip isolation or maintenance override facility. Common faults associated with most transmitting, switching and final control devices. Occasional circuit faults, including loose connections/failure of relays etc.
3	**Maintenance/Overhaul Guidelines:** Preventative maintenance (or safeguarding) schedules dramatically reduce the risk of system failure and are specifically designed to identify and rectify the common faults found in any complex control system. By carrying out regular checks we can thereby guarantee, as much as humanly possible, that these safeguarding systems are at all times properly maintained and fully operational.
4(a)	**Typical Supply Requirements:** Normally 24v dc. For failsafe (or fail to safety) purposes, systems are designed to de-energise in the trip condition. This provides additional protection, since any system faults resulting in loss of power to any part of the circuitry would cause the plant to shut down.
4(b)	**Output Options:** Normally 24v dc. These outputs are normally used to energise/de-energise solenoid valves, which in turn interrupt supply air to trip valves. When tripped or de-energised, solenoids switch off supply air, tripping valves into air fail condition which may be open or closed, depending upon air fail action. Outputs may also be used to energise/de-energise interposing relays used for tripping pumps, machinery etc.
5	**Specific Installation Requirements:** Should incorporate fail safe design as previously stated. Trip circuits should also have a maintenance override (MOS) or trip isolation facility to allow maintenance work to be carried out whilst plant is running.

Shutdown Logic Connection Diagram



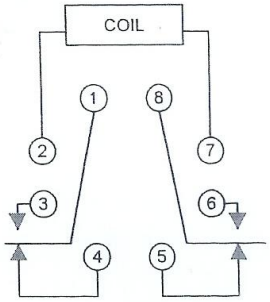


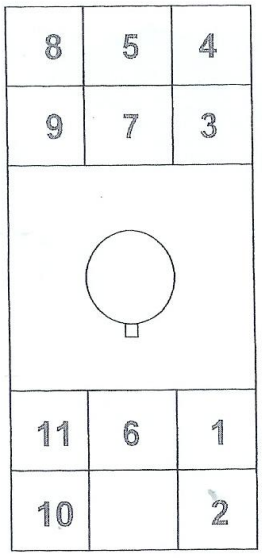
8 Pin Relay Base.

2 and 7 = Coil

1 = Common
3 = Normally Open
4 = Normally Closed

8 = Common
6 = Normally Open
5 = Normally Closed





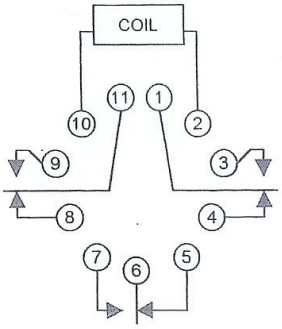
11 Pin Relay Base

2 and 10 = Coil

1 = Common
3 = Normally Open
4 = Normally Closed

6 = Common
7 = Normally Open
5 = Normally Closed

11 = Common
9 = Normally Open
8 = Normally Closed



PROJECT SHEET
Module I-11 Shutdown Systems & Alarms

Name:……..

Project Description: Design a Shutdown Circuit
Objective Nos: 1, 3, 6, 7
Project No: S1

PROJECT 1 - Working in groups of two or three, design and draw a shutdown circuit which incorporates the following features:

1. Two inputs consisting of one high trip and one low trip alarm
2. A latching circuit, complete with a manual reset facility
3. An emergency trip switch
4. A trip isolation facility
5. One output (to a solenoid valve or suitable device to indicate operation)

Your drawing (which is to be used later as a working drawing) should be clearly labelled and must include all correct relay connections/relay pin numbers and pressure switch connection.

Upon completion, you are then required to fully explain its operation to your Training Officer BEFORE moving on to project 2.

Using your drawing, build a fully operational trip circuit which incorporates all of the above features.

PROJECT SHEET
Module I-11 Shutdown Systems & Alarms

Name:……..

Project Description: Scheduled Alarm and Shutdown Checks on a Running Plant
Objective Nos: 8
Project No: S2

Note: Throughout the exercise you will be assessed by direct observation

Working in groups of three you are required to carry out a complete alarm and shutdown system check on a running plant following written procedures.

Throughout the exercise you must note down any faults or errors you might find and correct as required.

Upon completion of your checks – which should have been successfully carried out without tripping the plant – you are then required to complete all relevant paperwork and reports.

SUPPLEMENTARY QUESTIONS
Module I-11 Shutdown Systems and Alarms

The successful completion of these questions provides the additional competencies required for Module

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Shutdown systems are designed to protect the ……
…….....by tripping the plant, or part of it in an emergency or where critical process variables have gone above (or below) a pre-determined safe condition. The systems are designed so that they are "Fail Safe" that is, in the event of a ……. of any piece of equipment or supply, the system will shut the plant down to a …… condition. This is achieved by relying on power/utilities to keep the plant operating. Electrical circuits use the normally ……..….. contacts to achieve this. The normally …….…. contacts may be used for other functions.

A typical shutdown loop consists of:

- A measuring or detecting element, which may for example be……., thermocouple or RTD.
- A pressure switch or trip amp which receives the TX signal and switches an electrical circuit either ……. ..…or ……...once the pre-determined setting has been reached.
- A series of relays which, in turn, switch the output(s) to the final trip element(s) on or off.
- Solenoid Valve(s) which is/are essentially an ……operated …….switching device.
- The final trip element usually a …….which, when tripped, will move to its fully open or fully …….. position, depending upon its …….

The fail safe sequence on most shutdown systems is as follows:

1. Pressure switch contacts ……thereby interrupting 24v supply.

2. Relay coil……... As a consequence, its normally open contacts (previously closed when in energized state)……., interrupting 24v outputs to - …….. valve(s).

3. Solenoid coil now de-energizes, …… ……..to shutdown valve(s).

4. With supply air now removed, trip valve goes into its ……position, which may be ……..depending on its ……. …….. (i.e. AFVO or AFVC)

(Draw diagram to show how a solenoid valve is used to operate a shutdown valve)

Commonly, trip circuits have many inputs and outputs. Inputs are normally connected in ……so that the loss of any one input will trip the entire system.

(Draw diagram)

Two out of Three Voting or Majority Logic System

Variations may include a …….system. This configuration requires at least …….inputs to be lost for the plant to trip.
(Draw diagram)

Latching Circuit

To ensure that the system does not automatically re-set itself once the trip condition has cleared, a Latching Circuit is used. This utilizes a set of normally …….(or holding out) contacts in the final trip relay which, in turn, prevents its own relay …….from automatically re-energizing once the trip condition has cleared.
The system can only be re-set my momentarily bypassing these holding out contacts by pressing the …….button. This allows the relay coil to become ……, thereby…… the holding out contacts and re-setting the system.

(Draw diagram)

Emergency Trip Switch

In the event of an emergency (e.g. plant fire etc), manually operated emergency trip switches enable the plant to be instantaneously shut down. These are normally strategically placed around the plant and in the control room and are electrically connected in series with the trips circuit's …….supply rail.
(Draw diagram)

Trip Isolation or Maintenance Override Facility

This allows the trip system to be periodically checked and maintained whilst the plant is running.
Normally in the form of a key switch to prevent ……use, it maintains a 24v supply to the final trip devices by bypassing the ……..... ……contacts.

(Draw diagram)

Before attempting to remove the trip isolation, we must follow the correct ……..procedure. This is done by pressing the accept and reset buttons on the alarm panel and re-setting any plant trip lights by pressing the …….. ……button(s). Only after all ……..trip lights have been ..……... can we safely remove the trip isolation.

Scheduled Shutdown Checks

Shutdown systems must be checked at regular intervals to maintain the integrity of the system and ideally, must cover as much of the instrumentation and …….. as possible.

Checks are normally carried out to a set procedure and are designed to ensure that all ……or trip amp settings are correct, that all ……..are correctly ……..and ……. and that all equipment, including wiring, inter-connections and alarms are fully functional.

To prevent the plant from tripping whilst we carry out these checks, the …….. ……..must be used. The operation of solenoid valves can also be checked, provided that the line work is fitted with a ……facility.

Trip circuits are for emergencies only and should never be used to stop the plant for any other reason. For ……the correct shutdown procedure outlined within the ……must be followed.

Process Alarms

Process alarms are designed to give the operator ……
As with trip loops, signals are transmitted from the plant to …….or trip amps, which in turn switch a …… volt supply
either…… to activate an alarm.

In some industries, notably ICI, alarms are colour coded to denote importance:

Red - plant trip
Blue - trip isolation
Yellow- priority 1 alarm
White - priority 2 alarm

Once an alarm has operated it must be acknowledged and silenced by pressing the ……..button on the alarm panel. We must then press the ……..button to see if the alarm has…….

Where a series of alarms have operated simultaneously, the operator needs to know which of these came up first. This is achieved by the use of ……..modules. Once the …….button has been pressed, all windows will stop flashing except the one which came up first.

Logic Gates

Logic gates can be either represented as switches or symbols. (Draw both and explain function)

Switches **Symbol**

And Gate

Or Gate

Not Gate (switch equivalent cannot be drawn)